U.S. Department
of Transportation
Federal Aviation
Administration

# Advisory Circular

AC 120-29A

August 12, 2002

# CRITERIA FOR APPROVAL OF CATEGORY I AND CATEGORY II WEATHER MINIMA FOR APPROACH

**Forward.** This advisory circular (AC) provides an acceptable means, but not the only means, for obtaining and maintaining approval of operations in Category I and II Landing Weather Minima including the installation and approval of associated aircraft systems. It includes additional Category I and II criteria or revised Category I and II criteria for use in conjunction with RNAV, Required Navigation Performance (RNP), VNAV, xLS, satellite navigation systems (GLS), Head up Displays (HUD), and Category II during certain engine inoperative operations. This revision also updates and incorporates provisions of the former AC 120-29 through Change 3 into the revised AC 120-29A.

This revision incorporates changes resulting from the first steps toward international all weather operations (AWO) criteria harmonization taken by the Federal Aviation Administration (FAA), European Joint Aviation Authorities (JAA), and several other regulatory authorities. Subsequent revisions of this AC are planned as additional all weather operations harmonization items (AHI) are agreed and completed by FAA JAA, and other regulatory authorities.

/s/
Nicholas A. Sabatini
Associate Administrator for Regulation and Certification

# TABLE OF CONTENTS

**1. PURPOSE.** This advisory circular (AC) provides an acceptable means, but not the only means, for obtaining and maintaining approval of Category I and II Weather Minima including the installation and approval of associated aircraft systems. This AC is applicable to Title 14 of the Code of Federal Regulations (14 CFR) parts 121, 135, and those part 125 operators not exempted under section 125.1 or not having received an applicable deviation authorization under section 125.3. Certain aspects of this AC are applicable to 14 CFR part 129 operators. Many of the principles, concepts, and procedures described also may apply to 14 CFR part 91 operations and are recommended for use by those operators when applicable.

**a.** This AC provides some guidance that may be applicable to operations conducted by civil helicopters and powered-lift aircraft. Supplementary guidance for those aircraft may be provided by other FAA or industry documents.

**b.** Mandatory terms used in this AC such as “shall” or “must” are used only in the sense of insuring applicability of these particular methods of compliance when the acceptable means of compliance described herein is used. This AC does not change, add, or delete regulatory requirements or authorize deviations from regulatory requirements.

**c.** Major changes introduced in this revision include new provisions for Required Navigation Performance (RNP), Vertical Navigation (VNAV), Flight Management System (FMS), Global Navigation Satellite System (GNSS), Head Up Display (HUD), Global Positioning System (GPS) or GNSS Landing System (GLS), revised obstacle assessment criteria related to RNP, and revised airborne equipment requirements for Category I and II.

**d.** With issuance of AC120-29A, the former AC 120-29, Criteria for Approving Category I and Category II Landing Minima for FAR 121 Operators, dated December 3, 1974, is canceled.

**2. RELATED REFERENCES AND DEFINITIONS.**

**2.1. Related References.**

**a. Regulations.** 14 CFR part 91, sections 91.175, and 91.189; 14 CFR part 121, sections 121.579, and 121.651; 14 CFR part 125, sections 125.379, and 125.381; 14 CFR part 129, section 129.11; and 14 CFR part 135, section 135.225; 14 CFR part 25, sections 25.1309, and 25.1329.

**b. ACs.** Current editions of: AC 120-28, Criteria for Approval of Category III Landing Weather Minimal; AC 20-129, Airworthiness Approval of Vertical Navigation (VNAV) Systems for Use In the U.S. NAS and Alaska; AC 20-130, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors; AC20-138, Airworthiness Approval of GPS Navigation Equipment for use as a Supplemental Navigation System; and AC 25-15, Approval of Flight Management Systems in Transport Category Airplanes.

**c. Orders.** FAA Orders 8400.8, Procedures for Approval of Facilities for FAR Part 121 and Part 135 CAT III Operations; 8400.10, Air Transportation Operations Inspector’s Handbook; 8400.13, Procedures for the Approval of Category II Operations and Lower Than Standard Category I Operations on Type I Facilities; and 6750.24, Instrument Landing System (ILS) and Ancillary Electronic Component Configuration and Performance Requirements.

**d. OpSpecs.** Standard Operations Specifications Part A and C.

**e. Foreign.** Joint Aviation Authority (JAA) ACJ AWO 231, Flight Demonstration (Acceptable Means of Compliance) dated August, 1996.

**2.2. Definitions.** A comprehensive set of definitions pertinent to Category I and II is included in Appendix I.

## 3. BACKGROUND.

**3.1. Major Changes Addressed in this Revision.** This advisory circular includes additional Category I and Category II criteria or revised Category II criteria for use of Head up Displays, use of Required Navigation Performance (RNP), satellite based navigation, and "engine inoperative" Category II approach procedures. This revision expands information regarding Category I approach procedures, and now includes material pertinent to types of approach procedures other than ILS, MLS, or GLS (e.g., also addresses approaches previously considered as non-precision approaches).

**a.** This AC also clarifies existing criteria to address frequently asked questions.

**b.** This revision incorporates changes resulting from the first steps toward international all weather operations (AWO) criteria harmonization taken by the FAA, European JAA, and several other regulatory authorities. Subsequent revisions of this AC are planned as additional all weather operations harmonization items (AHI(s)) are agreed and completed by FAA and JAA, or internationally.

**3.2. Relationship of Operational Authorizations for Category I or Category II and Airborne System Demonstrations.** Approach weather minima are approved through applicable operating rules, use of approved instrument procedures and issuance of Operations Specifications (Op-Specs)*. Airworthiness demonstration of aircraft equipment is usually accomplished in support of operational authorizations on a one-time basis at the time of Type Certification (TC) or Supplemental Type Certification (STC). This demonstration is based upon the airworthiness criteria in place at that time. Since operating rules continuously apply over time and may change after airworthiness demonstrations are conducted, or may be updated consistent with safety experience, additional Category I or Category II credit or constraints may apply to Operators or aircraft as necessary for safe operations. In general, criteria related to operational approval is contained in the main body of this AC and criteria related primarily to the airworthiness demonstration of systems or equipment is included in the appendices to this AC.

> ***NOTE: Operations Specifications are unique Federal Aviation Regulations applicable to a particular operator. OpSpecs are based on the regulations. However, they are specifically applicable to and tailored to a particular operator's aircraft, routes, and operating circumstances. Standard Operations Specifications are developed by FAA and provided to FAA field offices to aid in development and issuance of the particular and unique OpSpecs issued to each operator.**

**3.3. Applicable Criteria.** Except as described below, new airworthiness demonstrations or operational authorizations should use the criteria of AC 120-29A. Airworthiness demonstrations may use equivalent JAA criteria where agreed by FAA through the FAA/JAA criteria harmonization process. Operators electing to comply with these revised criteria may receive additional credit when using the revised criteria. Aircraft manufacturers or modifiers may elect to demonstrate their aircraft using the revised criteria to seek credit for additional operations. Aircraft demonstrated using earlier criteria may continue to be approved for Category I or Category II operations in accordance with (IAW) that earlier criteria. Operators seeking additional credit provided for in this AC must, however, use the criteria of this AC for that credit.

**3.4. Category I, II, and III Terminology.**

**a.** Since 1985, the FAA has referred to all approaches other than Category II or Category III as Category I, for purposes of regulatory authorization for part 121, 125, 135, and 129 operators (e.g., Operations Specifications). Thus for consistency and continuity, all Category I approach procedures and operational authorizations are now addressed in this AC. In addition to typical Category I Instrument Landing System (ILS), Microwave Landing System (MLS) and Global Navigation Satellite System (GNSS) Landing System (GLS) procedures (e.g., procedures historically considered as precision approach), information about approaches other than ILS, MLS, and GLS are now included (e.g., procedures historically considered as non-precision approach). The use of the term "non-precision" has been dropped within this AC to reduce confusion which exists with use of this term with current and future systems and authorizations, particularly with Vertical Navigation (VNAV) and Area Navigation (RNAV), and with other approaches that may incorporate the use of barometric VNAV to provide a stabilized descent path to a runway.

**b.** Accordingly, Category I, II, and III terminology used in this AC is based on and is consistent with current U.S. Standard Operations Specifications for part 121, 125, 135, and 129 Operators. Definition usage is also consistent with other ACs (e.g., AC120-28D). Definitions of instrument approach Categories in current use in the U.S. are listed in Appendix 1 of this AC (i.e., Category I, Category II, Category IIIa, IIIb, and IIIc). While there are slight variations of these definitions as used within ICAO and various countries internationally, the broad objectives and practical operational applications are similar. It is significant to note that for U.S. applications to part 121, 125, 135, and 129 operators, Category I is considered to include any instrument approach procedure having minima not less than 200 ft. Height Above Touchdown (HAT) and RVR not less than 1800ft. Accordingly, approaches such as Localizer (LOC); LOC BCRS; Localizer-Type Directional Aid (LDA); Simplified Directional Facility (SDF); Very High Frequency (VHF) Omni-directional Radio Range (VOR); Non-Directional Beacon (NDB); and RNAV are each considered to be Category I approaches. In other states, Category I may only apply to straight-in ILS or MLS instrument procedures. Also, in certain states, lowest authorized minima may be slightly different than as promulgated by the U.S. or ICAO criteria. In a few states, these approach categories relate more closely to aircraft configuration or ILS facilities used, rather than directly landing minima (e.g., Decision Altitude (Height) (DA(H)) and visibility or RVR).

**3.5. Requirement for Evaluation Prior to Operations.** Instrument approach procedures in the United States and its territories must be validated by an authorized FAA process. Special procedure requests should be made through the CMO to AFS-400.

## 4. OPERATIONAL CONCEPTS.

**4.1. Classification and Applicability of Minima.** Landing minima are generally classified by Category I, Category II, and Category III. Definitions for Category I, II, and III are as specified by ICAO and individual states. For the U.S. these definitions are as included in Appendix 1. Certificate Holding District Offices (CHDO) and Operators should be aware that slight differences exist in definition and use of Category I, II, and III terminology in international operations. Operators should ensure that any differences in definitions do not adversely affect intended operations (see Paragraph 3.4 above).

**a.** This AC addresses criteria for Category I and Category II instrument approach operations. AC 120-28 addresses takeoff in low visibility conditions and Category III landing operations.

**b.** Landing minima are generally addressed by parts 91.175, 121.649, 121.651, 121.652 and standard or special OpSpecs Part C. Application of these definitions of Category I, II, and III to landing is discussed in paragraph 4.3.1 below.

**c.** Although a wide variety of normal and non-normal situations are considered in the design and approval of systems and procedures for Category I and Category II, landing weather minima are primarily intended to apply to normal operations. For non-normal operations, flightcrews are expected to take the safest course of action appropriate for the situation, notwithstanding landing weather minima. When aircraft systems have been demonstrated to account for certain non-normal configurations and a procedure is specified (e.g., an approach with an engine inoperative non-normal procedure), the flightcrew may take account of this information in assessing the safest course of action. In addition, when inoperative aircraft systems have been accounted for in the Airplane Flight Manual (AFM) as an alternate configuration using criteria of this AC (e.g., an approach with an engine inoperative is specified as a demonstrated configuration) operational credit for that configuration (alternate minima credit) may be authorized.

**d.** Takeoff minimums are generally addressed by parts 91, 121, 135, and standard or special OpSpecs. Application of takeoff minima is discussed in paragraph 4.2 below.

**4.2. Takeoff.**

**a. Takeoff Minima.**

**(1)** Takeoff minima are addressed by sections 91.175(f), 121.649, 121.651, 135.225, and standard or special OpSpecs Part C. The authority for lower than standard takeoff minima is contained in sections 135.225(h)(3) and 121.651(a)(1).

**(2)** OpSpecs are applicable to part 121 and 135 Operators and certain other Operators (e.g., part 125 and part 129). Where minima lower than that provided in standard OpSpecs are necessary, applicable criteria for use of those minima are specified in AC 120-28D. When appropriate, principal operations inspectors (POI(s)) issue OpSpecs specifying the lower minima through paragraph C056 for part 121 Operators and OpSpecs paragraph C057 for part 135 Operators. OpSpecs contain specific guidance regarding pilots, aircraft, and airports when lower than standard takeoff minimums are used.

**b. Takeoff RVR Equivalence and Assessment (See also 8.6.3).** For takeoff procedures where minima are published only in terms of RVR, but visibility is being reported as a meteorological visibility, tables referenced in Standard OpSpecs may be used to establish equivalent RVR (see Appendix 7, OpSpec Paragraph). This table does not apply to minima published as meteorological visibility being reported as RVR

**c. Pilot Assessment of equivalent RVR.** For takeoff circumstances where Touchdown Zone RVR is inoperative or is determined by the pilot to be significantly in error (e.g., patchy fog obscuring a transmissometer but not the runway, snow on transmissometer causing erroneous readings), a pilot assessment may be made in lieu of RVR (see Appendix 7, OpSpec Paragraph C078).

**(1)** To be eligible to use this provision the operator must ensure that each pilot authorized to make this determination has completed approved training addressing pilot procedures to be used for visibility assessment in lieu of RVR, and the pilot can determine the necessary runway markings or runway lighting that must be available to provide an equivalent RVR to that specified to ensure adequate visual reference for the takeoff.

**(2)** When any pilot assessment of equivalent RVR is made, the pilot must be able to positively determine position on the airport and correct runway, and positively establish that the aircraft is at the correct position for initiation of takeoff. Typically this equivalent RVR assessment is applicable only at a runway threshold where runway identifying markings and number(s) are visible from the takeoff position (e.g., not applicable to intersection takeoffs).

**(3)** When such a pilot RVR assessment is made, the result of the assessment should typically be provided to any pertinent air traffic facility when practical, and may also be provided to the operator (e.g., dispatch) to facilitate other operations.

**4.3. Landing.**

**4.3.1. Approach and Landing Concepts and Objectives.** Landing minima are classified as Category I, Category II, and Category III. Definitions of these categories are provided in Standard OpSpecs Part A paragraph A002, and in Appendix 1. While generally consistent with ICAO definitions, the definitions used in Standard OpSpecs, where different from ICAO, apply and take precedence for U.S. operators, or for international operators conducting operations within the United States, or at U.S. facilities.

**a.** For U.S. Operators, any instrument approach with a DA(H) or Minimum Descent Altitude (Height) (MDA(H)) and visibility above that specified in OpSpecs for Category I, (see Appendix 7) is considered to be a Category I operation (e.g., an approach with either a DA(H) or an MDA(H) which is not lower than 200 ft. HAT and visibility not less than 1800 RVR is considered to be Category I, even though it may be based on a Navigational Aid (NAVAID) other than ILS).

**b.** Any instrument approach with a DA(H) or visibility less than that specified for Category I, but above that specified for Category II, is considered to be a Category II operation.

**c.** Any instrument approach with a DA(H) less than that specified for Category II (or with no DA(H) or with an Alert Height), or with a visibility less than that specified for Category II, IAW applicable OpSpecs is considered to be a Category III operation.

**d.** Category I operations may be conducted manually using raw data information, by reference to flight guidance displays (flight directors), or automatically using approved autopilot or autoland systems. However, air carrier operations, particularly with turbine powered aircraft, typically have minima restricted by OpSpecs if a flight director or autopilot is not used.

**e.** For Category I, basic airworthiness certification for IFR under provisions of 14 CFR part 25 typically is considered an acceptable means of demonstration of capability for operational acceptance of an aircraft and its associated systems. Specific criteria for airworthiness demonstration of certain specific systems or capabilities for Category I are included in Appendix 2 (e.g., FMS or RNP).

**f.** For Category I minima, it is expected that for non-normal operations (e.g., engine(s) inoperative, hydraulic or electrical system(s) failure) the pilot or operator should consider any necessary adjustment of operating minima, wind limit constraints, or other factors to ensure safe operation with the non-normal condition.

**g.** Category II operations may be conducted manually using flight guidance (e.g., flight director) displays. However, most Category II operations are conducted using an autopilot or autoland system, or with combinations of systems using both automatic and flight guidance (e.g., flight director) elements. Additional demonstration or operational assessment beyond that required for basic IFR flight under provisions of basic aircraft 14 CFR part 25 type certification typically is necessary for operational authorization of an aircraft for Category II (see Paragraph 5 and Appendix 3). Specific criteria for airworthiness demonstration of systems or capabilities for Category II are included in Appendix 3 (e.g., for flight director(s), autopilot(s), or HUD) for cases where an applicant seeks prior credit for such a prior airworthiness demonstration documented in the AFM).

**h.** For Category II minima, certain non-normal conditions are typically considered in the assessment and authorization process. Response to those non-normal conditions may be explicitly defined in the Category II authorization (e.g., engine failure, electrical component failure, or engine inoperative Category II). For failures other than those addressed by the Category II authorization, the pilot or operator may need to adjust the operating minima used, introduce wind limit constraints, or address other factors to ensure safe operation for the particular non-normal condition.

**4.3.1.1. Operational Safety Evaluation.** For any instrument approach using either Category I or Category II minima, the operator must adequately consider and provide for safe operations considering at least the following:

**a.** The possibility of a failure of any one of the pertinent navigation systems, flight guidance system, flight instrument system, or annunciation system elements used for the approach or missed approach (e.g., ILS receiver failure, Autopilot disconnect, etc.).

**b.** The possibility of a failure of a key aircraft component or related supporting system during the approach or missed approach (e.g., engine failure, electrical generator failure, single hydraulic component failure). Even though a particular failure may in itself be considered too remote based on exposure time (e.g., engine failure), it is nonetheless important to address these considerations since, in practical circumstances, a “go-around” may be due to a factor which relates to or leads to the failure, and thus is not an independent event (e.g., flocking bird ingestion). This is consistent with the long standing principle of safety of operation of multi-engine aircraft in air carrier operations which notes that after passing V1 on takeoff, until touchdown, the aircraft should typically be able to sustain a failure such as engine failure and still safely be able to continue flight and land.

**c.** The possibility of a balked landing or rejected landing at or below DA(H), or MDA(H), as applicable.

**d.** The possibility of loss or significant reduction of visual reference, that may result in or require a go-around.

**e.** Suitable obstacle clearance following a missed approach, considering applicable aircraft configuration during approach and any configuration changes associated with a go-around (e.g., engine failure, flap retraction).

**f.** For special airports identified IAW section 121.445 (e.g., mountainous terrain), or other airports with critical obstacles that have not otherwise been accounted for, the ability to ensure suitable obstacle clearance following a rejected landing; applicable aircraft configuration(s) during approach and any configuration changes associated with a go-around and missed approach should be considered.

**g.** Unusual atmospheric or environmental conditions that could adversely affect the safety of the operation (e.g., extreme cold temperatures, known local atmospheric or weather phenomena that introduce undue risk, etc.).

When conducting a safety assessment of issues listed above, and uncertainty exists as to aircraft failure condition effects, procedural design intent or margins, aircraft characteristics or capabilities following failure, or other such issues, the operator should consult with an appropriate organization source able to provide reliable and comprehensive information. Typically this includes consultation with one or more of the following as applicable, and as necessary:

- Aircraft manufacturer,
- Avionics manufacturer;
- Procedure designer;
- Air Traffic Service provider, or regulatory authority.

**NOTE: For definitions and discussion of differences among the terms "balked landing," "rejected landing," "go-around," and "missed approach," see Appendix 1.**

**4.3.1.2. Primary and Supplementary Means of Navigation and Required Navigation Performance (RNP).** For the purpose of this AC, "Primary" and "Supplementary" means of navigation and Required Navigation Performance (RNP) are defined in Appendix 1. Application of these terms to instrument approach or takeoff is described below. In addition, it should be noted that the term "Primary Means of Navigation" may apply to either instrument approach initial, intermediate final approach, or missed approach courses of procedures flown to Category I or Category II minima. The term Supplemental Means of Navigation can typically apply to initial or intermediate segments or Missed approach segments, but typically does not apply to flying a final approach course of an instrument procedure. For definitions of Category I or Category II as used by the U.S. and ICAO, see Appendix 1.

**a. Primary Means of Navigation.** A "Primary Means" of navigation is a means of navigation that satisfies each of the necessary levels of accuracy and integrity for a particular area, route, procedure or operation. The failure of a "Primary Means" of navigation may result in, or require reversion to a "non-normal" means of navigation or alternate level of RNP.

**(1)** "Availability" as relates to a primary means of navigation is typically addressed in conjunction with the applicable operating rules for use of the system, in the context of the area, airspace, route, procedures, or operations for which system use is intended (e.g., use of multiple versus single sensors or systems, or NAVAID signal access, reliability, or continuity of service as might apply to a particular approach path).

**(2)** As applicable to instrument approach operations for an air carrier, particularly for a final approach segment or a missed approach segment, the following may be considered to satisfy requirements for a primary means of navigation.

**(3)** For sensor specific approaches (e.g., VOR, or NDB, or ILS) each particular airborne system using its respective associated NAVAID (e.g., ILS) may be considered as the "primary means of navigation" for completion of that respective specified approach procedure (e.g., ILS RWY 16R).

**(4)** When multiple components are required (e.g., ILS, with use of an NDB for the missed approach), the collective set of specified navigation components are considered to be the primary means of navigation for that procedure. Failure of any one of the required components may preclude use of the procedure, or may require reversion to a non-normal means of navigation for completion of the procedure (e.g., failure of the NDB missed approach NAVAID associated with an ILS approach).

**(5)** For RNAV based procedures where the only method of flying the procedure is by an RNAV or RNAV/RNP system (e.g., FMS), RNAV is considered to be the primary means of navigation for that approach procedure. Any associated NAVAID, or combinations of NAVAIDs, or airborne sensors necessary to achieve the necessary level of FMS performance may be considered as an input sensor(s) to the FMS, but the sensors or NAVAIDs taken alone are not necessarily considered to be the primary means of navigation.

**(6)** Where RNAV systems are used to overfly other types of instrument approach procedures (e.g., FMS RNAV systems over-flying VOR or NDB procedures), the RNAV system may be considered as a supplemental system if the aircraft can revert to use of the underlying procedure flown with "raw data," in the event of failure of the RNAV system (see b. below).

**b. Supplementary Means of Navigation.** A "Supplementary Means" of navigation is a means of navigation which satisfies one or more, but not necessarily all of the necessary levels of accuracy, integrity, and availability for a particular area, route, procedure, or operation. The failure of a "Supplementary Means" of navigation may result in, or require reversion to another alternate "normal" means of navigation for the intended route, procedure, or operation.

**(1)** As applicable to instrument approach operations for an air carrier, particularly for a final approach segment or a missed approach segment, the following may be considered to satisfy requirements as a supplementary means of navigation.

**(2)** When procedures have multiple methods to achieve compliance (e.g., a multi-sensor FMS over-flying a VOR approach, or an ILS approach with the choice of either an NDB or a VOR-based missed approach), those airborne systems which have another alternate normal means to accomplish the procedure, or a portion of the procedure, for one or more applicable segments, may be considered as supplementary for those applicable segments (e.g., if the FMS should fail, and the crew is monitoring the underlying VOR information, and the crew can transition to use of VOR-based navigation) the FMS may be considered as supplementary.

**(3)** Or, if, after an ILS approach, FMS RNAV capability is used to overfly a VOR/DME-based missed approach (with VOR/ DME NAVAID facilities operating), the FMS RNAV capability may be considered supplementary. Note, however, that if the specified approach/missed approach VOR/DME NAVAIDs are not operative, and the FMS RNAV operation is based on use of multi-sensor NAVAID capability, then the FMS use for that approach/missed approach would typically be considered a primary means of navigation.

**c. Required Navigation Performance (RNP).** Required Navigation Performance is a statement of the navigation performance necessary for operation within a defined airspace (Adapted from ICAO - IS&RP Annex 6). Required Navigation Performance is specified in terms of accuracy, integrity, and availability of navigation signals and equipment for a particular airspace, route, procedure, or operation.

**4.3.1.3. Use of ICAO Standard NAVAIDs.** U.S. Category I or Category II Operations are based on use of ICAO standard NAVAIDs, equivalent NAVAIDs, or other NAVAIDs acceptable to FAA and approved in OpSpecs. Authorization for use of NAVAIDs other than ICAO Standard NAVAIDs must be coordinated with AFS-400.

In the context of this AC, a Standard Landing Aid (SLA) is considered to be any navigation service or navigation aid provided by a State which meets internationally accepted performance standards (e.g., ICAO Standards and Recommended Practices (SARPs), or equivalent U.S. or other State standards - see Appendix 1).

**4.3.1.4. Standard Instrument Approach Procedures (SIAPS).**

**a. Acceptable Instrument Approach Procedure Basis.** Instrument approach procedures used by Operators IAW with this AC should be based on:

**(1)** U.S. Standard Instrument Approach Procedures;

**(2)** For non-U.S. airports, foreign instrument approach procedures acceptable to FAA promulgated by the state of the airport of landing (i.e., ICAO - State of the Aerodrome). The operator may propose use of such procedures for Principal Operations Inspector (POI), Aircrew Program Manager (APM), or Certificate Management Office (CMO) acceptance;

**(3)** Military instrument procedures acceptable to FAA for operations at military facilities. The operator may propose use of such procedures for POI, APM, or CMO acceptance;

**(4)** Special instrument approach procedures approved by the FAA;

**(5)** Special instrument approach procedures developed by the operator which are acceptable to FAA, or procedures developed by the operator using methods acceptable to FAA; or

**(6)** Special instrument approach procedures, acceptable to FAA, developed by other U.S. or non-U.S. Operators, or by the State of the Aerodrome (for foreign airports).

**b. Considerations for use of procedures other than U.S. Standard procedures.** For procedures other than those developed IAW FAA Order 8260.3, United States Standards for Terminal Instrument Procedures (TERPS), the operator must ensure consideration of at least the following factors related to use of those instrument procedures:

**(1)** Availability of suitable weather reporting and forecasts;

**(2)** Identification of any necessary alternate airports or alternate minima;

**(3)** Ability to discontinue an approach, if necessary, from any point to touchdown;

**(4)** Suitability of the airborne equipment to use the procedure (e.g., compatibility of the airborne equipment with the type/characteristics of the ILS, VOR, DME, NDB ground facilities used);

**(5)** Suitability of Ground Systems/Equipment (e.g., lighting, transmissometers, pilot control of lighting);

**(6)** Suitability of NAVAIDs (e.g., maintenance, monitoring);

**(7)** Suitability of Airport/Runway (e.g., obstructions, clear zones, markings);

**(8)** Availability of Aeronautical Information (e.g., timely NOTAM availability);

**(9)** Identification of any special Training or qualification related to the procedure; and

**(10)** Resolution of any issues identified from adverse “service experience” with the procedure.

**c. Special Instrument Approach Procedures.** Special instrument approach procedures should be coordinated with the Flight Standards Division of the FAA region having responsibility for the airport of the procedure. Special procedures should address any provisions associated with application of section 121.445 for special airport qualification. Special procedures are approved by AFS-400 and issued by the POI after coordination with pertinent FAA organizations.

**d. Use of FAA/JAA Harmonized Instrument Approach Minima Tables.** Information from FAA/JAA harmonized instrument approach minima tables are provided in Appendix 8. Unless otherwise authorized by AFS-400, procedures incorporating these minima are issued as special instrument procedures through OpSpecs, or through a Letter of Authorization (LOA). Minima based on values provided in Appendix 8 should not be below the lowest minima authorized through a Category I Standard OpSpec authorization, or below any applicable published foreign aerodrome minima when operating outside the United States (see Paragraph 6.2.18 and Appendix 8).

**4.3.1.5. "Steep Approaches" and Approach Path Descent Angle Constraints.** Approach path angles between 2.75 degrees and 3.77 degrees are considered standard for air carrier operations. Approach angles above 3.77 degrees are considered "steep angle" and, if authorized, may require additional assessment. Air carrier use of approach angles over 3.77 degrees requires coordination with AFS-400. Use of approach angles over 4.5 degrees should normally be based on an associated aircraft type AFM provision for "steep angle approaches," IAW AC 25-7A, Flight Test Guide for Certification of Transport Category Airplanes, or equivalent, and paragraph 6.8 of Appendix 2.

**4.3.1.6. "Normal Maneuvering" Considerations.** Part 91, section 91.175 requires that approach procedures should be based on use of "normal maneuvers" before and after passing DA(H) or MDA(H). Normal maneuvers typically do not involve use of bank angles greater than 30 degrees, pitch attitudes in excess of 25 degrees nose up or 10 degrees nose down, or sink rates in excess of 1100 ft. per minute below 500 ft. HAT while maneuvering to land within the touchdown zone, during go-around, or during a rejected landing. During a missed approach, pitch attitudes in excess of +30 degrees or bank angles greater than 30 degrees would typically be considered excessive.

**4.3.1.7. Non-Normal Events or Configurations.** Takeoff and landing weather minimums are intended for normal operations. When non-normal events occur, flightcrews are expected to take the safest course of action to ensure safe completion of the flight. Using emergency authority, crews may deviate from rules or polices, to the extent necessary for the circumstances, to minimize risk during landing.

Paragraph 6.1.8 addresses guidelines and procedures to be considered in conducting an instrument approach during a non-normal event.

**4.3.1.8. Go-Around Safety.**

**a. General.** A multiengine aircraft conducting a Category I or Category II instrument approach should be capable of safely executing a "one-engine-inoperative" go-around from any point in an approach prior to touchdown with the aircraft in a normal configuration, or specified non-normal configurations (e.g., engine out, if applicable). This is necessary to provide for go-around safety due to missed approaches or rejected landings due to a variety of circumstances such as:

- Unexpected environmental conditions (e.g., cross winds, turbulence)
- Aircraft related failures (e.g., gear unsafe)
- Air Traffic Service contingencies (e.g., RTO on a crossing runway)
- Loss of visual reference
- When a pilot finds the runway surface unsuitable (e.g., clutter, flocking birds)
- When the runway is blocked (airport vehicles or exiting aircraft ahead not clear), or due to a go-around or missed approach due to any other reason

**(1)** This objective may be achieved by the operator providing information to flightcrews on an appropriate lateral flight path to follow to enable the aircraft to safely operate to the runway, and out from the runway following a rejected landing. In the rare event that operation out of a runway may not be possible following a rejected landing, then provision of suitable information on a "commit point," or equivalent condition (e.g., limit weight, minimum speed, or suitable configuration) may instead be provided. The intent of providing information on safe go-around capability is to identify the best option or options for a safe lateral ground track and flight path to follow in the event that a missed approach, balked landing, rejected landing or go-around is necessary. It is not the intention of this provision to require or indicate the need for an analysis of each flight, or a dispatch assessment, or an individual flight landing weight assessment or limitation. Operators may make the judgment as to whether a review on a "per-flight" or specific condition basis may or may not be needed.

**(2)** While coping with the go-around contingency situation is appropriate for any operation, it is particularly important for low visibility operations in which the pilot has minimum time to respond, and may have limited visual reference available to safely cope with the adverse condition (e.g., night and poor visibility). Further, "go-around" safety should be addressed regardless of when an engine failure may occur prior to landing. However, operators may elect to distinguish between procedures or expected crew response for engine failures occurring at various times during a flight as follows:

(a) Engine failure occurring enroute or prior to passing a final approach fix or point,

(b) Engine failure during a final approach segment, or

(c) Engine failure after passing DA(H) or after descending below MDA(H) but prior to touchdown, or during a go-around or missed approach.

**(3)** For an engine failure occurring prior to final approach, flight diversion planning should allow for the potential need for a missed approach or balked landing, and for the need to maintain subsequent suitable obstacle clearance (e.g., when making suitable diversion choices - sections 121.161, 121.191, or 121.193. The pilot should consider any adjustment to minima, procedures or missed approach path that may be appropriate to facilitate safe obstacle clearance (e.g., following a suitable operator-developed takeoff procedure, published takeoff procedure, or IFR Departure Procedure (DP)). This is particularly appropriate if U.S. TERPS or ICAO PANS-Ops-specified instrument procedural gradients cannot be met during any portion of a go-around or missed approach, or if following a suitable lateral path cannot be ensured (e.g., crosswinds with no course guidance available, cannot maintain VMC, or at night).

**(4)** For engine failure during approach, if there is any doubt of the ability to safely complete the landing or ensure a safe balked landing and missed approach capability, the pilot should consider the advisability of discontinuing the approach and diverting to a different airport or runway, to better ensure safe missed approach or balked landing obstacle clearance.

**(5)** For engine failure after passing DA(H) or descending below MDA(H), the pilot should be prepared to expeditiously follow or join any pre-established and applicable "T-procedure" or "IFR Departure Procedure," or equivalent, until becoming established on a published segment of the missed approach procedure, at or above a safe altitude.

**(6)** Accordingly, an operator should have reviewed the missed approach and rejected landing flight path to ensure that in the event of a go-around the aircraft is able to ensure safe obstacle clearance following a missed approach or go-around. This can be particularly important in mountainous areas where the landing runway may be in a direction not typically used for takeoff (e.g., an airport that is one way in, and the opposite direction out).

**b. Go-Around Assessment Considerations.**

**(1)** Operators may accomplish such assessments generically for a particular runway, procedure, aircraft type, and expected performance, and need not perform this assessment for each specific flight. Operators may use simplifying assumptions to account for the transition, reconfiguration, and acceleration distances following go-around (e.g., use expected landing weights, assume anticipated landing flap settings).

**(2)** The operational considerations should include:

(a) Go-around configuration transitions from approach to missed approach configuration including expected flap settings and flap retraction procedures.

(b) Expected speed changes.

(c) Appropriate engine failure and shutdown (feathering if applicable) provisions, if the approach was assumed to be initiated with all engines operative.

(d) Any lateral differences of the missed approach flight path from the corresponding takeoff flight path, and

(e) Suitable balked landing obstacle clearance, until reaching instrument approach missed approach or enroute procedurally protected airspace.

(f) Any performance or gradient loss during turning flight, if necessary to follow a flight path that is not over the runway or is not aligned with the runway after the balked landing transition.

(g) Any relevant related situations such as if the aircraft cannot dump fuel and may need to make an emergency return landing above maximum landing weight immediately after takeoff.

(h) Methods used for takeoff analysis, such as "Overspeed V2", "engine-out maximum angle climb," or other such techniques may be used if determined to be appropriate by the operator or aircraft manufacturer.

(i) Applicable flight guidance system operational procedures used. Information about any techniques required to achieve the specified performance should be available to the flightcrew (e.g., appropriate mode selection).

(j) Operators may make obstacle clearance assumptions similar to those applied to corresponding takeoff flight paths (e.g., Section 121.189) in the determination of net vertical flight path clearance or lateral track definition or lateral track obstacle clearance within an airport boundary or beyond an airport boundary, until the point at which cruise or other obstacle clearance requirements apply.

**c. Go-Around Assessment Conditions.**

**(1)** Assessments may assume the following initial conditions:

**(a)** A "balked landing" starts at the end of the Touchdown Zone (TDZ).

**(b)** An engine failure occurs at the initiation of the balked landing, from an all-engine configuration.

**(c)** Balked landing initiation speed $\geq V_{REF}$ or $V_{GA}$ (as applicable).

**(d)** Balked Landing initiation height is equal to the specified elevation of the TDZ.

**(e)** Balked landing initiation configuration is normal landing flaps, gear down.

**(f)** At the initiation of the maneuver, all engines are at least in a spooled configuration.

**(2)** A TDZ typically is considered to be the first 3000 ft. of a designated landing runway. When appropriate for the purposes of this provision, Operators may propose to use a different designation for a touchdown zone. For example, alternate consideration of a TDZ may be appropriate for runways that:

**(a)** Are less than 6000 ft. in length and which do not have standard TDZ markings;

**(b)** Short runways requiring special aircraft performance information or procedures for landing;

**(c)** Runways for STOL aircraft; or

**(d)** Runway where markings or lighting dictate that a different TDZ designation would be more appropriate.

**d. "One Way" Airports, "Commit Point," or Other Special Situations.**

**(1)** Where obstacle clearance is determined by the operator to be critical such as for:

(a) "One-way in," "opposite way out" airports in mountainous terrain, or

(b) Runways at which a landing is to be planned or attempted, but at a weight which is significantly greater than that which would otherwise be allowed for a takeoff, or

(c) Where rejected landing obstacle clearance may not be readily ensured, a review should be completed by the operator to determine whether a contingency go-around path can be appropriately defined or whether a "commit point" or equivalent condition is necessary (e.g., limit weight, speed, or configuration).

**(2)** A "commit point" or equivalent condition however, should only be used where it is not otherwise possible to identify a safe go-around path. For a "commit point," the operator should either provide a representative weight, configuration or condition at which obstacle clearance can be ensured after initiation of a balked landing at the TDZ, or identify a path related waypoint, location, altitude, height, or fix, beyond which a go-around should not be attempted. For such determinations, the operator should consider at least the runway elevation, temperature, and appropriate aircraft configurations or configuration changes. If a "commit point" is used, the operator should provide any necessary advisory information to flightcrews to address any events which, while unlikely, could nonetheless occur beyond the designated "commit" point or condition (e.g., unforeseen significant wind shear, unacceptable winds, turbulence, or runway clutter, loss of visual reference, flare extending beyond the touchdown zone, or an obstruction on the runway).

**e. TERPS/ICAO PANS-Ops Criteria Not Applicable to "Non-Normal" Operations.** TERPS or ICAO PANS-Ops- based criteria do not typically address "special" instrument approach procedures, and they do not and are not intended to address non-normal operations (engine inoperative) or operations below published segments of instrument procedures (e.g., operations below DA(H) or MDA(H)). TERPS or ICAO PANS-Ops based criteria are intended only to address "standard procedures", normal operations (e.g., all-engine), and published segments of the resulting procedures. Thus, operator assessments of missed approach safety related to operations below published segments of instrument procedures, or operations with non-normal configurations or situations, need not apply provisions of TERPS or ICAO PANS-Ops. Compliance with TERPS or ICAO PANS-Ops based instrument procedure requirements alone may not necessarily ensure missed approach or rejected landing go-around safety. For example, it is recognized that certain types of aircraft (e.g., two-engine aircraft) may operate at weights that achieve gradients with an engine inoperative that may be less than TERPS or PANS-Ops gradients. Go-around from below DA(H) or MDA(H) (e.g., following loss of visual reference, or runway not suitable or available) does not necessarily provide for and does not need to apply TERPS or PANS-Ops criteria or provide for TERPS or PANS-Ops specified levels of obstacle clearance vertically or laterally. Methods related to TERPS or PANS-Ops criteria such as "Collision risk model (CRM)" also are not applicable to assessments other than for TERPS and PANS-Ops related procedure elements.

**f. Flight Guidance System (FGS) Use.** If not already assessed for the aircraft type during basic type certification, or STC, flight guidance systems (FGS) suitability for the intended procedure(s) should be considered. The operator may need to assess FGS mode use to ensure compatibility with intended flight path, mode transitions, and gradient determinations. This may be achieved by demonstrating (in simulation or flight) a safe go-around from 100 ft. above the TDZ (HAT) operationally for the specific procedure or, if applicable, for the most critical runway for that operator. For aircraft that have airworthiness demonstrations conducted IAW Appendix 2 or 3 or with AC 120-28D this provision is considered to be addressed.

**g. Performance and Obstacle Data Availability and Use.**

**(1)** Information or methods used by the operator for this assessment may be the best available information or methods from applicable aircraft manuals, terrain or obstruction charts, or supplementary information from aircraft or engine manufacturers. In the event that performance, obstacle, or flight path data are not otherwise available to support the necessary analysis from the above sources, the operator may develop, compute, demonstrate, or determine such information to the extent necessary to provide for safe obstacle clearance during an engine-out missed approach or an engine-failure following a rejected landing. Data or methods used need not necessarily be from the applicable AFM or from the original aircraft manufacturer. Data or methods may be developed by the operator based on equivalence to other data or methods (e.g., takeoff data) or may be derived by using standard practices applicable to aircraft performance assessment or procedure construction, or may be derived by appropriate aircraft performance or engineering analysis, techniques, or methods.

**(2)** Information on terrain or obstructions for these assessments may be based on the best available information to the operator or to the agency or entity supporting the operator at the time the information is supplied (e.g., data available to a performance information contractor, or chart supplier). Best available information may be used, notwithstanding that certain information or data may not necessarily be "approved" by an authority, or may be data that is not necessarily recent (e.g., certain types of charting or obstruction information is not frequently updated). FAA Order 8260.19, paragraph 271 describes how the accuracy of the source data should be considered when constructing the procedure.

**h. Related Information.** Other paragraphs of this AC contain information related to this paragraph. Paragraph 5.14 describes typical factors to be considered when assessing go-around capability for a particular aircraft and flight guidance system. Paragraph 6 addresses procedures including those used for go-around or rejected landing, and Paragraph 7 addresses Training and Crew Qualification including relevant aspects of missed approach, go-around, or rejected landing.

**4.3.2. ILS, GLS, or MLS (xLS) Instrument Approach Operations.** ILS, GLS, or MLS (i.e., xLS) operations may be authorized to the lowest applicable DA(H) for the procedure used, and to the lowest visibility minima specified in the OpSpecs for the NAVAID, facilities, and lighting systems used (see Appendix 7, Standard OpSpecs Part C Paragraph C053 for Category I, and Standard OpSpecs Part C paragraph C059 for Category II).

**a.** ILS, GLS, or MLS (e.g., xLS) operations are typically authorized based on use of two or more navigation receivers or multi-mode receivers (MMRs) of a pertinent type (see 14 CFR, part 121, section 121.349, and part 125 section 125.203), each providing independent information to the appropriate flight guidance system elements and pilot displays.

**b.** Provisions of sections 121.349, and 125.203 applicable to ILS may also be considered as applicable to GLS or MLS.

**c.** Provisions of section 121.349 for use of a single navigation (e.g., ILS) receiver are typically limited to operations using minima at or above RVR4000, or for Minimum Equipment List (MEL) authorization for dispatch with a NAVAID receiver inoperative.

**d.** Precision Approach Radar (PAR) procedures are not considered xLS procedures( see paragraph 4.3.3).

**4.3.3. Instrument Approaches other than ILS, GLS, or MLS (xLS).** Instrument approach procedures other than ILS, GLS, or MLS (xLS) that may be authorized for air carriers include the procedure types shown in the following paragraphs.

**a. Standard Instrument Procedures Other Than xLS.** The following NAVAID specific instrument procedures are considered to be standard procedures for the purpose of air carrier operation specification approval. Typically these procedures do not inherently specify use of vertical guidance (i.e., most were traditionally considered as non-precision approaches).

**(1)** Some of these approach types may provide vertical guidance (e.g., a glideslope), however, the procedure may be offset from the runway, may not otherwise permit a straight in landing in the touchdown zone when flying the specified path, or may not have flight deck display of path information. Hence the approach is not considered to be an xLS approach.

**(2)** Approvable standard approach types other than xLS are considered to include:

- Localizer (LOC)
- Localizer Back Course (BC)
- SDF
- LDA
- VOR
- VOR/DME
- NDB
- Dual NDB
- NDB/DME
- TACAN, and
- RNAV (2D)* based on a procedurally specified NAVAID (e.g., typically when a particular VOR/DME is specified as a "Procedure tuned" facility to serve as a basis for a particular RNAV procedure - These RNAV procedures usually are those which meet U.S. TERPS Chapter 15 criteria for RNAV).

**b. Standard Procedures Flown Using Vertical Navigation Path Guidance (VNAV).** The procedures specified in paragraph a. above may also be flown in conjunction with use of FMS derived vertical guidance (e.g., FMS VNAV capability). In this instance, VNAV capability is considered to be based on a pre-specified and defined vertical path.

**c. Standard Procedures Flown Using "Constant Vertical Descent Rate" Techniques.** NAVAID specific procedures other than xLS may be flown using "Constant Vertical Descent Rate" Techniques as a "pilot procedural technique" to maintain a pre-determined vertical speed to achieve a corresponding assumed descent path (e.g., "open-loop" vertical speed descent profile). Operators may use these techniques, particularly when xLS or VNAV path guidance is not available or cannot otherwise be used. However, such "Constant Vertical Descent Rate" techniques are not considered to be "VNAV vertical guidance". This is true regardless of whether such a procedure or technique is based on an altitude/distance cross check or not. While use of such techniques may be desirable for aircraft that are not using xLS or VNAV, they are not considered to be eligible for DA(H) use or credit.

**d. "RNAV" Procedures (3D or 2D)* Based On RNP.** Operators may use RNAV procedures based on RNP criteria that are found to be acceptable to FAA. Those RNAV procedures may use minima based on RNP criteria, or may use RNP for definition of some or all procedure segments (e.g., initial, intermediate, final, or missed approach segments).

**e. Other "RNAV" Procedures (3D or 2D)*.**

**(1)** When determined acceptable to FAA, Operators may also use RNAV Procedures (3D or 2D)* other than those based on criteria specified in U.S. TERPS Chapter 15 for RNAV (e.g., RNAV procedures as listed in paragraph a. above), or other than procedures based on RNP (RNAV procedures as listed in paragraph d. above), as follows:

- RNAV procedures identified as "GPS" instrument approach procedures, if those procedures are determined to be suitable for the aircraft and navigation system to be used (e.g., use of FMS with GNSS sensor inputs).
- International RNAV procedures, when appropriate for use at non-U.S. airports.

- RNAV procedures based on multi-sensor FMS using inertial systems and NAVAIDs other than specific “procedure-tuned” VOR or DME facilities. For example, RNAV Procedures (3D or 2D)* may be based on multi-sensor FMS systems which use DME-DME updating, or scanning DME updating, or VOR/DME updating, or VOR/VOR updating, from suitable and available NAVAIDs.
- RNAV procedures based on multi-sensor FMS using inertial systems and GNSS, or GNSS with Ground Based Augmentation System (GBAS), or Space Based Augmentation System (SBAS)).

**(2)** RNAV procedures may also be based on combinations of sensors if equivalent performance, availability, and integrity are established compared with any of the above methods.

***NOTE: For the purpose of this AC a “3D” approach procedure (3D) is considered to be one having both lateral and vertical path guidance (e.g., three dimensions - with x, y, and z path coordinates). These procedures may be identified as LNAV/VNAV. A “2D” procedure (2D) is considered to be one having only lateral path guidance (two dimensions - x and y path coordinates). These procedures may be identified as LNAV.**

**f. Airport Surveillance Radar (ASR) Procedures.** ASR or international equivalent procedures may be used.

**g. Precision Approach Radar (PAR) Procedures.** PAR or international equivalent procedures may be used.

**h. Other Limited Use Special Procedures.** Other special instrument approach procedures (e.g., LORAN, Transponder Landing System (TLS), airborne radar approach, Eastern European KRM). Special procedures include use of LORAN C, airborne radar, or any other landing system or non-ICAO NAVAID. Special procedures typically require unique approval of an operator’s operational procedures, flightcrew qualification, and maintenance programs as well as proof of concept demonstration prior to operational authorization. Special Category I operations, by definition, require the use of airborne and/or ground based or satellite-based equipment over and above the minimum equipment necessary to operate in the U.S. national airspace. Special Category I operations usually also require special knowledge, skills, proficiency, and procedures. As a result, changes and amendments to the operator’s overall Category I operations program are usually necessary to ensure safe conduct of these operations. There is additional criteria which must be incorporated into an operator’s program for special Category I operations.

**4.3.4. Applicability of a DA(H), MDA(H), or RA.** Instrument approach and landing operations have limitations related to the minimum altitude (height) to which descent can be made without establishing visual reference (e.g., 14 CFR part 91, section 91.175). Minimum altitude or height to which descent can be made is typically related to assurance of clearance over terrain or obstacles, airborne instrumentation and equipment, NAVAIDs, and visual aids. Such a minimum altitude or height is usually specified as a DA(H), or MDA(H). A DA(H) may be intended for use as either a Decision Altitude (DA), or as a Decision Height (DH). A DH may be used directly, or it may be specified as a corresponding radio altitude (RA) value above underlying approach terrain. The type of instrument approach procedure determines whether a DA or DH is used, and whether a DH is specified directly, or is defined in terms of a corresponding radio altitude (RA) value above terrain. For a Category I procedure, a DA is typically used. For a Category II procedure, a DH with a corresponding radio altimeter (RA) height above approach terrain is usually used. When a RA value above approach terrain is specified, it typically corresponds to a particular desired DH value for the intended height above the TDZ (HAT).

Uses of DA(H), MDA(H), and RA are further described in paragraphs 4.3.4.1 through

**a. DA, DH, RA, OCA, OCH, OCL.** For xLS approaches (e.g., precision approaches), and certain RNAV approaches with VNAV, the minimum altitude or height for flight without having established the necessary visual reference during an approach is specified as a DA(H). For Category I within the U.S., the DA element of a DA(H) usually defines the applicable minima. For Category II, applicable minima are usually based on a DH, expressed in the published procedure as an RA value. In other countries, for Category I, either a DA or a DH may be used. For Category II outside the U.S., minima may be based either on a direct specification of DH, or on a corresponding RA value, as is done within the U.S. Other expressions of minima equivalent to a decision altitude (DA) or decision height (DH) may also be encountered outside of the U.S., such as when an obstacle clearance altitude (OCA), obstacle clearance height (OCH), or obstacle clearance limit (OCL) is specified, and is to be treated as a corresponding DA or DH.

**(1)** In the United States and other countries that use U.S. TERPS criteria, the minimum instrument flight altitude for xLS approaches is considered to be the DA element of the DA(H) if minima are based on a barometric altimeter, or the (H) value of the DA(H) expressed as an RA minima, if minima are based on use of a radio altimeter. When a DH applies, it is usually specified as an RA value above the pertinent underlying approach terrain, considering a nominal approach vertical path. When a barometric altimeter specified DA is used to establish minima, the associated height value (H) is typically considered to be advisory. When a DH specified in terms of a radio altitude (RA) value is used, the corresponding published RA value is considered to be controlling, and any associated barometric altitude value shown in a procedure is typically considered to be advisory.

**(2)** For procedures with minima based on a DA, the DA is specified as a decision altitude referenced to mean sea level (MSL) using QNH altimeter settings. While the (H) element of the DA(H) is typically advisory for such procedures, in certain circumstances the (H) value may be the basis for minima, such as when a QFE referenced barometric altimeter setting is used.

**(3)** Obstacle Clearance Height (OCH) and Obstacle Clearance Limit (OCL) are used in some countries IAW various versions or revision levels of ICAO PANS-OPS. OCA, where used, is referenced to a barometric altitude (MSL). OCH and OCL are referenced to height above either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold.

**b. Minimum Descent Altitude (MDA), Minimum Descent Height (MDH), HAT, Height Above Airport (HAA), Obstacle Clearance Altitude (OCA), OCH, OCL.**

**(1)** For approaches other than xLS, the minimum height or altitude may be specified as a decision altitude DA or a DA(H) if suitable vertical guidance is authorized and provided (e.g., VNAV path), or specified as a minimum descent altitude MDA of an MDA(H) if vertical guidance is not provided. Minima may also be specified height above touchdown (HAT), height above airport (HAA), minimum descent height (MDH), obstacle clearance altitude (OCA), obstacle clearance height (OCH), or obstacle clearance limit (OCL). MDA, HAT, and HAA are typically used by certain countries that use various earlier versions of U.S. TERPS criteria. OCA, OCH, and OCL are used in countries having procedures established IAW ICAO PANS-OPS. Although ICAO PANS-OPS now does not use OCL, some procedures still use OCL criteria from previous versions of PANS-OPS. Some countries, in addition to OCA and OCH, provide MDA and MDH. MDA and OCA are barometric flight altitudes referenced to mean sea level (MSL). HAT, HAA, MDH, OCH, and OCL are radio or radar altitudes referenced to either the elevation of the airport, the elevation of the touchdown zone, or the elevation of the landing threshold.

**(2)** Accordingly, for international operations, the following equivalent minima formulations should be used by U.S. Operators:

(a) Use the altitude value of the MDA(H) where OCA may be specified for procedures other than xLS.

(b) Use the equivalent altitude value of the MDA(H) where HAT, OCH, or OCL are specified for “straight-in” approach procedures.

(c) Use the equivalent altitude value of the MDA(H) where HAA, OCH, or OCL may be specified circling approach maneuvers.

**c. Lowest Permissible DA(H) or MDA(H).** The lowest permissible DA(H) or MDA(H) for instrument flight (IMC) for any approach should not be lower than the most restrictive of the following, as applicable:

- Minimum height or altitude published or otherwise established for the instrument approach

- Minimum height or altitude authorized in OpSpecs for the approach
- Minimum height or altitude authorized for the flightcrew
- Minimum height or altitude authorized for the operator, aircraft, and airborne equipment
- Minimum height or altitude permitted by operative airborne equipment and NAVAIDs
- Minimum height or altitude for which required NAVAIDs can be relied upon*
- Minimum height or altitude which provides adequate obstacle clearance*, and
- Minimum altitude which provides compensation for extremely cold temperatures, if applicable**

*** Note: Item normally addressed by the published instrument approach procedure.**

**** Note: Applicable only when an operator has a procedure to correct altimeter errors for extremely cold temperatures (Typically T less than -22F/-30C).**

**4.3.4.1. Application of a DA(H) for Category I.** Procedures established based on use of NAVAID electronic vertical guidance (e.g., ILS, MLS, or GLS) use the barometrically based DA (of the specified DA(H)) for minima determination. Radio altitude above the approach terrain or touchdown zone, if provided, is advisory.

Procedures established based on use of other acceptable electronic vertical guidance (e.g., Baro VNAV meeting provisions of this AC, GNSS based geometric path VNAV) may use a barometrically based DA (of the specified DA(H)) for minima determination if an appropriate obstacle assessment has been completed for the region between the earliest point along the approach path at which the DA may be reached, to the runway threshold. Radio altitude, if provided, is advisory.

For Category I a decision height (DH) is not used.

DA(H) is applied to Category I instrument approach procedures as follows:

**a. Category I ILS, MLS, or GLS (xLS) Approaches.**

**(1)** For Category I approaches based on ILS, MLS, or GLS (e.g., xLS, or precision approaches), a DA(H) is typically specified. The DA(H) represents the minimum altitude in an approach to which descent may continue, or by which a missed approach must be initiated, if the required visual reference to continue the approach has not been established. The DA(H) “altitude” value is typically measured by a barometric altimeter, and is the determining factor for descent minima for an xLS approach procedure. The “height” value specified in parenthesis is typically a radio or radar altitude equivalent height above the TDZ (HAT) used only for advisory reference, and does not necessarily reflect actual height above underlying terrain. Where a Middle Marker (MM) beacon is installed, it may be used as advisory information, confirming a barometrically determined DA(H) that is coincident with the glide slope altitude at that point.

**(2)** For approaches which normally provide vertical guidance (e.g., xLS), but when vertical guidance capability cannot be used, such as due to an airborne system failure, see paragraph 4.3.4.2 below.

**b. Category I Approaches with VNAV.** For Category I approaches other than ILS, MLS, or GLS which use a published VNAV descent path to the runway threshold, a DA(H) may be specified instead of an MDA(H). See (a) above for DA(H) applicability.

**c. Precision Approach Radar (PAR) procedures.** For Category I minima, a DA(H) may be specified for PAR. See paragraph a. above for DA(H) applicability. Category II is not typically applicable to civil aircraft use of PAR (see 4.3.8.g).

**4.3.4.2. Application of an MDA(H) for Category I.** Procedures that are not based on use of vertical guidance (e.g., VOR, NDB, Back Course ILS) use the barometrically based MDA (of the specified MDA(H)) for minima determination. Radio altitude, if provided, is advisory.

**a. Category I Approaches other than ILS, MLS, or GLS.** For Category I approach other than ILS, MLS, or GLS (e.g., non-precision approaches), an MDA(H) is typically specified. The MDA(H) represents the minimum altitude in an approach to which descent may continue, until either the required visual reference is established and the aircraft is in a position to continue the descent to land using normal maneuvering, or until reaching the specified missed approach point. The MDA(H) "Altitude" value is typically measured by a barometric altimeter, and is the determining factor for descent minima for approaches other than ILS, MLS, or GLS (other than xLS) Category I instrument approach procedures. The "Height" value specified in parenthesis is typically a radio or radar altitude equivalent height above the touchdown zone (HAT), and is used only for advisory reference. This height value does not necessarily reflect actual height above underlying terrain. Where a VHF marker beacon (e.g., FM) is used, it may indicate a longitudinal position for a step-down fix, if identified in the procedure.

**b. Circling Approaches.** Many instrument procedures provide for circling approach minima. U.S. criteria require SIAP publication of circling maneuver minima if the inbound course does not meet straight-in alignment criteria, or when a specified descent gradient for a straight-in approach is steeper than a maximum value allowed by instrument procedure design criteria. Sufficient visual references for manually maneuvering the aircraft to a landing must be maintained throughout a circling maneuver. The pilot must keep the aircraft's position within the established maneuvering area while performing the circling maneuver. The circling MDA(H) or equivalent must be maintained until an aircraft is in a position from which a normal descent can be made to touchdown within the touchdown zone, using normal maneuvers and a safe descent path.

**4.3.4.3. Application of a DA(H), or equivalent (i.e., Inner Marker), for Category II.** Procedures using Category II minima typically use a radio altimeter and the associated DH (of the specified DA(H)) for minima determination. Barometric altitude is advisory.

**a.** Procedures that have "Radio Altitude Not Authorized (RA NA)" (for example, due to irregular underlying terrain) typically use the first indication of arrival at the "inner marker" as a means to establish DA(H). However, an operator may elect to use first indication of arrival at either the "inner marker" or the barometric altitude DA, which ever comes first, as the means for minima determination. In the first instance, both radio altitude and barometric altitude are advisory. In the second instance barometric altitude may be an acceptable means to establish DA(H), but only if it occurs before arriving at the "inner marker." When a procedure specifies "RA NA," a DA(H) greater than 100 ft. HAT is typically not used, since a marker beacon is not located in a position along the approach path corresponding to that minima.

**b.** While for Category II the use of barometric decision altitude (DA) is advisory, this does not preclude an operator or flightcrew from initiating a missed approach if the altitude equivalent to the barometric altitude minima (DA) is reached prior to arrival at the specified DH. A barometrically specified "DA" is not currently used for air carrier Category II minima. This applies regardless of whether radio altimeter or inner marker determines the DH.

**c.** For Category II a Decision Height of a published DA(H) (or an equivalent Inner Marker (IM) for irregular pre-threshold terrain) is used as the applicable descent minima. Any "altitude" value specified is considered to be advisory. The altitude value is available for cross-reference and backup. Use of the barometrically referenced DA element of a published DA(H) is not currently authorized for parts 121, 129, or 135 operations at U.S. facilities. If an operator elects to base discontinuance of an approach on the DA, if the DA is reached prior to the applicable DH, the DA element of a DA(H) may be considered applicable to Category II in other than an advisory capacity.

**4.3.4.4. "Specified Visual Reference" Requirements for Category I or Category II.**

**a.** Section 91.175 and Standard OpSpecs specify that for operation below the DA(H) or MDA(H) on an instrument approach, the required visual reference to continue the approach must be established. Unless otherwise authorized by the CMO (e.g., POI or APM for a particular type) the required visual reference may be considered to be those provisions as listed in section 91.175 items (c) and (d).

**b.** Circumstances in which the operator may request and the CMO may authorize use of alternative visual reference provisions might be situations such as certain Category I and II minima are based on use of autoland or HUD (see paragraph 10.5.3). In this instance provisions such as those shown in section 91.175 (c) (3) (i) for "red terminating bars" or "red side row bars" may not be necessary or appropriate. This is because these particular approach lighting visual references or configurations may not always be needed when operations are predicated on HUD or autoland use. They may not even be installed or applicable as a part of the approach lighting system for the runway or runways to be specially authorized. Conversely, for operations such as the ones noted above for autoland or HUD, it may be determined by the operator and CMO that continued descent below the DA(H) based solely on visual contact with a VGSI (which may in instances be otherwise permitted by 14 CFR), but without having sight of either the runway, runway lights, touchdown zone lights, centerline lights, or runway markings would not be appropriate. In this instance, the CMO may authorize the operator to define and use alternate visual references or visual reference combinations for Category I and II operations, rather than relying solely on the sighting of a VGSI as a basis for continued descent below a DA(H).

**c.** Refer to FAA Order 8400.13 for lower Category I operations. Changing the required visual reference requires the use of a Special Procedure and additional authorization.

**4.3.5. Visibility and RVR Minima.** Visibility minima are as specified in Standard or Special Instrument Approach Procedures approved for use by the operator, or as otherwise listed in standard OpSpecs applicable to that operator for Category I or II landing. Operating minimums may be expressed as meteorological visibility (VIS), runway visual range (RVR), or runway visibility values (RVV).

**a. Meteorological Visibility (VIS).** Meteorological visibility may be used as reported by the NWS, a source approved by the NWS, by FAA, or a source approved by the FAA.

**(1)** Outside of the U.S., the FAA may accept meteorological reporting sources for use by a particular operator. Outside the U.S. meteorological visibility determination may vary, and the operator should ensure that the meaning, definition, and significance of any meteorological visibility reported for use in determining minima is understood by that operator's pilots.

**(2)** For approval of use of weather sources other than the NWS (e.g., international), Operators should consult their respective CMO, CMU, or POI. FAA FSDOs, CMOs, or CMUs that need assistance in responding to operator inquiries regarding approval of weather sources that are not otherwise already addressed by current directives (e.g., FAA Order 8400.10) should consult AFS-400.

**b. Runway Visual Range (RVR).** RVR is considered to be an instrumentally derived value measured by transmissometers. RVR is calibrated by reference to runway lights and/or the contrast of objects.

**(1)** Controlling RVR means the reported values of one or more RVR reporting locations (TDZ, Mid, Rollout, or equivalent international locations) used to determine whether operating minima are or are not met, for the purpose of approach initiation, or in some cases, approach continuation.

**(2)** All U.S. Category I operating minimums below 1/2 statute mile (RVR2400) and all Category II and III operating minimums are based on RVR.

**(3)** Where RVR is used, the controlling RVR for Category I minima is touchdown RVR. All other readings are advisory.

**(4)** For Category II minima, controlling RVR is as specified by OpSpecs.

**(5)** RVR use has practical limitations that should be familiar to both the operator and pilot. For example, RVR is a value which typically only has meaning for the portions of the runway associated with the RVR report (TDZ, MID, or Rollout). RVR is a value that may vary with runway light step settings (1 through 5). Operators should ensure that pilots are familiar with runway light setting effects on reported RVR. RVR may not be representative of actual visibility along portions of the runway due to the location of the transmissometer baseline and limited length of the baseline, or due to variable conditions of fog, blowing snow, or other obscurations along the runway, or due to obscurations varying rapidly in time (e.g., patchy fog). Additionally, newer RVR systems may have localized performance sensitivity since they do not use a baseline along the runway (e.g., a scatter array may be used for visibility assessment). Thus, pilots and Operators should note that RVR is an instrumentally derived value that has operationally significant limitations and can be greater than or less than the actual visibility available to a pilot at typical flight deck eye height (ground level) at the runway. This is particularly true at night, if runway lights are not at settings standard for the prevailing conditions, or if unusual daylight conditions are experienced such as when a runway is aligned with a sunrise or sunset condition, in shallow or patchy fog.

**(6)** Outside of the U.S. some RVR reports may not necessarily be instrumentally derived by transmissometers or scatter meters, and may alternately be made by pilots or other weather observers. Accordingly, Operators should ensure that the meaning, definition, significance, and variability of any non-instrumentally derived value of RVR reported to the pilot for use in determining minima is understood by that operator, and that operator's pilots.

**c. Runway Visibility Values (RVV).** RVV minima are now used infrequently, are being phased out, and should be used only where minima cannot otherwise be specified as a meteorological visibility (VIS) or runway visual range (RVR).

**4.3.6. Visibility Assessment and RVR Equivalence for Landing.**

**a.** For instrument procedures where minima are expressed in terms of meteorological visibility, but reported visibility available to the flightcrew is specified as an RVR, the tables referenced in standard OpSpecs may be used to establish equivalent meteorological visibility minima. (see Appendix 7, OpSpecs paragraph C051).

**b.** Conversely, for instrument procedures outside of the United States where minima available to the flightcrew on instrument procedures are expressed only in terms of RVR, but reported visibility available to the flightcrew by ATS or other approved source is specified only as a meteorological visibility and RVR is not reported, the "Visibility-RVR Equivalence" table referenced in standard OpSpecs may be used to establish an equivalent RVR value (see Appendix 7, OpSpec paragraph C051). Use of this provision, however, specifically requires FAA authorization in addition to issuance of paragraph C051, and should be limited by the POI or CMO to only those Operators and locations outside of the U.S. that have a need to use the "visibility-RVR" equivalence table for this type of determination.

**4.3.7. General Requirements for Category I Operations and Minima.**

**4.3.7.1. Category I Definition, Background, Classification, and General Criteria.**

**a. Category I Definition.** Within the United States, a Category I instrument approach is considered to be any instrument approach or approach and landing with a decision altitude (height) not lower than 60m (200 ft) and with either a visibility not less than 1/2 statute mile (800m), or a runway visual range not less than 550m (1800 ft).

**b. Background.** Originally the term Category I applied only to the difference between basic turbojet ILS minima and use of a 200 foot DH with a commensurate low RVR. Subsequently, the definition and common use of the Category I classification evolved several additional times, and variations in its use developed internationally. For U.S. air carriers, the current Category I definition has been in use since FAA's standard OpSpecs were revised in the 1980s. Air carriers since that time have been issued these revised OpSpecs, in both domestic and international operations.

**(1)** This latest adjusted U.S. Category I definition was necessary because previous criteria for instrument approaches relating to "precision" and "non-precision" approach classification was inadequate to address modern air carrier operations. Provisions were not made for numerous levels of navigation system performance capability that are possible and needed by operators. Systems or methods such as FMS, RNAV, VNAV, electronic map displays, multi-sensor filtering, GPS, inertial systems, RNP, and various GPS augmentation schemes such as GBAS or SBAS now make possible significant improvements in instrument approach capability and cannot be suitably addressed by former criteria or classifications. Combinations of the above approach capability also cannot be adequately classified, represented, or used. Former classifications and criteria failed to appropriately consider the linear nature of modern RNAV systems, certain rare-normal and non-normal conditions, and often did not properly relate to necessary supporting airport systems (e.g., lighting, markings) or meteorological reporting capabilities (e.g., RVR). Previous criteria did not recognize that some procedures or systems formerly considered as "non-precision" (RNAV) may actually have superior performance to systems considered as "precision" systems (e.g., FMS can have better performance than ILS at and beyond distances several miles from the runway). With former criteria and classifications, it was not easy to appropriately classify these systems or derive appropriate benefits.

**(2)** An important consequence of the U.S. definition for Category I is that, for an air carrier, any instrument approach with minima not less than a DA(H) or MDA(H) of 200 HAT, and visibility not less than RVR 1800, is considered to be Category I. This means that VOR, NDB, RNAV, LOC, Back Course LOC and other such approaches, other than ILS or MLS, are also treated as Category I. This is true even though those approach types may have been considered "non-precision."

**(3)** This use of Category I is important to consistently apply to certification and authorization criteria for modern systems and procedures. It is also necessary to ensure that Operators or authorities can implement safety and efficiency advances in a timely and effective way, provide effective and uniform training, and provide necessary facilities, meteorological services, and air traffic services.

**c. Instrument Approach Classification.**

**(1)** Accordingly, this AC is based on and uses the definition of Category I as provided in 4.3.7.1. a. The AC treats classification of instrument approach procedures as being grouped into any one of three broad classes:

(a) "xLS,"

(b) "RNAV," and

(c) "Instrument procedures other that xLS, or RNAV" (e.g., traditional or classic procedures such as VOR, NDB, LOC, and ASR).

**(2)** Procedures identified as "xLS" may apply to ILS, MLS or GLS.

**(3)** Procedures identified as RNAV include procedures based on use of

- FMS
- RNAV systems using traditional VOR/DME sensors systems, or
- GNSS (GPS) or augmented GNSS systems (e.g., includes SBAS/WAAS)

**(4)** RNAV procedures are addressed as either three-dimensional (3-D) if suitable LNAV and VNAV is used, or two-dimensional (2-D) if only lateral navigation is used. It is recognized that various levels of performance are possible either laterally or vertically. Hence, provision is made to address Required Navigation Performance (RNP). RNAV procedures are also considered to include those which may use RNAV methods, techniques or systems to fly traditional sensor specific VOR, NDB, or Localizer based approaches (e.g., use of FMS to fly a VOR, NDB or Back Course Localizer approach in LNAV and VNAV, based on an electronic map display rather than using a "raw data" readout of course deviation). The remaining instrument procedure group titled "Instrument approaches other than xLS, or RNAV" address traditional or classic procedures such as VOR, VOR/DME, NDB, LOC, BC

LOC, and ASR. This group is considered to include any other remaining types of instrument approach procedures that are not already covered by or addressed by the groups xLS or RNAV.

**(5)** The AC and associated classification schema do not use former terminology of "precision" or "non-precision" as applies to xLS or RNAV instrument approaches. However, it does not preclude continued use of the term by Operators as apply to classic procedures, particularly when training materials or manuals may take a very long time to eventually be amended in the normal course of longer term revision. Since the terms "precision" and "non-precision" are not necessary to implement or conduct operations and can be confusing and ambiguous, their use is discouraged in favor of use of the common generic term "instrument approach" or use of "xLS", "RNAV", or "approaches other than xLS or RNAV" for many important applications (e.g., Inappropriately classifying as "non-precision" operations of aircraft using RNAV systems to fly multi-sensor based and highly accurate levels of RNP and accurate VNAV paths, to a low DA(H)).

**d. General Criteria For Category I.** The following general requirements apply to the operational authorization of Category I instrument approach procedures:

**(1)** The airborne system(s) should meet the requirements of the applicable paragraphs of 5.2 for the type of Category I procedures to be flown;

**(2)** Appropriate NAVAIDs and airport/lighting facilities for the procedures to be flown should be available, consistent with paragraph 8;

**(3)** Flightcrew qualification consistent with provisions of paragraph 7 for Category I has been completed;

**(4)** An acceptable airworthiness (maintenance) program for the airborne system is provided IAW paragraph 9; and

**(5)** An operational authorization has been completed IAW paragraph 10 for a U.S. operator or paragraph 11 for a Non-U.S. operator.

**e. Minimum authorized DA(H).** For simplicity of description, where a minimum authorized DA(H) is cited in this paragraph as applicable to Category I minima, it is stated in terms of a height above touchdown zone elevation (e.g., HAT value), even though operational minima for Category I are specified as a DA, based on MSL altitudes.

**4.3.7.2. "xLS" Procedures - Minima not less than 200 feet DA(H).** Instrument approach operations that may be authorized Category I minima not less than 200 ft. DA(H) include at least the following:

**a.** ILS.

**b.** GLS (GBAS/LAAS).

**c.** MLS.

**d.** Special Procedures - Special procedures having individual FAA approval for each operator or location that are capable of supporting a DA(H) down to at least 200 ft. HAT may be authorized (e.g., PAR, GLS SCAT I). Such special procedures typically require associated conditions or limitations for special flightcrew training, for navigation facility use coordination, site-specific suitability review, or operator or other agency monitoring (e.g., as for DOD provision of PAR capability).

**4.3.7.3. "3D" RNAV Procedures - Minima not less than 200 feet DA(H).** Instrument approach operations that may be authorized Category I minima not less than 200 ft. DA(H) include:

**a.** 3D RNAV procedures based on suitable levels of RNP and VNAV capability (e.g., RNP.15/125 ft. or lower)

**b.** 3D RNAV procedures based on acceptable full capability GNSS/SBAS(WAAS) augmentation

**4.3.7.4. "3D" RNAV Procedures - Minima not less than 250 feet DA(H).** Instrument approach operations that may be authorized Category I minima not less than 250 ft. DA(H) include:

**a.** NAVAID specific procedures flown using RNAV lateral and vertical guidance (e.g., "VOR Rwy 16R" flown using acceptable FMS LNAV and VNAV) such as a VOR, VOR/DME, NDB, Localizer, or Localizer Back Course approach flown using RNAV, when the procedural identified NAVAID(s) are referenced in the FMS position determination, or when the procedure is flown with the crew monitoring the specified facility(s) by instrument display cross reference (e.g., RDMI raw data display, or equivalent);

**b.** RNAV (FMS LNAV/VNAV) Procedures overlaying a NAVAID-specific procedure, when FMS position updating is referenced to "data base procedural tuning" of the specified facility(s) (e.g., "RNAV or VOR Rwy 16R" flown using acceptable LNAV and VNAV, with FMS using the appropriate procedurally identified NAVAID(s) along with any other applicable sensors for position determination);

**c.** RNAV (FMS LNAV/VNAV) Procedures overlaying a NAVAID-specific procedure, when FMS position updating is not based on the "data base procedural tuning" of the specified facility(s), but instead is based on the FMS's selection of optimum NAVAIDs or sensors (e.g., "RNAV or VOR Rwy 16R" flown using an FMS which is using optimally identified sensors or NAVAID(s) combinations for position determination); These procedures may be flown with or without the underlying NAVAID operational;

**d.** RNAV (FMS LNAV/VNAV) Procedures not based on a specific ground based NAVAID, when suitable FMS position updating is used (e.g., a "GPS Approach" flown using a suitably capable FMS and appropriate updating capability); or

**e.** RNAV RNP based procedures with levels of RNP or vertical navigation capability other than as qualify paragraph under 4.3.7.2.

**4.3.7.5. "2D" RNAV Procedures (e.g., VOR/DME-based RNAV, or GPS-based RNAV) - Minima not less than 250 ft. MDA(H).** Instrument approach operations in this group may be authorized **Category I** minima of not less than **250 ft. MDA(H).**

**a.** This group includes at least the following:

- 2D RNAV based on sensor inputs from GPS
- 2D RNAV based on sensor inputs from DME/DME
- 2D RNAV based on sensor inputs from VOR/DME
- 2D RNAV based on sensor inputs from combinations of LOC and VOR or DME

**b.** RNAV (2D - LNAV only) Procedures overlaying a NAVAID-specific procedure (e.g., FMS/RNAV, used to fly an underlying VOR or NDB approach, but flown as a 2D RNAV procedure - without procedural tuning of the specified NAVAID facility);

**c.** RNAV (FMS LNAV/VNAV) Procedures not based on a specific ground based NAVAID, when suitable FMS position updating is used (e.g., a "GPS Approach" flown using a suitably capable FMS and appropriate updating capability); or

**d.** Other FAA authorized RNAV-based approach procedures (e.g., Loran, Airborne radar).

**4.3.7.6. Procedures Other than xLS or RNAV (e.g., VOR, NDB, LOC, Back Course LOC, or ASR Procedures) - Minima not less than 250 ft. MDA(H).** Instrument approach operations in this group may be authorized Category I minima of not less than 250 ft. MDA(H).

**a.** This group includes ICAO or U.S. NAVAID-specific procedures other than those based on xLS or RNAV, including at least the following:

- VOR
- VOR/DME
- NDB
- NDB/DME
- LOC
- LOC Back Course
- LDA, and
- SDF

**b.** NAVAID-specific procedures as listed in item (1) above, but when flown with vertical guidance (e.g., using VNAV)

**c.** NAVAID-specific procedures as listed in item (1) above, but when flown with an “open loop” vertical speed based descent profile, and

**d.** Radar Surveillance Approach Procedures including ASR.

**4.3.7.7. Other Special Procedures or Authorizations.** Other special procedures or authorizations may be issued as follows:

**a.** Lower than Standard Category I minima authorizations may be issued, as addressed in FAA Order 8400.13 (e.g., Authorization for HUD or Autoland RVR 1800 minima, when using limited facilities for approach lighting and runway lighting).

**b.** Special Obstacle Assessment Procedures may be issued for a particular runway, operator, or a group of Operators (e.g., KDTW RW21R). Special Authorization to use a 200 ft. HAT DA(H) based on an obstacle assessment of the runway touchdown zone region and operator use of flight director or autoflight guidance systems.

**c.** Airborne Radar Approach authorizations may be issued to qualified applicants, for use with qualified airborne systems.

**d.** Special Limited Use (Non-ICAO) Procedures (e.g., TLS, KRM).

**4.3.7.8. Previously Approved Category I Operations or Use of Previous or New Category I Criteria.** Operators approved IAW criteria of earlier versions of AC 120-29 (e.g., AC 120-29 Change 3) for Category I, or operating IAW approved OpSpecs for instrument approaches other than ILS, MLS, or GLS may continue to operate IAW their previously approved program, consistent with current standard operations specifications or any special provisions approved for that operator in that Operator’s approved operations specifications.

**a.** Approval criteria used for a particular aircraft are typically listed in an AFM. If not shown in an AFM, the applicable FAA Aircraft Evaluation Group (AEG) may be consulted through the POI or CMO, to determine eligibility.

**b.** Aircraft qualified using other than FAA criteria will be as designated in approved OpSpecs or as designated by the applicable AEG (e.g., through the FAA Flight Standardization Board Report for the aircraft type) or AFS-400.

**c.** Aircraft demonstrated to meet airworthiness provisions of previous versions of AC 120-29 through Change 3, or criteria previous to AC 120-29, may remain eligible for previously approved operational authorizations. Additional airworthiness demonstration under provisions of this AC are not necessary for these aircraft unless additional credit based on meeting the criteria in the appendices of this AC is specifically sought.

**d.** Operators seeking credit provided for only by this version of AC 120-29A and which were not available in previous versions of AC 120-29 must meet operational criteria as described in the main body of this AC.

**e.** New airworthiness approvals addressing Category I, intended for use by an air carrier, may use criteria earlier than this AC only on a case by case basis as determined by FAA. Examples of cases where criteria prior to this AC may be acceptable include providing information from a service bulletin based on a previous version of AC 120-29 to ensure compliance status of an "in-service" aircraft. Another situation would be for continuing the production and delivery of an aircraft or autoflight system type which had a type certification basis using a preceding version of this AC, or when seeking certification of a new derivative aircraft which has an autoflight system the same as or very similar to one previously approved based on an earlier version of AC 120-29.

**4.3.8. Requirements for Category II.**

**4.3.8.1. General Category II Requirements.** The following requirements apply to the operational authorization of Category II instrument approach procedures:

**a.** The airborne system should meet the requirements of the applicable paragraph of 5.2 for the type of Category II procedures to be flown,

**b.** Appropriate NAVAIDs and airport/lighting facilities for the procedures to be flown, consistent with Paragraph 8, should be available,

**c.** Flightcrew qualification consistent with provisions of Paragraph 7 for Category II has been completed,

**d.** An acceptable airworthiness program for the airborne system is provided IAW Paragraph 9, and

**e.** An operational authorization has been completed per Paragraph 10 for a U.S. operator or Paragraph 11 for a Non-U.S. operator.

**4.3.8.2. Specification of a Category II DA(H).** To simplify description of Category II operations and minima, the lowest authorized DA(H) for Category II is cited in this paragraph as an equivalent DH related to wheel height above touchdown zone elevation (e.g., HAT value of 100 ft.). This is done even though operational minima for Category II are typically specified as an equivalent DH value based on radio altitude height above the underlying approach terrain.

**a.** DH for a Category II procedure may be set and procedurally identified by the following nominal conditions:

**(1)** The aircraft's navigation reference point tracks the center line of the glide path and FAS,

**(2)** Standard wheel to navigation reference point height and distance assumptions are used,

**(3)** A 100 foot or 150 foot wheel height HAT is assumed for the landing aircraft at DH, depending on minima to be specified, and

**(4)** A determination is made of the actual radio altitude above underlying terrain that occurs when an aircraft with nominal wheel to navigation reference height reaches the point on approach where its wheel height first reaches 100 ft. HAT.

**b.** Alternately a Category II DH may be set based on specifying use of a 100 foot DH above underlying terrain, regardless of circumstance in which the 100 foot above terrain point is reached. In this instance, the first point or time in which any aircraft, with any arbitrary wheel to navigation reference height, pitch attitude, configuration, lateral displacement, or speed, first reaches the point at which 100 ft. radio altitude is indicated above underlying terrain, the aircraft is considered to have reached DH.

**c.** While a DA is conceptually not precluded for use with Category II, DAs are not currently operationally used for Category II, except as a backup for inner marker-based minima when irregular terrain precludes reliable radio altimeter use to determine minima.

**4.3.8.3. Eligibility for Category II Minima not less than 100 ft. DA(H).** Instrument approach operations that may be authorized Category II minima not less than 100 ft. DA(H) include:

**a.** ILS,

**b.** GLS (GBAS/LAAS), and

**c.** MLS.

**4.3.8.4. Use of Inner Marker.** Use of Inner Marker may be authorized in lieu of a DA(H). An Inner Marker is typically used at runways designated by the applicable procedure, such as where radar altimeter use is limited due to irregular underlying terrain (e.g., RA NA).

**4.3.8.5. Barometric Altimeter DAs not currently used for 14 CFR Parts 121 or 135 Category II.** Barometric altimeter-specified DAs are not currently used as a basis for minima for air carrier Category II, except for those Operators electing to discontinue an approach upon reaching either the DA or DH, which ever is reached first, when visual reference is not established, or upon reaching either the DA or IM, which ever is reached first, when using an IM as the basis for Category II minima.

**4.3.8.6. Category II on U.S. Type I ILS.** Category II on FAA Type I ILS (limited to FAA-specified locations) for certain qualified flight guidance systems. Instrument approach operations may be authorized Category II minima not less than 100 ft. DA(H). Criteria for special authorizations for air carriers to conduct Category II operations on certain FAA Type I ILS facilities is contained in FAA Order 8400.13

**4.3.8.7. Category II using RVR 300 "Meter" Minima.** Category II using RVR300m minima (at designated international locations) may be authorized when meeting special provisions of Standard OpSpecs paragraph C059a Table 1. (see Appendix 7). This provision permits an operator to be authorized use of Non-U.S. State minima of RVR300m with a DA(H) of 100 ft. HAT at certain international runways qualifying for a minima less than that specified by ICAO for Category II. A flight guidance system meeting provisions of Appendix 7, Paragraph C059, paragraph c, is required. Corresponding flightcrew procedures must be used. Following successful operational experience using this provision, FAA may determine that the above authorization may be also acceptable using an auto-coupled approach to 100 ft. HAT or other flight guidance system (e.g., HUD) without necessarily meeting other provisions for Category III. Following successful operational experience using this provision, FAA may determine that the above authorization may also be approved for use at certain U.S. facilities having appropriate Category II procedures with a minimum RVR of 1000 and a DA(H) of 100 ft. HAT. For use of this provision internationally, where such operations are authorized by the State of the Aerodrome (e.g., certain European airports), FAA considers the operation to be the equivalent of a limited U.S. Category III operation (1000RVR), even though the State may locally classify or consider it to be Category II.

**4.3.8.8. Precision Approach Radar (PAR).** Precision Approach Radar Minima may be authorized to minima of not less than 200 ft. HAT, or the published PAR minima, whichever is higher. PAR authorizations are limited to those Operators and crews specifically qualified to use PAR. Request for PAR operations with minima below 200 ft. HAT are approved only on a case by case basis, considering any special crew qualification required, the aircraft type and its characteristics (e.g., aircraft size, aircraft geometry, and PAR radar signature), and the specific facilities to be used.

**4.3.8.9. Previously Approved Category II Operations or Use of Previous or New Category II Criteria.** Operators approved IAW earlier versions of AC 120-29 (e.g., AC 120-29 Change 3) for Category II may continue to operate IAW their previously approved program, consistent with current standard OpSpecs or any special provisions approved for that operator in that Operator's approved OpSpecs.

**a.** Approval criteria used for a particular aircraft are typically listed in an AFM. If not shown in an AFM, the applicable FAA Aircraft Evaluation Group (AEG) may be consulted through the POI or CMO, to determine eligibility.

**b.** Aircraft qualified using other than FAA criteria will be as designated in approved OpSpecs or as designated by the applicable AEG (e.g., through the FAA Flight Standardization Board Report for the aircraft type) or AFS-400.

**c.** Aircraft demonstrated to meet airworthiness provisions of previous versions of AC 120-29 through Change 3, or criteria previous to AC 120-29, may remain eligible for previously approved operational authorizations. Additional airworthiness demonstration under provisions of this AC are not necessary for these aircraft unless additional credit based on meeting appendices of this AC is specifically sought.

**d.** Operators seeking credit provided for only by this version of AC 120-29A, and that were not available in previous versions of AC 120-29 must meet operational criteria as described in the main body of this AC.

**e.** New airworthiness approvals addressing Category II, intended for use by an air carrier, may use criteria prior to this AC only on a case by case basis as determined by FAA. Examples of cases where criteria prior to this AC may be acceptable include providing information from a service bulletin based on a previous version of AC 120-29 to ensure compliance status of an "in-service" aircraft. Another situation would be for continuing the production and delivery of an aircraft or autoflight system type which had a type certification basis using a preceding version of this AC, or when seeking certification of a new derivative aircraft which has an autoflight system the same as or very similar to one previously approved based on an earlier version of AC 120-29.

**4.3.9. Runway Field Length Requirements and Runway Clutter.** For Category I or II, landing distance requirements are as specified by 14 CFR 121.185, 121.187, 121.195 or 121.197.

**a.** The following typical means of complying with the above provisions of part 121 are considered to be acceptable. Examples are provided for turbine aircraft. Aircraft other than turbine powered aircraft, or aircraft operating under 14 CFR parts other than part 121, may apply equivalent provisions in a similar manner.

**b.** Part 121 turbine aircraft operations must meet provisions of section 121.195(b). Normally these landing distances (e.g., that already include the specified 60% factor) are factored into the AFM data provided for landing distance. They do not have to be added additionally or separately to the AFM data.

**c.** If it is determined during dispatch, in weather forecasts or reports, that the landing runway may be wet (e.g., may is considered to include "chance," "occasional," "temporary," or a probability equal to or greater than 10%), the effective runway length must be at least 115% (i.e., IAW section 121.195(d)) of the distance determined under section 121.195(b).

**d.** Unless otherwise authorized by FAA, wet is considered to be any condition "not clear and dry" on any part of the useable area of the runway (useable area does not include edges, sides, melting of ice or snow banks at edges or sides, area beyond the advertised plowed and sanded surface, overruns, etc.).

> **NOTE 1: FAA may authorize a wet grooved runway with good braking friction characteristics, or equivalent, to be considered a dry runway for purposes of dispatch determination. A wet runway is considered to be a runway that is other than clear and dry, and has no standing water.**

**NOTE 2: Aircraft for which a special demonstration has been made for stopping distance on a wet runway for compliance with section 121.195(d) may use information from this determination for low visibility landing distance assessment (see AC 121.195-1A).**

**e.** If any useable part of the expected landing runway or runways are slippery (e.g., wet and not-grooved or porous friction coarse (PFC), snow, slush, ice, or standing water) the provisions of section 121.195(d) apply. In addition, operators should consider the possible need for extra stopping distance beyond that required by section 121.195(d) if braking action is reported or expected to be worse than “good.” The amount of additional stopping distance, if any is determined by the operator to be appropriate, may be related to any estimated reduction in stopping capability for the assumed conditions.

**f.** Information on autobrake distance provided by the manufacturer may be used as the basis for Category I or Category II field length determinations. If AFM autobrake data is used as the basis for determining acceptable landing distance, the operator should ensure that appropriate factors for use of autobrakes are considered, and if appropriate, accounted for (e.g., brake configuration, autobrake setting(s), runway surface friction, and runway slope). If a dispatch process applies, dispatch should consider, and provide any necessary information to the flightcrew regarding any pertinent “autobrake settings” on which dispatch may be based. If autobrakes are to be used, it is not necessary to additionally factor autobrake stopping distance data by the 115% specified in section 121.195(d) beyond the stopping distance otherwise protected by section 121.195(d). However, if expected stopping distance based on using an autobrake system, or any particular setting(s) of an autobrake system, is greater than that protected by section 121.195(d), then the operator should take that fact into consideration and provide appropriate stopping distance information or stopping procedures to the flightcrew.

**g.** When an operator needs to provide for an instrument approach and low visibility landing following an emergency return after takeoff, or when using a takeoff alternate, the operator should consider the expected landing configuration, braking method, and initial braking speeds in assessing landing field length requirements (e.g., consider landing weight, engine out flap settings, engine inoperative speeds as applicable, potential for partial brakes, or partial antiskid, or inoperative reverse thrust).

**h.** When determining alternate airport field length provisions (e.g., section 121.187 or 121.197 as applicable) it is recommended that the operator consider the weights, flap settings and approach speeds that may be applicable to use of that alternate airport with an engine inoperative. For credit for use of an alternate airport based on “Engine Inoperative Category II” capability, the operator must consider such representative speeds, as applicable to the engine inoperative configuration, in assessment of the required landing distance.

**i.** The following field length factors and considerations are considered acceptable:

**(1) Category I Field Lengths.**

(a) For minima or conditions expected to be at or above RVR 3000, the runway field-length requirement for Category I is as specified by section 121.195 for either a dry or wet runway. For minima or conditions expected to be below RVR 3000, the field length requirement should be based on conditions for a wet runway (section 121.195(d)).

(b) Field length requirements are determined based on applicable weather reports and forecasts considered at the time of dispatch or release (i.e., section 121.195 reference to “takeoff”). Once an aircraft is enroute, it is recommended that field length requirements be reassessed if conditions significantly change from the conditions on which the departure was based.

**(2) Category II Field Lengths.** The Runway Field-Length Requirement for Category II is as specified by section 121.195(d) for a wet runway.

(a) When auto brake systems are used for Category II, information must be available to the flightcrew to assist in making the proper selection of a suitable auto brake setting consistent with the field length available for landing and the runway condition, including braking action.

(b) Category II operations should not normally be conducted with braking action less than "fair" unless the operator has a method to ensure that timely updates of field conditions are provided to the flightcrew, and, if applicable, also provided to the dispatcher, and that the flightcrew considers that sufficient runway length is available for the landing in the conditions reported.

**(3) Runway Field Length Airborne Considerations.** Runway field length requirements are typically considered to be dispatch or release (pre-departure) requirements rather than "in-flight" assessment requirements. In the event of unforecast adverse weather enroute, or if braking system or other failures affecting stopping performance occur enroute, the crew should consider any adverse landing distance consequences that may result from a decision to make a landing on a particular runway (e.g., braking action reports, clutter).

**4.3.10. NAVAIDs or Landing System Sensors and Aircraft Position Determination.**

**a.** Various landing system sensors (NAVAIDs) or combinations of sensors may be used to provide the necessary position fixing capability to support authorization of Category I or II landing weather minima. While certain navigation sensors (NAVAIDs) are installed and classified primarily based on landing operations, the sensors described in this paragraph may also be used for takeoff, missed approach, or other operations (e.g., RNAV position determination). Regardless of the sensors, NAVAIDs, or combination of NAVAIDs used, the NAVAIDs and sensors must provide coverage for the intended flight path and anticipated displacements from that flight path for normal operations, rare normal operations (e.g., winds and wind gradients), and for specified non-normal operations where applicable (e.g., "VNAV out" flight path, "engine-out go-around" flight path). In addition, Category I or II authorizations should be consistent with the provisions or characteristics for specific sensors listed below in paragraph 4.3.10.1 through paragraph 4.3.10.3 unless otherwise accepted or approved by FAA.

**b.** For NAVAID-specific procedures (e.g., ILS), use of ICAO recognized NAVAIDs are eligible for authorization as either a Standard Instrument Approach Procedure or as a Special Instrument Approach Procedure. NAVAID types that are not recognized by or in ICAO criteria (e.g., in Annex 6, Annex 10, ICAO Doc 9365/AN910 Manual of All Weather Operations) are eligible only for authorization as Special Instrument Approach Procedures.

**4.3.10.1. Instrument Landing System (ILS).** The ILS provides a reference signal aligned with the runway centerline and deviation signals when the airplane is displaced left or right of the extended runway centerline. The linear coverage area for this signal is approximately 3 degrees either side of the extended runway centerline from a point emanating at the far end of the runway. The ILS also provides a vertical flight path (nominally 3 degree descent angle) to a point in the landing zone of the runway. The vertical coverage is approximately 0.7 degrees on either side of the vertical reference path. ILS characteristics should be considered as defined in ICAO Annex 10, unless otherwise specified by FAA. U.S. ILS systems are classified by Type as defined in FAA Order 6750.24 (II/D/2, etc.).

**4.3.10.2. Microwave Landing System (MLS).** The MLS provides a reference signal aligned with the runway centerline and deviation signals when the airplane is left or right of the extended centerline. The linear coverage area is approximately 40 degrees either side of the extended runway centerline emanating from a point at the far end of the runway. The MLS provides a vertical flight path to the runway similar to ILS. MLS characteristics should be considered as defined in ICAO Annex 10, unless otherwise specified by FAA. U.S. MLS systems are classified by Type, similar to ILS.

**4.3.10.3. Global Navigation Satellite System (GNSS) Landing System (GLS).** GLS is a landing systems based upon the Global Navigation Satellite System (GNSS). For lowest Category I minima and Category II operations the landing system typically includes a local area differential augmentation system in the vicinity of the runway for which lowest Category I or Category II procedures are specified. The local area system may serve one or more runways, or nearby airports, depending on its classification for each particular runway. The classification of a GLS service may be different for different runway ends (e.g., III/E/3 for Runways 14L and 14R, but I/D/1 for RW 22L). Desired path, centerline, and deviation signals as applicable, are computed by airborne avionics. The coverage area for GLS is typically within a 30 mile radius of a ground facility, but extended service volumes are possible. GLS provides for both vertical and lateral flight path specification to the touchdown zone of the runway(s) served, and a lateral path for rollout or takeoff guidance. GLS characteristics should be considered as defined in ICAO Annex 10, unless otherwise specified by FAA (e.g., FAA-accepted references to RTCA SC-159 MASPS). U.S. GLS systems should typically be classified by “Type” of system for each runway end served, similar to ILS (e.g., GLS II/D/2), or by an equivalent schema. Authorization for use of GLS is for each specific air carrier, aircraft type, and GLS system type until pertinent GLS international standards accepted by FAA are promulgated.

**4.3.10.4. Satellite Systems.** Navigation Satellite systems currently consist of the U.S. Global Position System (GPS) and the Russian Federation Global Navigation Satellite System (GLONASS). These systems may be considered part of a GNSS.

**a.** Various forms of augmentation exist or are in development including Space Based Augmentation Systems (SBAS), Ground Based Augmentation Systems (GBAS), and Aircraft Based Augmentation Systems (ABAS).

**b.** These augmentation systems may also be classified as wide area (e.g., EGNOS, WAAS, MSAS) or local area augmentation systems (e.g., LAAS).

**c.** GNSS may be combined with certain augmentation systems (e.g., LAAS) to provide a GNSS based Landing System (GLS).

**4.3.10.4.1. GPS/GLONASS and Reference Datum Information.** Satellite position fixing systems authorized for use by U.S. Operators include GPS and FAA-authorized augmentation systems for use with GPS (e.g., WAAS or LAAS). These systems may be used in the U.S., in U.S. territories, in other States that authorize GPS use, and in international airspace.

**a.** When using GPS or navigation systems that base position fixing on GPS, it is the responsibility of the operator to ensure that in airspace outside of the U.S. that an appropriate Reference Datum (e.g., WGS-84) is used for definition of waypoint or critical path point coordinates. Information on states using WGS-84 or various other databases are typically available from commercial charting sources, and may be available on the worldwide web.

**b.** An example of one worldwide web data source for “Datum” information that is acceptable for use is:

http://www.jeppesen.com/qref.html

**c.** GLONASS, or other satellite position fixing systems than GPS, may be used only as approved by the CHDO/POI following coordination with AFS-400.

**4.3.10.4.2. Local Area Systems.** Ground Based Augmentation Systems (GBAS) are considered to include the FAA's Local Area Augmentation System (LAAS) and non-federally provided systems (e.g., SCAT I).

**a.** Initial GLS augmentation authorizations have been limited to use of a DA(H) not lower than 200 ft. HAT. This value may be reduced as more capable airborne or ground based LAAS equipment is implemented or upgraded, amended criteria are issued, increasing numbers of GLS operational authorizations are issued for a wider variety of operating conditions, and satisfactory operating experience is gained.

**b.** Procedures based on any form of GBAS augmentation with performance that is equivalent to or better than a U.S. Type I ILS may be identified as “GLS” (GPS Landing System) procedures.

**4.3.10.4.3. Wide Area Systems.**

**a.** Space Based Augmentation Systems (SBAS) include the FAA’s wide area augmentation system (WAAS) and other internationally accepted wide area augmentation systems (e.g., EGNOS, MSAS).

**b.** Credit for use of SBAS augmentation alone would currently be limited to use of DA (H) not lower than 200 ft. HAT. Procedures based on any form of SBAS augmentation alone or SBAS augmentation in multi-sensor systems such as FMS should be identified as "RNAV" or "RNAV RNP" procedures, as applicable.

**4.3.10.5. LOC/LDA/SDF/Back Course.** Localizer, Localizer Type Directional Aid (LDA), Simplified Directional Facility (SDF), and Back Course (BC) ILS procedures are authorized for air carrier use and may be authorized to Category I minima not less than 250 ft. HAT.

**4.3.10.6. VOR Authorized Procedures.** VOR based procedures, when based on VOR alone, when based on multiple VORs, or when specified in conjunction with use of DME, may be authorized to use Category I minima not less than 250 ft. HAT.

**a.** VOR or VOR/DME based procedures may be flown using any of the following flight instrument displays suitable for the procedure to be accomplished, and for course or intended flight path to be achieved, including:

- EHSI or ND Map Display
- EHSI or ND Raw data display (e.g., EHSI lateral deviation display or VOR needle(s))
- Electromechanical HSI
- RMI, RDMI, or equivalent, or
- raw data lateral deviation display (e.g., cross pointer display)

**b.** VOR procedures, when flown as a procedure without vertical guidance (e.g., without VNAV), should use an MDA(H).

**c.** Qualifying VOR procedures, when flown with approved vertical guidance (e.g., with VNAV), may use either an MDA(H) or a DA(H), as determined to be suitable by the operator for the procedure or group of procedures to be flown.

**d.** The aircraft navigation system or flight instrument system display(s) used should be determined to be acceptable by the POI, for the procedures to be flown, considering that operator's routes, procedures, crew qualification, training, and recency of experience policies or programs.

**e. Use of a Single VOR Airborne System.**

**(1)** Under certain conditions, the use of a Single Airborne VOR system may be acceptable. The objective is for the pilot to have multiple ways of navigating, when operating with a single airborne VOR system such that, in the event of failure of a single element of the airborne navigation or display system, or the NAVAID, the approach can be safely discontinued at any point during the approach to touchdown, or at any time during a missed approach.

**(2)** Additionally, following initiation of the missed approach or rejected landing, a transition can be made to use some other NAVAID or NAVAIDs, other than the failed system or facility, to complete a safe missed approach and subsequent flight and an approach to an alternate.

**NOTE: A period of dead reckoning may be permissible between the time the failure occurs and the time alternate navigation means are established for continuing the missed approach and flight to alternate. During this period of dead reckoning the aircraft should not be unduly exposed to loss of obstacle clearance due to proximity to terrain or significant obstacles. Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or NAVAID, without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.**

**f. Use of RNAV for VOR, VORTAC, or TACAN Fix Substitution.** VOR, NDB and TACAN fixes may be authorized for substitution use with "xLS" procedures.

**(1)** RNAV waypoints or along track fixes may otherwise be substituted for any VOR, TACAN, DME, NDB, Compass Locator, marker beacon, or other fix on any segment of a VOR, VOR/DME, ILS or MLS, LOC, LOC BCRS, or NDB procedure where a corresponding VOR azimuth (radial) or TACAN fix is procedurally specified or can be determined by the FMS to the necessary degree of accuracy and reliability.

**(2)** The substitution of RNAV capability based on FMS or GPS must be determined to be acceptable for that operator by the CMO or POI.

**g. Inoperative or Unsuitable VOR, VORTAC, TACAN, or DME NAVAID.** If VOR, VORTAC, TACAN, or DME updating is used in support of area navigation system (e.g., FMS) position determination, Operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or NAVAID element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAID's recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error).

**4.3.10.7. DME.** DME based procedures, when used in conjunction with VOR, NDB, LOC, LDA, SDF, or BC are authorized for air carrier use, and may be authorized to Category I minima not less than 250 ft. HAT.

**a.** When used in conjunction with ILS or MLS, DME along track fixes may be authorized for use with Category I, II, or III procedures, as applicable to the specified procedure.

**b.** Except for Category II or Category III procedures that are specifically identified by FAA as requiring use of an Inner Marker, DME along track fixes may otherwise be substituted for any marker beacon, VOR, NDB, or Compass Locator on any segment of an ILS or MLS procedure where the corresponding DME value is procedurally specified or can be determined.

**c. Use of RNAV for DME Fix Substitution.** Suitable RNAV systems including FMS or GPS may be used to substitute for DME when equivalent DME fix information can be established by the flightcrew. For this substitution to be authorized, suitable chart information and flight deck navigation system display information (e.g., electronic navigation map displays) must be available to establish the equivalent DME fix capability required for the areas, airspace, routes, or procedures to be used by the operator. Such substitution may be applicable to normal inflight use, to continuation of flight after failure, or to dispatch with inoperative DME capability if consistent with the applicable MMEL for the aircraft type. The substitution of RNAV capability based on FMS or GPS must be determined to be acceptable for that operator by the CMO or POI.

**d. Inoperative or Unsuitable DME NAVAID.** If DME updating is used in support of area navigation system (FMS) position determination, Operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or NAVAID element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAIDs recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error).

**4.3.10.8. NDB Authorized Procedures.** NDB based procedures, when based on NDB alone, when based on multiple NDBs, or when specified in conjunction with use of DME are authorized for air carrier use, and may be authorized to minima not less than 300 ft. HAT.

**a.** NDB or NDB/DME based procedures may be flown using an appropriate EHSI or ND Map Display, EHSI or ND Raw data display, Electromechanical HSI, RMI, RDMI, or ADF display for course guidance, as determined acceptable to the POI considering the crew qualification, training, and recency of experience applicable to that operator.

**b.** NDB procedures, when flown as a procedure without vertical guidance (e.g., without VNAV), use an MDA(H).

**c.** NDB procedures, when flown as a procedure with approved vertical guidance (e.g., with VNAV), may use a DA(H).

**d. Use of a Single NDB/ADF Airborne System.** Other than following an in-flight failure of one of several installed airborne systems NDB/ADF receivers, instrument procedures based on NDB/ADF may be flown using a single airborne NDB/ADF receiver in lieu of two airborne NDB/ADF receivers (reference section 121.349) under the following conditions:

**(1)** The operator is authorized to conduct procedures using a single airborne NDB/ADF receiver;

**NOTE: Authorization for use of a single NDB/ADF may be for a specific procedure, a group of procedures, for an operator's particular fleet of aircraft (e.g., B727 fleet), for all of an operator's aircraft, or for a geographic region (e.g., within the United States and U.S. territories), as applicable to the operator's route structure, and fleet.**

**(2)** Instrument procedures requiring simultaneous use of more than one NDB/ADF NAVAID facility are not authorized, unless approved for that operator and each specific procedure;

**(3)** In the event of failure of the airborne NDB/ADF receiver, or other essential element of the airborne NDB/ADF navigation or display system, or the NDB/ADF NAVAID, the approach can be safely discontinued at any point during the approach to touchdown, or at any time during a missed approach, and

**(4)** Following initiation of the missed approach or rejected landing, a transition can be made to use some other NAVAID or NAVAIDs, other than the failed system or facility, to complete a safe missed approach and subsequent flight to an alternate.

**NOTE: A period of dead-reckoning may be permissible between the time the NDB/ADF airborne system or NDB/ADF NAVAID failure occurs and the time alternate navigation means are established for continuing the missed approach and flight to alternate. During this period of dead-reckoning the aircraft should not be unduly exposed to loss of obstacle clearance due to proximity to terrain or significant obstacles. Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or NAVAID, without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.**

**e. Use of RNAV for NDB Fix Substitution.**

**(1)** Suitable RNAV systems including FMS and GPS may be used to substitute for NDB or ADF when equivalent NDB fix information can be established by the flightcrew. RNAV (FMS) fixes may be authorized for use as an NDB substitute with Category I, II, or III procedures, as applicable. RNAV fixes based on FMS may also be substituted for bearing or cross track fixes. RNAV waypoint or along track fixes may be substituted for any NDB, Compass Locator or other NDB based fix on any segment of a VOR, ILS or MLS, LOC, LOC BC, or NDB procedure where the corresponding NDB bearing is procedurally specified or can be determined by the FMS to the necessary degree of accuracy and reliability.

**(2)** For substitution to be authorized, suitable chart information and flight deck navigation system display information (e.g., electronic navigation map displays) must be available to establish the equivalent NDB fix capability required for the areas, airspace, routes, or procedures to be used by the operator. Such substitution may be applicable to normal inflight use, to continuation of flight after failure, or to dispatch with inoperative ADF capability if consistent with the applicable MMEL for the aircraft type. The substitution of RNAV capability based on FMS or GPS must be determined to be acceptable for that operator by the CMO or POI.

**f. Inoperative or Unsuitable NDB NAVAID.** If NDB updating is used in support of area navigation system (FMS) position determination, Operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or NAVAID element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAID's recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error).

**4.3.10.9. Radar Systems (e.g., PAR, ASR).** Various other systems are in limited use (e.g., PAR, ASR). These systems are considered for air carrier operations only as described below.

**a.** Air carrier approach operations using ASR or PAR may only be approved if OpSpecs contain authority for their use.

**b.** For use of ASR, dedicated training is not specifically required unless the POI determines that the Operators general training and qualification program is not satisfactory for routine use of ASR procedures, and that specific ASR training is needed.

**c.** For use of PAR, dedicated PAR training is appropriate unless the POI determines that the Operators training and qualification program is otherwise able to ensure adequate crew preparation so that dedicated PAR/ASR training or demonstration is not needed (also see 4.3.8.8).

**4.3.10.10. Other Systems, Procedures, and Special Systems.**

**a. Marker Beacons.** 75 MHz marker beacons are used in the NAS or internationally as part of ILS, and for other limited or special applications (e.g., step-down fixes, departure turn points for instrument departure heading assignments). Use of marker beacons does not require dedicated crew training or qualification beyond that for conduct of ILS approaches.

**b. Airborne Radar Approach.** Operational authorization of use of any "airborne radar approach" procedure (e.g., use of ground mapping radar or equivalent) for purposes of conducting an instrument approach requires coordination with AFS-400, and may require proof of concept demonstration acceptable to FAA.

**c. KRM, RMS, SRE** or other unique systems or procedures which are not necessarily used IAW ICAO criteria (e.g., as used in certain parts of Europe) may only be approved for use by an air carrier if the aircraft is suitably equipped to receive and use the specified system and the system can meet the performance, integrity, and availability standards equivalent to those established for currently approved types of U.S. operations (e.g., ILS, LDA, ASR, RNAV using FMS). Minima authorized should not be less than any corresponding minima that would be applicable to an equivalent U.S. procedure. If not otherwise an ICAO standard NAVAID, operational authorization of use of such systems should include coordination with the state of the aerodrome and with AFS-400, and may require acceptable review of use or demonstration of use to FAA (e.g., to a POI, APM, or CMO).

**d. Transponder Landing System.** Transponder Landing System or other such "multi-lateration" systems may only be approved for an air carrier if the system can meet the performance, integrity, and availability standards equivalent to those established for currently approved types of operations (ILS, FMS, etc.), to corresponding minima. Operational authorization of use of any of these systems requires successful completion of a proof of concept demonstration acceptable to FAA.

**e. Enhanced Vision Systems** are intended to provide the flightcrew with a visual presentation of a view of the approach to a runway that may otherwise be obscured by weather or darkness. Air carrier approach operations using these systems may only be approved if the system can meet the performance, integrity, and availability standards equivalent to those established for currently approved types of operations (e.g., ILS, FMS, etc.), to corresponding minima. Operational authorization for use of enhanced vision systems requires successful completion of a proof of concept demonstration acceptable to FAA.

**4.3.10.11. Circling Approaches.** When instrument approach design criteria or operational factors do not permit a "straight-in" approach to the landing runway, circling procedures may be used. U.S. criteria require SIAP publication of circling maneuver minima if the inbound course is offset more than 30 degrees from the runway centerline, or when a specified descent gradient for a straight-in approach is steeper than a maximum value allowed by instrument procedure design criteria.

**a.** Use of circling minima, however, does not preclude a pilot making a straight in landing if the requirements of section 91.175 can be continuously met below MDA(H), to touchdown, for adequate visual reference and for normal landing maneuvering. Typically, circling approaches are based only on an MDA(H). Use of a DA(H) for circling is addressed because certain procedures using a DA(H) may apply to "sidestep" maneuvers, or may be used with very high values of DA(H), such as in mountainous areas that otherwise may require a circling maneuver to position to land after reaching minimums.

**b.** The circling maneuver can be initiated from any instrument approach procedure where circling is authorized, and may be continued below MDA(H) or beyond the missed approach point (MAP) only when the specified visual reference exists, and when in a position for a normal descent to landing. Electronic course or glidepath information, or FMS flight path presentations are only considered supplementary information to visually accomplishing the circling maneuver. The pilot must keep the aircraft's position within the established maneuvering area for the approach speed and category specified for the procedure while performing the circling maneuver. An altitude at or above the circling MDA(H) must be maintained until an aircraft (using normal maneuvers) is in a position from which a normal descent can be made to touchdown within the touchdown zone. A missed approach must be executed when external visual references are lost or sufficient visual cues to manually maneuver the aircraft cannot be maintained.

**c.** It is important to note that the published missed approach procedure may not provide obstacle clearance when below DA(H) or MDA(H), or when past the published missed approach point (MAP). If it is necessary to conduct a missed approach from below the DA(H) or MDA(H) or from past the published MAP (e.g., as a result of a balked landing, rejected landing, loss of visual reference, not in a safe position to land, blocked runway, or other similar reason for a go-around), reference to the associated IFR departure procedure for the applicable runway(s) usually provide help to the pilot in determining a safe course of action to climb back to procedurally protected airspace (adequate obstacle clearance) as specified by the published missed approach procedure.

**d.** When a missed approach from a circling maneuver is executed from below DA(H) or MDA(H) such as when visual reference is lost after passing DA(H) or MDA(H), or when initiating the missed approach from beyond the missed approach point such as when not able to maneuver to be able to accomplish a normal landing in the touchdown zone, the direction of the initial missed approach turn should typically be in a direction toward an appropriate runway, to ensure obstacle clearance. This is to keep the aircraft within the maneuvering area, until climb above the DA(H) or MDA(H), and intercept of a published segment of the missed approach procedure can be accomplished. Pilots should be aware of the applicable radius of protected airspace for the respective approach category used for the circling maneuver, and attempt to maneuver the aircraft within that protected airspace radius from the airport.

**e.** Operators may be authorized to perform circling approaches as published, or may choose not to train flightcrews to accomplish circling maneuvers and accept corresponding high minima limitations regarding circling approaches. If an operator chooses not to train for circling approaches, a 1000 ft HAT DA(H) or MDA(H) and 2 mile visibility limit, or greater, is typically included in OpSpecs to limit use of circling minima for that operator or aircraft type.

**f.** It is recommended that unless special circumstances exist, wide body (long wingspan) aircraft or aircraft needing to accomplish circling maneuvers at speeds in excess of 165 KTS ground speed should not typically be authorized circling minima below 1000 ft. HAT and 3 miles meteorological visibility.

**4.4. RNAV/Flight Management Systems (FMS).** An FMS provides a means to navigate along a flight path based upon earth referenced waypoints. These waypoints can define a flight path that originates or terminates at a runway or at other relevant fixes located in terminal or en route airspace. This type of system may be approved for low visibility approach and missed approach operations IAW criteria in pertinent appendices of this AC and standard OpSpecs.

**a.** FMS systems eligible for use must meet criteria of AC 25-15, AC 20-129 and AC 20-130, or subsequent criteria, or equivalent criteria. Equivalent systems are considered to be those systems previously shown to meet AC 90-45 which predated the above references, but would have otherwise been capable of meeting essential elements of the later criteria (e.g., B757, B767), or other aircraft that have subsequently been determined to be capable of meeting essential elements of the above criteria even though they were not specifically certificated using that criteria (e.g., certain non-U.S. manufactured aircraft such as the A320).

**b.** For RNP operations, additional information is provided below and in paragraph 4.5 and Appendix 5.

**4.4.1. FMS Use for xLS Procedures**

**a.** ILS, MLS, or GLS approaches or procedures are typically flown with FMS only to the extent that the FMS:

- Serves as a means to display the ILS, MLS, or GLS procedure (e.g., as on a navigation map display);
- May be used to tune appropriate ILS, MLS, or GLS NAVAIDs or radio frequencies;
- May be used to define and display and fly various LNAV or VNAV segments to intercept the final approach path or segment, or glideslope; or
- May be used to define, display and fly various LNAV or VNAV segments for a missed approach path.

**b.** Use of FMS to fly ILS, MLS, or GLS approaches when ILS, MLS, or GLS navigation aids are out of service (e.g., localizer or glideslope inoperative, or GNSS GBAS facility inoperative) may be authorized only in conjunction with RNP criteria (See paragraph 4.4.4 below).

**4.4.2. FMS Use for Procedures Other Than xLS or RNAV.** FMS may be used to conduct VOR, VOR/DME, NDB, NDB/DME, LOC, and LOC Back Course approaches when suitable navigation position updating which provides required accuracy and integrity is used by the FMS (e.g., DME-DME-IRS, or scanning DME, or VOR/DME, or GNSS position updating, or Localizer (LOC) updating, etc.).

**4.4.3. FMS Use for RNAV.** FMS may be used as a 2D or 3D RNAV system, to conduct RNAV instrument approaches.

**a.** RNAV procedures may be authorized based on one or more "procedure specified" NAVAID(s) (e.g., the FMS data base identifies a specific VOR/DME "Procedure tuned ("P" tuned)" NAVAID, or a combination of specific DME facilities to use as a basis for the procedure).

**b.** GPS approaches are considered to be RVAV approaches when flown by an FMS. GPS approaches may only be flown by those FMS systems which are capable of suitable GPS position updating and have appropriate navigation data base information to properly load and display the procedure to the flightcrew. Not all GPS approaches may necessarily be suitable for use with FMS because of procedure design, vertical path definition, an inability to "call up" or "load" the procedure from a data base, because the FMS may not be able to appropriately recognize "GPS" as a type of approach classification, or because the airplane AFM may not suitably provide for GPS procedure use. Operators intending to fly "GPS approaches" using FMS should treat such procedures as

RNAV procedures, and ensure that the FMS can properly fly each procedure or each type of procedure to be used (e.g., LNAV/VNAV or LNAV only).

**c.** RNAV procedures may also be authorized based on use of a "NAVAID rich environment" in which specific "procedure identified" NAVAIDs may not be identified, but rather the FMS is permitted to select optimum NAVAID's from those available. When such RNAV and NAVAID updating procedures are used, the NAVAID service provider, authority, or operator must ensure that the normally selected NAVAID(s) and the alternately selected NAVAID(s) suitably support the procedure to an acceptable level of accuracy and availability (e.g., at ranges, at altitudes, and along the expected flight paths relevant to achieving appropriate system approach performance). For an FMS which uses DME-DME or VOR-DME-based NAVAID sensors in conjunction with IRS, in a NAVAID rich environment, this can typically be accomplished by analysis, or by in-flight assessment (usually during line operations) to show suitable NAVAID reception for normal facilities to be used and for the first alternate facilities anticipated to be used for a particular system and procedure if the normal facility(s) become unavailable. For equivalent RNAV procedure assessments for RNP-qualified aircraft, see paragraph 4.4.3.3 below.

**d.** RNAV procedures that do not use "procedure tuned facilities" may be authorized for use with multi-sensor FMS based on use of "DME-DME" updating, "VOR/DME" updating, "scanning DME" updating, or "GNSS (GPS)" updating. These methods may be used individually, or may be used in combination, or may be used in conjunction with inertial position filtering.

> **NOTE: For purposes of this paragraph, any 14 CFR part 97 procedure with a specified DME limitation must be reviewed and resolved by the POI prior to the operator's use of that procedure.**

**4.4.3.1. Use of a Single RNAV Airborne System.** Other than following an in-flight failure of one of several installed airborne RNAV systems (e.g., failure of one FMS), instrument procedures based on RNAV may be flown using a single airborne RNAV system in lieu of two RNAV systems (reference section 121.349) under the following conditions:

**a.** The operator is authorized to conduct procedures using a single RNAV (FMS) system,

> **NOTE: Authorization for use of a single RNAV may be for a specific procedure, a group of procedures, for an operator's particular fleet of aircraft (e.g., B737 fleet), for all of an operator's aircraft, or for a geographic region (e.g., within the United States and U.S. territories), as applicable to the operator's route structure, and fleet.**

**b.** Instrument procedures requiring simultaneous use of more than one RNAV system are not authorized, unless approved for that operator and each specific procedure,

**c.** In the event of failure of the airborne RNAV system, or other essential element of the airborne RNAV navigation or display system, or associated NAVAID(s), the approach can be safely discontinued at any point during the approach to touchdown, or at any time during a missed approach, and

**d.** Following initiation of the missed approach or rejected landing, a transition can be made to use some other NAVAID or NAVAIDs, other than the failed RNAV system or facility(s) used by that system, to complete a safe missed approach and subsequent flight to an alternate.

> **NOTE: A period of dead-reckoning may be permissible between the time the RNAV system is used and reversion to another system, or following NAVAID failure, to the time alternate navigation means are established for continuing the missed approach and flight to alternate. During this period of dead-reckoning the aircraft should not be unduly exposed to loss of obstacle clearance due to proximity to terrain or significant obstacles. Suitable navigation performance should be achievable to safely complete the missed approach, fly to the alternate, and complete a subsequent approach using a different navigation system or**

**NAVAID(s), without loss of knowledge of position, loss of appropriate obstacle clearance, or loss of terrain clearance.**

**4.4.4. FMS Use for RNAV with RNP.** RNP operations may be based on capability as specified in a FAA approved AFM. RNP operations may also be based on "Fleet Qualification" of and individual aircraft, a group of aircraft, or an aircraft type using criteria acceptable to FAA (e.g., RTCA DO-236 Appendix D for RNP Fleet Qualification).

**a.** Approach or departure RNP operations for an air carrier typically require dual FMS capability for RNP.

**b.** See paragraph 4.4.2 above for operations and limitations that may apply for a single FMS with RNP capability. In addition, procedures for departure or approach for air traffic separation that are based on use of RNP may require use of dual RNP-capable systems, when so designated.

**c.** FAA may authorize other approach types for use by FMS on a case by case basis for each operator or aircraft type.

**4.4.4.1. Standard RNP Qualification.** FMS may be used as a 2D or 3D RNAV RNP system, as appropriate, to conduct RNAV instrument approaches based on aircraft qualification for RNP. Operations should be consistent with the approved AFM and apply appropriate RNP obstacle clearance criteria. Appendix 5 provides obstacle clearance criteria for RNP that can be used for RNAV approaches using RNP-based minima. FAA Order 8260.47, or other criteria acceptable to FAA, may be used to specify vertical obstacle clearance criteria for use of VNAV.

**4.4.4.2. "Fleet Qualification" For Use of RNP.** Some FMSs do not incorporate provisions for RNP as part of their type design approval. Aircraft with such FMSs may be candidates for fleet qualification for one or more RNP levels when certain provisions are met for autoflight systems, displays, annunciations, and FMSs. These aircraft may use corresponding RNP procedures and criteria (e.g., see Appendix 5 for RNP-based obstacle criteria). Criteria of Appendix 5 applicable to RNP-based RNAV approaches may be used for these FMS systems when approved by the FAA. RNP vertical criteria or vertical criteria of FAA Order 8260.47, or other criteria acceptable to FAA, may be used to specify vertical obstacle clearance requirements for use of VNAV.

**a.** Examples of aircraft and systems which may typically "fleet qualify" under this provision would be aircraft having IRS and dual FMS incorporating GPS updating, or dual FMS using DME-DME or scanning DME updating when the aircraft is operated in an area with a significant number of DME facilities. A significant number of DME or other NAVAID facilities are considered to be a number which provide for adequate signal coverage in the event of failure of any single facility, and with more than one facility or facility pair providing acceptable position update geometry and accuracy, considering the updating requirements for the FMS and any other relevant sensors used (e.g., IRS, IRU, ADIRU). Typically, aircraft having FMS and sensor systems such as these are considered to meet either /E or /F flight plan classification.

**b.** The following capabilities for aircraft and systems (e.g., for aircraft systems described, named or described differently but providing equivalent capability) should be considered for fleet qualification for RNP 0.3 or greater.

**(1)** Suitable autopilot or Flight Director use*,

**(2)** Suitable alerting; e.g., an "IRS Only" annunciation message, should suitable NAV updating not be available, and

**(3)** Suitable navigation display; e.g., A 10 mile (or lower) EFIS Map Scale, showing the designated flight path (such as an FMS designated green or magenta flight path line), with a suitable aircraft position symbol allowing a pilot to suitably monitor availability of a correct flight path, and aircraft path displacements (FTE)**,

**(4)** Suitable navigation check procedures; e.g., if not otherwise ensured by system performance or flight deck annunciation, a "reasonableness check" for acceptable position fixing error to be completed not later than passing a Final Approach Fix (FAF), and

**(5)** Suitable navigation system status assessment; e.g., a NAVAID or sensor updating capability suitability cross check, performed not later than passing a Final Approach Fix (FAF)***.

**c.** Additional criteria may be necessary depending on the specific fleet, and desired operations, routes, or procedures. Additional information may be found in DO 236, Appendix D.

*__NOTE: Credit may be limited by Flight Technical Error (FTE) capability that can be achieved.__

**__NOTE: The objective is to assure that the pilot has that information, in a suitable form, necessary to conduct the operation (e.g., appropriate to the airspace/type of operation). Credit for systems other than EFIS "map displays" (e.g., systems using only an HSI or lateral deviation scale display) for RNP may be permitted, but credit is limited to use of "simple procedures." Procedures considered to be unacceptable (i.e., not simple) are those procedures involving:__

- **multiple short flight path segments,**
- **frequent or large angle turns**
- **critical obstacles adjacent to turns**
- **adjacent aircraft flight paths with turns**
- **adjacent significant or mountainous terrain**
- **use of multiple or complex VNAV gradients**
- **procedures requiring a high level of pilot "situation awareness" to detect and correct the consequence of flight path definition or waypoint difficulties (e.g., an FMS "Legs Page" waypoint "Bypass")**
- **procedures unduly sensitive to pilot setup errors or mistakes made in programming a navigation system that could readily be detected when using a map display**
- **procedures that require unusual levels of attention, FTE monitoring, or**
- **other criticality that are aided by use of a map display**

*****NOTE: May be a limiting factor for the level of RNP to be authorized, considering the pilot or operator's ability to assess position fixing errors as relate to sensors or NAVAIDs intended to be used.**

**4.4.4.3. Assessment Credit for RNP-qualified aircraft flying "non-RNP" based RNAV Procedures.** RNAV procedure assessment credit may be based on an RNP (AFM qualified) aircraft flying non-RNP based RNAV procedures to demonstrate that acceptable system performance is achieved and that a NAVAID rich environment (e.g., DME-DME IRS or RNAV-DME IRS updating) is capable of appropriately supporting an RNAV procedure for that aircraft and system type. For such assessments, it is acceptable for an operator to show that the demonstrated ANP (EPE) remains below an acceptable value throughout an approach, and any applicable parts of a missed approach, for the normal and first alternate FMS NAVAID facility selections expected to be used (see paragraph 4.4.3).

**4.4.4.4. Assessment of Expected Levels of ANP for RNP-qualified aircraft flying "RNP" Procedures.** When RNP qualified aircraft ("AFM Qualified" or "Fleet Qualified") fly "RNP" based RNAV procedures, suitable levels of positioning accuracy (e.g., anticipated, projected, or achievable) should be available appropriate to the level(s) of RNP intended and the procedures used.

**a.** If the procedure specifies ground-based facilities to be used for the procedure, this assessment may be considered to have already been done. Otherwise, an assessment must be accomplished (e.g., by that operator, by another operator, by a designee, by an authority, or by a service provider).

**b.** An accuracy assessment of navigation services may apply to an airspace, areas, routes, procedures or operations planned or otherwise intended (e.g., contingency alternates). The assessment may be accomplished by any one or more of a variety of technically qualified people or organizations, including the operator, a pilot, a fleet manager or other qualified representative of the operator (e.g., dispatcher), an authority, airspace planners, procedure developers, air traffic services, charting agencies, through ICAO global or regional agreement, by technically qualified supporting contractors to any of the above entities, or by a relevant aircraft or avionics manufacturer.

**c.** When determining the suitability of the airplane/system to achieve the expected level(s) of accuracy, the person or organization accomplishing the assessment should refer to appropriate airplane and system material. The expected levels of accuracy should be applicable to the system or systems to be used (e.g., airborne system as well as supporting NAVAIDs or space-based system elements external to the aircraft), should be suitable to support the level(s) of RNP to be used for the time period(s) to be used, and should be compatible with the airspace or procedures to be used (e.g., consider geographic or geometric effects such as "terrain masking," if applicable).

**d.** Acceptable source material for determining anticipated, expected, projected, or achievable ANP may include any one or more of the following:

- Information from an applicable aircraft AFM
- Information from an applicable aircraft operating manual
- Applicable operational navigation documents (e.g., Systems Requirements and Objective (SR&O) documents) available from the aircraft or avionics manufacturer that apply to a navigation system
- Appropriate authority or air traffic service provider assessments or airspace studies
- Appropriate published instrument procedure provisions
- Authority, ATS provider, or ICAO-specified NAVAID locations, standard NAVAID characteristics, NAVAID performance and service volume charts or plans
- Published GNSS satellite constellation characteristics or GNSS augmentation method characteristics found acceptable to FAA and the State of the Aerodrome or ICAO
- NOTAM information
- AIP or AIM, or equivalent, information
- Appropriate studies or assessments conducted by an operator found acceptable to FAA, or
- Any other source material able to help assess projected accuracy that is found acceptable to FAA

**e.** The primary and secondary NAVAIDs identified during this process should be determined to be operating prior to use (e.g., the operator or pilot should ensure that the pertinent NAVAIDs are not "out of service").

**4.4.5. FMS VNAV.** FMS procedures typically use vertical navigation capability (VNAV) based on a barometric pressure-based VNAV path (e.g., Barometric (Baro) VNAV). FMS systems may also use a VNAV path based on a geometrically defined VNAV path which is fixed in space by "earth centered earth fixed (ECEF) coordinates" (e.g., fixed relative to earth reference and does not vary with barometric pressure - analogous to an ILS Glide Slope, except does not compensate for earth curvature). In this AC these paths are referred to as "ECEF Geometric VNAV Paths."

**a.** ECEF Geometric VNAV Paths (if and when used) typically are only used for final approach segment path definition. ECEF Geometric VNAV Paths, if used in either an FMS or instrument procedure, must be clearly distinguished from Baro VNAV paths, and must have clearly defined and compatible transitions from Baro VNAV paths to the ECEF Geometric VNAV Path. Baro VNAV paths may be used for all applications including final approach paths.

**b.** Baro VNAV paths may be defined as follows:

**(1)** Baro VNAV paths with constraints for "at," "at or above," "at or below," or the proceeding with corresponding speed constraints.

**(2)** Baro VNAV geometrically-based path defined as an approximate straight line segment from one defined WP pressure altitude to another WP pressure altitude (following earth curvature), or

**(3)** Baro VNAV geometrically-based path defined as two approximate straight line segments from one defined WP pressure altitude to another WP pressure altitude (following earth curvature), but using a reduced gradient for the final part of the path preceding the "to" WP to accommodate a speed constraint at the "to" WP, or

**(4)** Baro VNAV Performance-based climb or descent paths may be used.

**(5)** When used for a final approach segment, Baro VNAV paths may be based on a defined descent path angle rather than a segment between two sequential WP barometric altitudes, and

**(6)** For credit within this AC for use in a final approach segment (e.g., DA(H) credit) a Baro VNAV path should:

(a) Meet provisions of AC 20-129, as amended, for VNAV, or equivalent (e.g., equivalent means aircraft such as the B757 or A320 which meet AC 90-45A or other earlier international standard as a certification basis, but have systems which operationally have been determined to meet objectives of AC 20-129. Such aircraft system designs preceded issuance of AC 20-129, and were the basis for its subsequent development), and

(b) Be capable of providing vertical tracking performance within ± 125 ft vertically (two sigma) (e.g., meeting or meeting the equivalent of RNP 0.3/125 ft. for the vertical performance component), excluding temperature correction for deviation from ISA, (see 4.2.5-1),

**or,**

(c) Alternately, FMS systems may provide for additionally more accurate vertical tracking performance within ± 45 ft vertically (two sigma) or + 15 ft. vertically (e.g., meeting or meeting the equivalent of RNP x.xx/45 ft. or RNP x.xx/15 ft. for the vertical performance component), excluding temperature correction for deviation from ISA, (see 4.2.5-1), and

(d) Provide a VNAV path vertical displacement scale display showing a displacement range within at least ± 550 ft. or less (with a scale of ± 400 ft. recommended), unless meeting the more stringent requirement of paragraph 5.9.2 Figure 5.9.2-1 for final approach segment displays.

**c.** It is also recommended that the FMS systems have digital readout capability available to the pilot showing vertical displacement (e.g., FMS progress page or equivalent).

**d.** For "Go-Around," when using a VNAV path for a final approach segment and a corresponding DA(H) is authorized for use, momentary descent below the DA(H) is considered acceptable while the aircraft transitions from the descent approach path to a missed approach.

**4.4.6. FMS Use for International Procedures.** For international operations (e.g., for instrument procedures outside the United States), equivalent criteria to the criteria specified above (e.g., ICAO PANS-OPS) may be used. In addition, operators may use criteria of this AC, and related U.S. criteria referenced by this AC, internationally when approved by FAA, and when found acceptable by the country in which the Aerodrome is located for the procedure being used. For international operations it may be important to apply provisions of this AC regarding use of an appropriate waypoint or NAVAID reference datum (e.g., WGS-84 see paragraph 6.2.17), or provisions for extreme cold temperature correction (see paragraph 8.13).

**4.4.7. FMS RNAV Use for Substitution for VOR, DME, NDB, or Marker Beacon NAVAIDs or Fixes.** Where suitable NAVAID updating of an FMS or GNSS navigation system is available, FMS or GNSS-based RNAV may be used to substitute for inoperative or unavailable VOR, DME, NDB, or Marker Beacon NAVAIDs or fixes for approach procedures, missed approach procedures, or departure procedures. For such substitution, except as provided in item 4 below where an authority has already specified an acceptable substitution, the operator should ensure that the navigation system used and updating method available, taken with the available remaining NAVAID(s) or sensors are suitable for the route or procedure segment to be flown.

**a.** FMS RNAV substitution for VOR, DME, NDB, or Marker Beacon NAVAIDs or fixes may be applied if:

**(1)** The operator can ensure the necessary accuracy of the aircraft's RNAV system to substitute for the desired fix, NAVAID, or waypoint, and

**(2)** If the aircraft's navigation system is able to suitably depict the substitute WP, facility, or fix, and

**(3)** The aircraft can suitably fly any applicable leg, route, or procedure segment that otherwise would be based on the inoperative NAVAID or unavailable fix, or

**(4)** If the responsible authority (e.g., FAA or JAA) has otherwise established or provided for, and the operator uses, an acceptable RNAV substitution (e.g., IAW AIM GPS substitution provisions for NDB or DME, or FAA's enroute NAVAID RNAV substitution policy, or IAW an acceptable RNAV substitution method promulgated via NOTAM).

**b.** Also see provisions for various specific NAVAID types within paragraph 4.3.10, such as 4.3.10.7 for inoperative DME substitution.

**4.4.8. Inhibiting RNAV System Use of Inoperative or Unsuitable VOR, DME, VORTAC, TACAN, or NDB NAVAIDs.** If VOR, DME, VORTAC, TACAN, or NDB updating is used in support of area navigation system (FMS) position determination, Operators and flightcrews should be aware of when and how to disable RNAV system use of an unsuitable NAVAID or NAVAID element within the navigation system. This is especially true when the unsuitable NAVAID is likely to cause a significant map shift (e.g., movement of a ground NAVAID to a new geographic location without making a corresponding update to that NAVAID's recorded position in an aircraft's navigation system database, thus leading to introduction of a sudden navigation system map display position error).

**4.5. Required Navigation Performance (RNP).** RNP is a navigation performance standard for a particular area, airspace, route, procedure, or operation. A definition of RNP is specified in Appendix 1.

**a.** The specification of RNP has two major aspects, the airspace (e.g., area, route, route segment, leg, procedure, or particular operation) and the airborne system. The airspace requirement is to specify airspace, routes, procedures, or operations within which the aircraft must be located with a high degree of assurance. The airborne systems requirement is to provide a level of performance that is reliable, repeatable, and predictable. The airborne system specification of navigation performance is as defined in RTCA DO-236, or equivalent (e.g., as agreed in an FAA-approved certification plan), except as otherwise found acceptable to FAA.

**b.** Application of an appropriate airborne specification for RNP serves as a basis to ensure that airborne system performance will match or exceed the level necessary for the area, route, route segment, leg, procedure, or operation. RNP criteria have currently been developed and applied for area navigation standards for use with lateral types and levels of RNP (e.g., types such as addressing 95% lateral performance only, or addressing lateral performance using RNP x 2 containment areas, or various levels of RNP such as RNP .3, RNP .5, RNP 1). Extension of the RNP concept to other types or levels of RNP (e.g., levels such as RNP .15/45 ft.) represent more stringent lateral and vertical performance standards that may in the future be applied to approaches or 3D terminal arrival and departure VNAV paths. Other future applications of RNP may provide for along track performance (e.g., "Required Time of Arrival (RTA)") and are anticipated to evolve as general navigation requirements and operational concepts evolve.

Hence this AC currently addresses only initial RNP applications, and recognizes that RNP criteria will continuously evolve to address other future operational requirements as necessary to define and manage evolutionary changes in the International Airspace System (INAS). Accordingly, different aircraft may meet RNP requirements in different ways regarding sensors used or criteria met (e.g., FANS 1, FANS A, RTCA DO-236, Fleet qualification). Regardless of RNP application, however, it must be possible to determine that each specific aircraft meets the level of RNP required for the airspace application, and that a suitable identifiable standard has been applied.

**c.** RNP addresses the aircraft and navigation service (non-aircraft) accuracy, integrity, continuity, and availability requirements for normal and rare fault-free performance and for performance with failures. RNP specifies the nominal and limit lateral, and if applicable, vertical flight path displacements permissible for a particular procedure. RNP can be related to obstacle clearance or aircraft separation requirements to ensure a consistent set of operational procedures and design requirements.

**d.** The following elements of RNP, and error components, are thus considered applicable to systems and operations, as defined and described below in Figure 4.5-1.

**e.** A **desired flight path** is the path that the pilot, or pilot and air traffic service, expect the aircraft to fly. A desired flight path may be identified by the pilot, by ATS, by an airspace planner or by a procedure developer. It is typically specified in the form of a route or procedure, or is as otherwise identified by ATS in a pre-specified flight plan or clearance, or is as defined by an ATS clearance issued in “real time” (e.g., an assigned track, radial, bearing, course, arc, or heading). The desired flight path may be a simple straight segment, may be a path defined by multiple waypoints connected by straight segments, or may be a complex path defined by continuous straight and curved segments. The path may be defined in two dimensions (2D) consisting of lateral and longitudinal elements, three dimensions (3D) including vertical path elements, or may be defined in four dimensions (4D) including a longitudinal position as a function of time elements, or “time of arrival” constraints at waypoints.

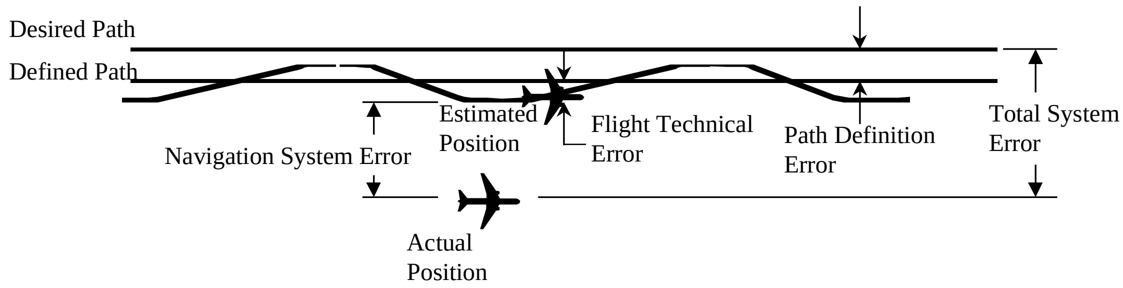
**f.** In order for an aircraft to follow the desired flight path it is necessary that the navigation system (airborne or on the ground) generate a **defined flight path.** The defined flight path is the path as determined by the path definition function of an aircraft’s navigation system (Note: It may also be defined by a system external to the aircraft, and intrinsically provided, or otherwise communicated to the aircraft). While the defined flight path is typically intended to be the same as the desired flight path, the defined flight path is often only a close approximation to the desired flight path due to unavoidable path definition error factors. Factors such as non-spherical earth shape or curvature, determination of geometric altitude versus true altitude or pressure altitude, changing magnetic variation or outdated NAVAID declination, differences in “great circle” route calculations, survey errors, database resolution limitations, or other such factors can result in the defined path being slightly different than the desired path. This difference between the desired path and the defined path is called the **path definition error.**

**g.** The aircraft elements of the navigation system estimate the aircraft’s position and compare that position with the defined flight path. A deviation indication is produced which represents the calculated displacement of the airplane from the defined flight path. This deviation is typically displayed on a primary flight display, or navigation displays, for flightcrew awareness, and is provided as an input to an autopilot and/or flight director system for command guidance or automatic control. The resulting difference (i.e., non-zero deviation) between the estimated aircraft position from the desired flight path is called the **path steering error.** This error includes display errors and flight technical error.

**h.** The error in the estimation of the aircraft’s position is referred to as position estimation error, or **navigation system error**. The navigation system error may result in a displacement from the desired flight path.

**i.** The accuracy with which the aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or defined flight path position is called **flight technical error (FTE)**. FTE does not include human performance conceptual errors (e.g., entry of an incorrect waypoint or waypoint position, selection of an incorrect procedure, selection of an incorrect NAVAID frequency, or failure to select a proper flight guidance mode). FTE can be influenced by factors such as flightcrew response to guidance (e.g., response to Flight Director information), or external environment conditions such as a wind gradient or turbulence.

**j.** The sum of the path definition error, navigation system error, and the path steering error (i.e., flight technical error plus any display error) is the **total system error** (TSE), which is the difference between the desired flight path and the actual flight path. Figure 4.5-1 below shows the error terms considered in the cross-track dimension of the total system error.




**Navigation Lateral Error Components Related to RNP**
**Figure 4.5-1.**

**k.** Particular levels of RNP can be satisfied using various NAVAIDs such as ILS and MLS, or by the use of a combination of navigation sensors (DME/DME, VOR/DME, IRU/IRS, GNSS, etc.) using a navigation computer (e.g., FMS). When a computed path (e.g., series of waypoints) is used as the basis for an approach operation, the desired flight path must typically be defined by a series of three dimensional earth-based coordinates for the applicable waypoints or path definition points.

**l.** Approach or missed approach operations can be approved by demonstration of the capability to meet the required navigation performance (e.g., accuracy, integrity, availability) for a specific approach procedure, for a set of particular procedure types, or for a set of RNP levels.

**m.** The transition from typical en route or terminal RNP levels to an approach RNP level is accomplished by transitioning to the required RNP level for the approach IAW the approved instrument procedure or by a point no later than the final approach fix, if an aircraft is radar-vectored to final.

**n.** Associated with the RNP level is a containment limit that is specified as "two times the level of RNP (2xRNP)." The system performance integrity provided by this RNP containment limit is intended to support its application as a basic element for either aircraft separation or obstacle or terrain clearance assessment. However, other considerations such as an obstacle rich environment, potential weather factors, high traffic density, limited communication or surveillance environment, or other such factors may also be appropriate to consider in determining if any additional airspace buffers may be appropriate beyond the RNP containment limit. Similarly, operations at less than 2xRNP, may be found to be appropriate, such as if an ATS communication and surveillance environment otherwise safely permits ATS management of the airspace by other means than RNP containment (e.g., where ATS radar monitoring and radar vector separation on adjacent Standard Terminal Arrival Route (STAR) transitions may be used to ensure safe separation, in lieu of use of RNP containment).

**4.5.1. RNP Levels or Types.** The expression "RNP Level" is used to describe a specific value or level of required navigation performance. The term "RNP Level" may be interchangeably described as "RNP Type" in some industry and FAA references. However in this AC, the term "RNP Level" is meant to apply only to a lateral RNP element (e.g., RNP .5) or to specific paired lateral and vertical elements (e.g., RNP .3/125 ft.). The term "RNP Type" is generally reserved for future uses, in which future vertical and longitudinal elements or other conditions of RNP may additionally apply.

**a.** Table 4.5.1-1 provides RNP Levels that could support initial, intermediate, final and missed approach segments. These RNP levels have not yet been established as international standards.

**Table 4.5.1-1.**
**RNP LEVELS FOR APPROACH**

| RNP Level | Applicability/Operation (Approach segment) | Normal Performance (95%) | Containment Limit (*) |
|---|---|---|---|
| **RNP 1** | Initial/Intermediate approach | +/-1 nm | +/-2 nm |
| **RNP 0.5** | Initial/Intermediate/Final approach [Supports limited Category I minima] | +/-0.5 nm | +/-1 nm |
| **RNP 0.3** | Initial/Intermediate/Final approach [Supports limited Category I minima] | +/-0.3 nm | +/-0.6 nm |
| **RNP 0.3/125 ft.** | Initial/Intermediate/Final approach with specified baro vertical guidance [Supports limited Category I minima] | +/-0.3 nm<br>+/-125 ft | +/-0.6 nm<br>+/-250 ft |
| **RNP 0.03/45 ft.** | Final approach with specified vertical guidance[Supports Category I minima] | +/-0.03 nm (**)<br>+/-45 ft | +/-0.06 nm<br>+/-90 ft |
| **RNP 0.01/15 ft.** | Final approach with specified vertical guidance [Supports Category I/II minima] | +/-0.01 nm (***)<br>+/-15 ft | +/-0.02nm<br>+/-30 ft |
| **RNP 0.003/15 ft.** | Final approach with specified vertical guidance [Supports Category I/II/III minima] | +/-0.003 nm<br>+/-15 ft (****) | +/-0.006 nm<br>+/-30 ft (*) |

**(*) NOTE: For barometric VNAV, the obstacle assessment methodology described in Appendix 5 may be used to addresses vertical containment limits which consider multiple factors such as altimeter error, temperature, and "along track" fix error. Each of these factors should be considered, as necessary, in determining Required Obstacle Clearance (ROC). Nominal vertical values shown in this Table associated with various levels of RNP are intended to be used in conjunction with and considering factors described in Appendix 5, as applicable to the vertical path specified and the type or types of sensor systems used. For other forms of VNAV (e.g., when using an ECEF coordinate specified geometric path), assurance of vertical containment may be met by any FAA approved method, including the method specified by Appendix 5. Examples of acceptable methods other than that based on Appendix 5 would be methods where containment is considered as a "designed-in capability" of a system or aircraft (e.g., as for GBAS or SBAS), or a specific system/infrastructure/operational assessment method, acceptable to FAA, with potential corresponding operational or procedural requirements.**

**(**) NOTE: Performance consistent with Category I operation based on ILS performance requirements at 200 feet**

**(***) NOTE: Performance consistent with Category II operation based on ILS performance requirements at 100 feet**

**(****) NOTE: Consistent with landing and rollout performance (refer to AC 120-28D). Vertical accuracy does not apply below 100 feet HAT due to the transition to a flare maneuver consistent with reduction in sink rate and landing dispersion requirements.**

**b.** RNP is a required navigation performance level described by the specification of a numeric value indicating the required navigation accuracy for a specific operation, typically specified laterally in nautical miles (e.g., RNP 1 is a Required Navigation Performance of +/-1 nautical mile (95% Probability)).

**c.** RNP containment is specified as RNP (X) x 2.

**d.** RNP Levels are defined for lateral performance, or lateral and vertical performance, if applicable. Standard values for RNP for general use are as specified in RTCA's Minimum Airspace Performance Standards (MASPS) for RNP (RTCA DO-236) as amended, this AC, related ACs, or as otherwise specified by FAA through published instrument procedures, the Aeronautical Information Manual (AIM), or by NOTAM. ICAO specified types or levels of RNP as promulgated in ICAO Manuals or ICAO Regional Supplements for International Airspace may also be considered as acceptable RNP levels for Approach operations.

**e.** RNP Levels typically used for various approach and missed approach segments supporting Category I procedures may be based on use of multi-sensor RNAV (e.g., FMS with IRS, VOR, DME, or GNSS inputs), or on other aircraft navigation systems having FMS-like capabilities (e.g., GPS based navigation systems). RNP Levels applicable to Category I may also take advantage of, or also be based on, sensor inputs received from specific landing systems (e.g., ILS, MLS, or GLS).

**f.** RNP Levels typically used for various approach and missed approach segments supporting Category II procedures may be based on the same capability specified above for Category I, except that for any portions of a final approach segment below 200 ft. HAT for Category II, use of specific landing system sensors (e.g., ILS, MLS, or GLS) may be determined to be necessary to achieve the desired level of RNP. Similarly, for portions of any FAS below 200 ft. HAT, use of a multi-sensor RNAV system should have suitable integrity and availability capability (e.g., may require use of multiple FMS with IRS, and suitable ILS, GNSS, or GBAS inputs to achieve the necessary RNP capability).

**4.5.2. Other RNP Levels or Types.** Other RNP Levels or Types may include types specified by a particular Authority for specific applications (e.g., RNP 5 within certain geographic areas; RNP .15 for a particular air carrier "Special approach procedure")

**4.6. Flight Path Definition.** Certain flight segments and waypoints are necessary to effectively implement approach and missed approach operations using landing systems where the required flight path is not inherent in the signal structure of the navigation aid (e.g., integrated multi-sensor area navigation systems and other RNAV systems such as satellite systems). The concepts and criteria described below may be applied to other types of navigation systems when using area navigation and RNP concepts.

**a.** In general, an operator must have an acceptable method to ensure that any waypoints or path points which are considered critical to an instrument procedure (if any) are correctly defined, and are loaded into each applicable aircraft's database, initially, and at each change cycle.

**b.** RNP-based area navigation systems may use any leg types available and suitable for RNP path definition as specified by acceptable FAA or industry criteria (e.g., RTCA DO-236; ARINC 424) for a particular type of navigation system), or leg types as otherwise approved by FAA for use with RNP. Leg types may be specified to define a suitable path in space in conjunction with established waypoints, new waypoints, or path definition points.

**c.** Levels of RNP may be procedurally specified, may be specified in a data base for automatic call up for an entire procedure when a procedure is loaded, may be specified in a data base for automatic call up for each leg or segment of a procedure, may be entered by the flightcrew into the navigation system for a procedure or leg, or may be based on navigation system default settings if those default RNP settings are found to be acceptable to FAA (e.g., when using standard FMS RNP default values and standard instrument procedures with a compatible RNP level specified). When possible, it is recommended that RNP levels be specified by the instrument procedure, and automatically set for each applicable leg, to minimize flightcrew input workload and potential for FMS or navigation system input error.

**d.** Levels of RNP may be specified for individual path segments, for an entire procedure, or for portions of a procedure (e.g., Intermediate segment, FAS, IMAS, or an entire missed approach path).

**e.** The following criteria and considerations are appropriate to specify the landing and rollout flight path. A graphic depiction of the points, heights, angles or other considerations described below is shown in Figure 4.6-1.

**f.** The approach segment connects with the rollout segments. An approach flight path is considered to terminate at the beginning of the rollout segment.

**4.6.1. Landing and Rollout Flight Path.** The following criteria specifies certain reference points and other criteria necessary to effectively implement landing and rollout operations using a landing system where the required flight path (e.g., FAS and RWS) is not inherent in the signal structure of the navigation aid (e.g., for satellite based sensor systems).

**4.6.2. Runway Datum Point (RDP).** The RDP is used in conjunction with the FPAP and the vector normal to the WGS-84 ellipsoid at the RDP to define the geodesic plane of a final instrument approach flight path to touchdown and rollout (e.g., FAS). It is a point typically at the designated center of the landing runway. An RDP is defined by a specified latitude, longitude, ellipsoidal height, and orthometric height. The RDP is a reference point used to connect the approach flight path with the runway. The RDP may or may not be coincident with, and need not necessarily be coincident with the designated runway threshold.

**4.6.3. Flight Path Alignment Point (FPAP).** The FPAP is a point, usually at or near the stop end of a runway, used in conjunction with the RDP and a vector normal to the WGS-84 ellipsoid at the RDP, to define the geodesic plane of a final approach and landing flight path (e.g., FAS and RWS). The FPAP typically may be the RDP for the reciprocal runway.

**4.6.4. Flight Path Control Point (FPCP).** The Flight Path Control Point (FPCP) is a calculated point located above the RDP in a direction normal to the WGS-84 ellipsoid. The FPCP is used to establish the vertical descent path and descent angle of the final approach flight path (e.g., FAS) to the landing runway.

**4.6.5. Datum Crossing Height (DCH).** The height of the Flight Path Control Point (FPCP) above the Runway Datum Point (RDP). Note that the FPCP may be specified in units of feet or meters, but is typically specified in units of feet.

> **NOTE: A standard datum crossing height should typically be 50 ft. For sloped runway touchdown zones, a DCH in the range of 50 to 55 ft above the designated datum point is acceptable. Other values are accepted on a case by case basis considering the airport need for a different value, and the type of aircraft and operations to be used (e.g., STOL). Typically a DCH is coincident with the runway threshold (TCH). (Also see Sections 5.12.3 and 5.12.4).**

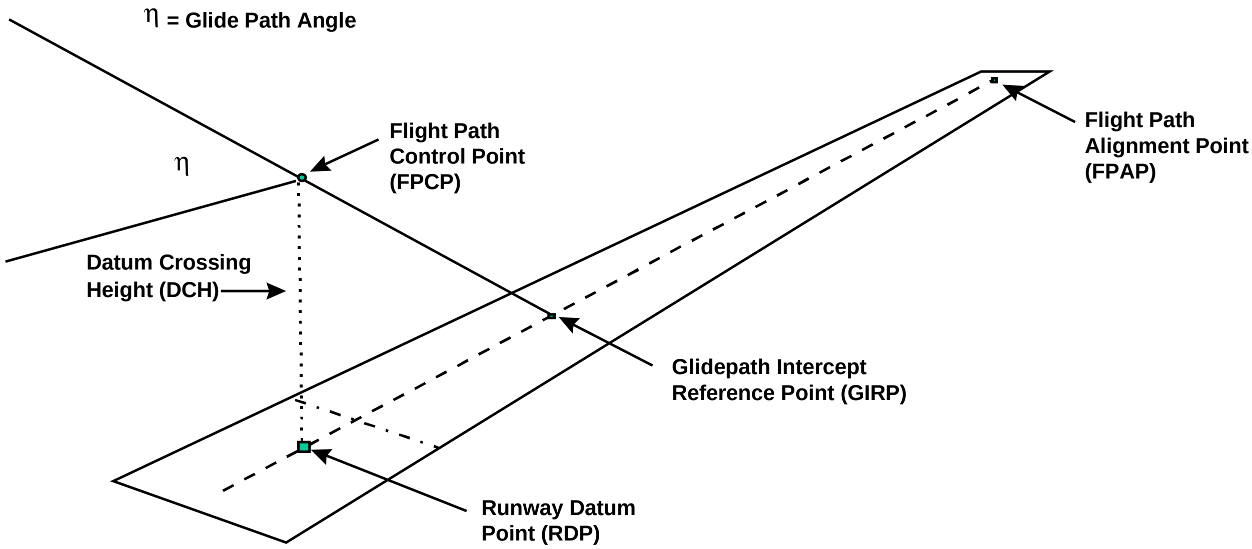
**4.6.6. Glide Path Angle (GPA).** The glide path angle is an angle, defined at the FPCP, that establishes the descent gradient for the final approach flight path (e.g., FAS) of an instrument approach procedure. It is measured in the geodesic plane of the approach (defined by the RDP, FPAP, and a vector normal to the WGS-84 ellipsoid at the RDP). The vertical and horizontal references for the GPA are a vector normal to the WGS-84 ellipsoid at the RDP and a plane perpendicular to that vector at the FPCP, respectively.

**4.6.7. Glide Path Intercept Reference Point (GIRP).**

**a.** The GIRP is the point at which the extension of the final approach path (e.g., FAS) intercepts the runway.

## Points, Heights, Angles Or Other Considerations For Definition of An Approach And Landing Flight Path

## Figure 4.6-1




**b.** The locations established for, and the values assigned to, the **RDP, FPCP, DCH** and **GPA** will be selected based upon the operation need to establish the required **GIRP**. Operational considerations include:

**(1)** Path of wheels over threshold(s),

**(2)** Need for coincidence with other aids and systems - visual and non-visual,

**(3)** Runway characteristics (upslope and downslope, crown, etc.),

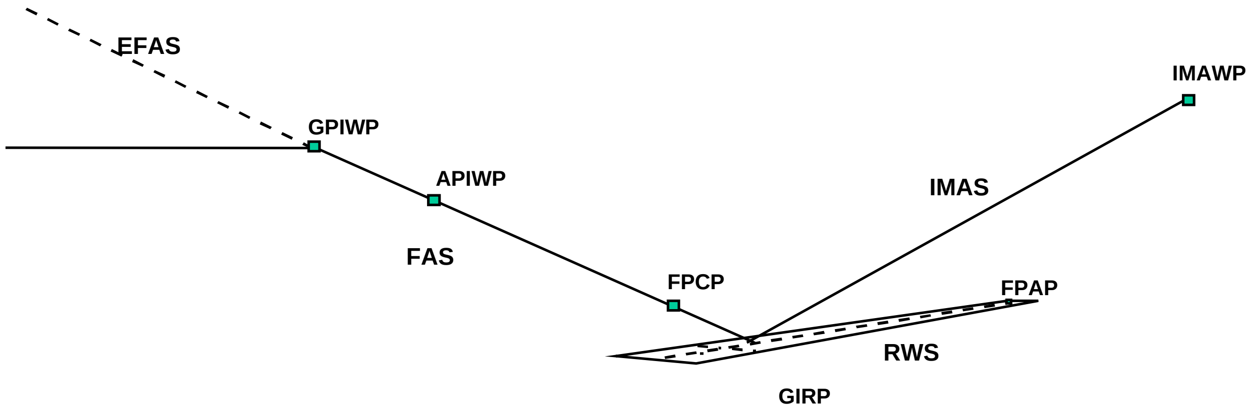
**(4)** Actual threshold, displaced threshold or multiple threshold characteristics,

**(5)** Actual clearway or stopway characteristics.

**4.6.8. Approach and Missed Approach Segments.** Figure 4.6-2 below shows the applicable reference points, path points, waypoints and leg types typically used to construct instrument approach procedures applicable to air carrier operations.

**Waypoint and Segment Placement**

**Figure 4.6-2**




**4.6.9. Procedure Design Related Waypoint Definitions and Use.** The following procedure design-related waypoint definitions and uses are provided:

**a. Glide Path Intercept Waypoint (GPIWP)** - The point at which the established glide slope intercept altitude (MSL) meets the Final Approach Segment (FAS), on a standard day, using a standard altimeter setting (1013.2 HPa or 29.92 in).

**b. Approach Intercept Waypoint (APIWP)** - A variable waypoint used when necessary to link a barometric LNAV/VNAV flight path with a Final Approach Segment (FAS) that is fixed in space (e.g., a xLS final segment). The APIWP permits LNAV and barometric VNAV segments, which may vary vertically in location on an approach as a function of barometric pressure setting or temperature variation from standard, to join or be connected to a FAS which is otherwise fixed in vertical location with respect to a runway.

**c. Initial Missed Approach Waypoint (IMAWP)** - (Used only for MAP) A Waypoint generally aligned with the runway centerline, beyond the touchdown zone, used to establish a suitable initial climb segment beyond the touchdown zone. The IMAWP intends to provide a safe path and altitude, if applicable, in the vicinity of the runway, to be used to establish a safe initial go-around path following a low altitude go-around or rejected landing.

**d. Procedure Design Related Segment Definitions.** The following procedure design related segment definitions are provided:

| | |
|---|---|
| Final Approach Segment (FAS) | The segment of an approach extending from the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP), whichever occurs later, to the Glidepath Intercept Reference Point (GIRP). For the purpose of procedure construction, The Final Approach segment is defined as beginning at the FAF and ending at the Flight Path Control Point (FPCP) or point at which the missed approach segment starts (e.g., point of lowest nominal DA(H)). |
| Extended Final Approach | That segment of an approach, co-linear with the Final Approach Segment, but |

| | |
|---|---|
| Segment (EFAS) | which extends beyond the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP). |
| Runway Segment (RWS) | That segment of an approach from the glidepath intercept reference point (GIRP) to Flight Path Alignment Point (FPAP). |
| Initial Missed Approach Segment (IMAS) | That segment of an approach from the Glide Path Intercept Waypoint (GIRP) to the Initial Missed Approach Waypoint (IMAWP). |
| Missed Approach Segment (MAS) | That segment of an instrument approach procedure from a point on the FAS corresponding to the position where the lowest DA(H) occurs under nominal conditions, to the designated IMAWP, or missed approach holding WP, as specified for the procedure. |

**5. AIRBORNE SYSTEM REQUIREMENTS.**

**5.1. General.** The following accuracy, integrity and availability criteria are specified for aircraft systems intended for Category I or II. Aircraft related systems are addressed by 5.1.1. Non-aircraft systems (e.g., NAVAIDs) are addressed in 5.1.2. Specification of flight path is addressed in 5.1.3, such as is applicable to defining an RNAV, LNAV, or VNAV path to be followed by an aircraft. Specific airborne equipment requirements for Category I or II authorizations are addressed in 5.2 and 5.3.

**5.1.1. Airborne Systems.**

**a.** Airworthiness criteria for aircraft systems intended to meet requirements of this AC are specified in paragraph 5.1.3 through 5.19 below, or Appendix 2 or 3 for demonstration of airborne systems for eligibility for Category I or II minima respectively.

**b.** For aircraft which completed an airworthiness demonstration applicable to Category I or II using earlier versions of this AC, or previous applicable ACs, new operational authorizations may be requested or may be continued only as provided for in standard OpSpecs.

**5.1.2. Non-Airborne Systems (e.g., NAVAIDs or equivalent GNSS capability).** Unless otherwise specified by FAA, NAVAID/landing system characteristics to be used should have been addressed using an acceptable means of facility or capability classification (e.g., For a U.S. ILS facility, and example of a typical classification would be "II/E/2").

**a.** The classification should be specified in a manner suitable to address:

**(1)** Intended NAVAID performance level (or an equivalent capability for GNSS),

**(2)** Signal or capability coverage with respect to the intended flight path(s) and runway, and

**(3)** NAVAID or capability "availability and integrity" (e.g., considering standby capability and power, as applicable).

**b.** This classification schema should at least be provided for any xLS capability (e.g., ILS, MLS, or GLS). Typically this is done by use of FAA or ICAO criteria such as specified by FAA Order 6750.24 as amended, or ICAO Annex 10 Criteria, as suited to the applicable NAVAID facility or capability. NAVAID facility or capability operational use is then predicated on suitable facility or capability classification respectively for ILS, MLS, or GLS (e.g., for ILS, III/E/2).

**c.** NAVAID classifications or equivalent capability classification schema should be consistent among ILS, MLS or GLS to the maximum extent possible.

**d.** At non-U.S. facilities, consideration of equivalence to U.S. classification may be necessary for operational authorizations.

**e.** For GLS, classification schema are evolving and are expected to continue to do so as new GNSS elements or augmentation methods become operational. Nonetheless, an appropriate classification method equivalent to that used for ILS, or as otherwise specified by FAA or ICAO, should be used (e.g., addressing "Performance Level"/"Coverage"/"Integrity" such as "PL2/T/1").

**f.** NAVAID facility or capability classification schema or associated airborne system documentation referring to that classification schema for ILS, MLS, or GLS should not be defined or expressed in operational authorization terms (e.g., Category I, II, or III xLS). This is necessary to recognize that operational authorization criteria for Category I, II, or III may change in time, and because authorizations may not be unique to a particular NAVAID classification or capability, and further, may depend on and be a function of evolving airborne system elements, procedures, or other factors.

### 5.1.3. Flight Path Specification.

#### 5.1.3.1. Lateral.

**a. Category I.** The following levels of lateral performance shown in Table 5.1.3-1 are acceptable for Category I and corresponding minima may be applied. Any one or more methods listed below may be demonstrated, but the method(s) used should be identified as the basis for the demonstration.

**Table 5.1.3.1-1.**
**CATEGORY I - LATERAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS) | [Minima equivalent to ILS at 200 ft. HAT]<br>[Lateral tracking performance from 1000 ft. HAT to 200 ft. HAT should be stable without large deviations (i.e., within $\pm$50 microamps deviation) from the indicated course or path, or equivalent; using at least 3 different representative facilities for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.] |
| 2) | "ILS Equivalent" (e.g., SCAT I/ MASPS;WAAS/MOPS) | [Minima equivalent to ILS at 200 ft. HAT] |
| 3) | RNP<br>RNP $\leq$ .03<br>.03 <RNP< .3<br>RNP $\geq$ .3 | <br>[Minima equivalent to ILS at 200 ft. HAT]<br>[Minima typically not lower than a DA(H) of 250 ft. HAT]<br>[Minima restricted to not lower than a DA(H) of 250 ft. HAT] |
| 4) | FMS (LNAV/VNAV or LNAV) | [Minima restricted to not lower than a DA(H) of 250 ft. HAT] |
| 5) | RNAV | [Minima as specified by Standard OpSpecs/SIAP] |
| 6) | LOC, LOC BCRS, VOR, VOR/DME, NDB, ASR, PAR | [Minima as specified by Standard OpSpecs/SIAP] |

**b. Category II.** The following levels of lateral performance shown in Table 5.1.1-2 are acceptable for Category II. Any one or more methods may be demonstrated, but the method used should be identified as the basis for the demonstration.

**Table 5.1.3.1-2.**
**CATEGORY II - LATERAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS) | [Minima equivalent to ILS at 100 ft. HAT]<br><br>See Category I Criteria to 300 ft. HAT, and in addition,<br><br>[Lateral tracking performance from 300 ft. HAT to 100 ft. HAT within $\pm$25microamps deviation from the indicated course or path, or equivalent, (for 95% of the time/per approach) using at least 3 representative facilities and for a minimum of 20 total approaches. System performance should be acceptable without undue oscillation.]*<br><br>* NOTE: Or using JAA ACJ AWO 231 Method |
| 2) | RNP<br>RNP $\leq$ .01 | <br>[Minima equivalent to ILS at 100 ft. HAT] |

**c. Lateral Performance below or beyond DA(H).** For either Category I or II procedures with a DA(H) below 250 ft. HAT*, when guidance is provided (e.g., for autoland, or HUD flare/rollout), the lateral performance should at least be equivalent to that attainable using an ILS Type I/E/1 localizer (or RNP .003) from 200 ft. HAT, or 100 ft. HAT as applicable, to the end of rollout.

***NOTE: This provision does not apply to systems intended for Category III - see AC120-28D for Category III requirements.**

**d.** From 200 ft. HAT or 100 ft. HAT, as applicable, until returning to an established missed approach segment of the approach procedure, if guidance is provided, performance should be at least equivalent to that attainable using an ILS Type I/E/1 localizer front and back course, or RNP.3 as applicable.

**5.1.3.2. Vertical.**

**a. Category I.** The following levels of vertical performance are acceptable for Category I and corresponding minima may be applied. Any one or more methods listed below may be demonstrated, but the method(s) used should be identified as the basis for the demonstration.

**Table 5.1.3.2-1.**
**CATEGORY I - VERTICAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS Glide Slope/Glide Path (any one xLS Glide Slope) | [Minima equivalent to ILS at 200 ft. HAT]<br>[Vertical tracking performance from 700 ft. HAT to 200 ft. HAT should be stable without large deviations (i.e., within $\pm$75 microamps deviation) from the indicated path, or equivalent, using at least 3 different representative facilities and for a minimum of 9 total approaches. System performance should be acceptable without undue oscillation.] |
| 2) | "ILS Glide Slope Equivalent" (e.g., SCAT I/ MASPS; WAAS/MOPS) | [Minima equivalent to ILS at 200 ft. HAT] |
| 3) | RNP<br>RNP $\leq$ .03 and ECEF** VNAV<br>.03 <RNP< .3 and BARO VNAV<br>RNP $\geq$ .3 with or without BARO VNAV | <br>[Minima equivalent to ILS at 200 ft. HAT]<br>[Minima typically not lower than a DA(H) of 250 ft. HAT]<br>[Minima restricted to not lower than a DA(H) of 250 ft. HAT] |
| 4) | FMS BARO VNAV | [Minima restricted to not lower than a DA(H) of 250 ft. HAT] |
| 5) | RNAV | [Vertical performance not applicable*] |
| 6) | LOC, LOC BCRS,VOR, VOR/DME, NDB, ASR, PAR | [Vertical performance not applicable*; except PAR minima equivalent to ILS] |

***Note: A procedure addressing a stabilized approach from the Final Approach Fix to MDA(H) is recommended for these procedures (except this note does not apply to PAR).**

****Note: ECEF VNAV - VNAV referenced to "Earth Center Earth Fixed Coordinates," or geometric height above the "earth reference surface" based VNAV.**

**b. Category II.** The following levels of vertical performance are acceptable for Category II. Any one or more methods may be demonstrated, but the method used should be identified as the basis for the demonstration.

**Table 5.1.3.2-2**
**CATEGORY II - VERTICAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS Glide Slope/Glide Path) | [Minima equivalent to ILS at 100 ft. HAT]<br>See Category I Criteria to 300 ft. HAT, and in addition,<br>[Vertical tracking performance from 300 ft. HAT to 100 ft. HAT within ±35** microamps deviation from the indicated course or path, or ±12 ft, which ever is greater, or equivalent, (for 95% of the time/per approach) using at least 3 different representative facilities and for a minimum of 20 total approaches. System performance should be acceptable without undue oscillation.]*<br>* NOTE: Or using JAA ACJ AWO 231 Method<br>** NOTE: When this provision is applied to path tracking in conjunction with Category III, momentary excursions up to ± 75 microamps during test demonstrations may be acceptable if flight guidance system touchdown and landing performance is otherwise shown to be satisfactory. |
| 2) | RNP<br>RNP ≤ .01 with ECEF** VNAV | [Minima equivalent to ILS at 100 ft. HAT] |

**c. Category I or Category II.**

**(1) Vertical (VNAV) performance at altitude constraints prior to a Final Approach Fix (FAF) or Final Approach Point (FAP), or at an FAF or FAP.** For procedures with VNAV segment(s) prior to an FAF or FAP, at an FAF or FAP (e.g., intercepting an FAS from an en route segment, STAR, Profile Descent, initial approach or intermediate approach segment), vertical performance should normally be based on use of a vertical "Fly by" path rather than a "Fly over" path. The small vertical displacement which may occur at a vertical constraint as a result of using a vertical "Fly by" waypoint rather than vertical "Fly over" waypoint is considered operationally acceptable, and desirable, to ensure asymptotic capture of a new (next) vertical segment. This momentary deviation below the published minimum procedure altitude is acceptable provided the deviation is limited to no more than 100 ft. and is a result of a normal VNAV capture. This applies to both "level off" or "altitude acquire" segments following a climb or descent, or vertical climb or descent segment initiation, or joining of climb or descent paths with different gradients.

**NOTE: A "Fly By" vertical waypoint is a WP for which an aircraft may initiate a vertical rate change and depart the specified vertical path to the active WP prior to reaching that WP, in order to asymptotically capture the next vertical path. A "Fly Over" vertical waypoint is a WP for which an aircraft must stay on the defined vertical path until passing the active WP and may not initiate the necessary vertical rate change to capture the next vertical path until after passing the active WP. Hence, after passing the active WP, as the next WP becomes active, and if there is a vertical path change, the aircraft must re-adjust vertical rate to re-capture the vertical path after having already overshot the first opportunity for an asymptotic capture of that new path.**

**(2) Vertical (VNAV) performance at waypoint altitude constraints near the point at which DA(H) or MDA(H) may occur.** For procedures with waypoints at or near the point at which DA(H) may occur, vertical (VNAV) performance should not preclude continuous descent of the aircraft to the runway, following the established VNAV path to the runway (e.g., VNAV should not initiate inappropriate capture of a missed approach segment and automatic level off (at MDA(H)) or initiation of MAP climb, without pilot confirmation that a missed approach or go-around is intended (e.g., TOGA initiation).

**(3) Vertical (VNAV) performance below or beyond DA(H) or MDA(H).** For procedures with a DA(H) below 200 ft. HAT* (e.g., for autoland, or HUD flare/rollout), the glide path/glide slope vertical performance should at least be equivalent to that attainable using an ILS glide slope at a facility classified as Type I/E/1, between 200 ft. HAT and 50 ft. HAT.

***NOTE: This provision does not apply to systems intended for Category III - see AC120-28D for Category III requirements.**

**5.1.3.3. Longitudinal.** Longitudinal (along track) requirements for Category I or II operations are as specified below.

**a. Category I.** The following longitudinal (along track) requirements are acceptable for Category I. Any one or more methods listed below may be demonstrated, but the method(s) used should be identified as the basis for the demonstration.

**Table 5.1.3.3-1.**
**CATEGORY I - LONGITUDINAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS, or any combination provided by MMR) | |
| | Use of VHF OM/MM Marker Beacons | [Minima equivalent to ILS at 200 ft. HAT] |
| | Use of VOR/TACAN Fixes (other than for MM) | [Minima equivalent to ILS at 200 ft. HAT] |
| | Use of LOM/LMM NDBs | [Minima equivalent to ILS at 200 ft. HAT] |
| | Use of suitable DME Distance Information | [Minima equivalent to ILS at 200 ft. HAT] |
| | Use of FMS RNAV Fixes (other than for MM) | [Minima equivalent to ILS at 200 ft. HAT] |
| | Use of Distance to "Runway Threshold WP" | [Minima equivalent to ILS at 200 ft. HAT] |
| | Other methods (e.g., Radar fixes, Fan Markers) | [Restricted minima may apply - DA(H)$\geq$250 ft. HAT] |
| | No specific method of assuring along track position | [Restricted minima may apply - DA(H)$\geq$250 ft. HAT] |
| 2) | "ILS Equivalent" (e.g., SCATI/MASPS;WAAS/MOPS) | [Same as for ILS/MLS/GLS described above |
| 3) | RNP* | |
| | RNP $\leq$ .03 | [Minima equivalent to ILS at 200 ft. HAT] |
| | .03 <RNP< .3 | [Minima typically not lower than a DA(H) of 250 ft. HAT] |
| | RNP $\geq$ .3 | [Minima restricted to not lower than a DA(H) of 250 ft. HAT] |
| | | *Note: RNP Systems/Procedures that do not provide for display of distance to a "Runway Threshold WP" may have minima additionally restricted. |
| 4) | FMS (LNAV/VNAV or LNAV) | [Minima restricted to not lower than a DA(H) of 250 ft. HAT] |
| 5) | RNAV (Op-Specs Part C; Para C063) | [Minima as specified by Standard Op-Specs/SIAP] |
| 6) | LOC, LOC BCRS,VOR, VOR/DME, NDB, ASR, PAR | [Minima as specified by Standard Op-Specs/SIAP] |

**b. Category II.** The following levels of longitudinal (along track) performance are acceptable for Category II. Any one or more methods may be demonstrated, but the method used should be identified as the basis for the demonstration.

**Table 5.1.3.3-2**
**CAT II - LONGITUDINAL PERFORMANCE/MINIMA**

| | | |
|---|---|---|
| 1) | ILS/MLS/GLS (any one xLS, or any combination provided by MMR) | Same as for Category I, except that an IM or suitable distance readout to a "Runway Threshold WP" is also required. |
| 2) | RNP<br>RNP $\leq$ .01 | <br>[Same as for ILS/MLS/GLS above.] |

**5.1.3.4. Typical Wind and Wind Gradient Disturbance Environment.** The lateral and vertical performance described in paragraph of 5.1.3 above should typically be expected to be achievable in conditions at least as described below. Performance may be estimated, assessed analytically, demonstrated in simulation, or demonstrated in flight. Relevant associated information on demonstrated winds encountered or estimated wind gradient capability may be included in the AFM, as desired by the applicant.

**a.** Systems intended for use with procedures for either Category I or Category II should be capable of coping with at least the following wind, wind gradient, and turbulence conditions:

- Reported Surface Headwind Component - 25 kts
- Reported Surface Tailwind Component - 10 kts
- Reported Surface Crosswind Component - 15 kts

**b.** Wind Gradients/Shear - at least 4 kts per 100 ft. from 500 ft. HAT to the surface;

**c.** Recommended Capability - Ability to cope with 8 kts per 100 ft. for 500 ft., moderate turbulence, knife edge shears of at least 15kts over 100 ft., 20 kts lateral directional vector shears of 90 degrees over 100 ft., and ability to cope with a 20 kt logarithmic shears between 200 ft. and the surface.

**5.2. Airborne Equipment for Category I.** The following equipment (along with any additional equipment specified by 14 CFR for IFR flight) is the recommended aircraft equipment for an authorization for Category I.

**a.** For ILS, GLS, or MLS approach capability:

- Two navigation receivers, or equivalent type of device, of each type intended for use,

  **NOTE 1: The navigation receivers specified above may be provided as two or more integrated multi-sensor units (e.g., MMR),**

  **NOTE 2: For GLS, at least one data link receiver capable of receiving GBAS uplinked corrections for GNSS position fix correction data may be considered acceptable, when used with dual navigation receiver capability (e.g., dual GPSSU sensors) receiving GPS SV ranging information. Dual data link receivers capable of receiving GBAS uplinked corrections for GNSS are recommended.**

  **NOTE 3: Installation of only one navigation receiver may be authorized by FAA for special circumstances, considering the particular facilities and routes to be used, such as if suitable minima restrictions and requirements for alternate navigation capability are applied (e.g., one GLS receiver if two ILS receivers are installed).**
- Suitable navigation displays, attitude, vertical speed, and airspeed displays for each pilot (see paragraph 5.9 for details)
- Suitable failure annunciation visible to each pilot
- One or more Marker Beacon systems (unless an approved RNAV substitute is available, or if not necessary for the route of flight, including alternates)
- One or more DMEs (unless an approved RNAV substitute is available, or if not necessary for the route of flight, including alternates)
- One or more ADFs (unless an approved RNAV substitute system is available, or unless ADF is not required for the intended route of flight, including alternates). Note that two ADFs may be required IAW paragraph 121.549 for certain international operations, and for certain obstacle or terrain critical departure, approach, or missed approach procedures
- For aircraft intended for approval of landing minima below RVR 3000, at least one flight director or one autopilot

- It is recommended that the following capability be available:
  - Radar Altimeter
  - Standby power for at least one pilot's ILS/GLS navigation receiver and displays
  - Rain removal capability

**b.** For approaches other than ILS, GLS, or MLS (e.g., RNAV, VOR, VOR/DME, NDB).

- 2 navigation receivers and associated displays of the type of the approach system to be used (unless otherwise authorized by FAA for the facilities and route to be used), or
- 2 FMS systems (unless use of 1 is authorized by FAA for the facilities and route to be used) which are capable of using the necessary NAVAIDs or equivalent (e.g., space vehicles (SVs)), or which can be monitored by using raw data NAVAID data (e.g., on an associated ND display or RDMI).
- Suitable navigation displays, attitude, vertical speed, and airspeed displays for each pilot (see paragraph 5.9 for details)
- Suitable failure annunciation visible to each pilot
- For ASR or PAR, at least 2 communication radios capable of receiving communications of ASR or PAR information.
- It is recommended that the following capability be available:
  - Radar Altimeter
  - Standby power for at least one pilot's VOR or RNAV navigation receiver and displays
  - Rain removal capability

**c.** For aircraft types and systems approved previously to issuance of this AC using earlier AC120-29A or equivalent criteria, the aircraft must have a system which meets that earlier criteria. While such systems may continue to be produced and installed for retrofit in aircraft, or may continue to be installed in new production aircraft or variants, or future derivatives of those types or variants, any additional credit permitted by this AC for Category I capability may be limited to those aircraft and systems meeting revised provisions of this AC, including those provisions shown in Appendix 2.

**d.** For requirements related to equipment inoperative dispatch pertaining to Category I approach capability see paragraph 5.22 below. For situations involving in-flight failure of equipment pertaining to Category I approach capability see paragraph 5.23 below.

**5.3. Airborne Equipment for Category II.** The following equipment (along with any applicable equipment otherwise specified above for Category I) is the minimum aircraft equipment considered necessary for an authorization for Category II.

**a.** Two independent navigation receivers, or equivalent, of each type intended for use,

**NOTE 1: The navigation receivers specified above may be provided as two or more integrated multi-sensor units (e.g., MMR),**

**NOTE 2: For GLS, at least one data link receiver capable of receiving GBAS uplinked corrections for GNSS position fix correction data may be considered to be acceptable, when used with dual navigation receiver capability (e.g., dual GPSSU sensors) receiving GPS SV ranging information. Dual data link receivers capable of receiving GBAS uplinked corrections for GNSS are recommended.**

**b.** A suitable Automatic Flight Control System, or manual flight guidance system, or both (e.g., flight director) as follows:

- A system or systems designed to meet criteria of Appendix 3, or

- For aircraft types and systems approved previously to issuance of this AC using earlier AC 120-29A or equivalent criteria, the aircraft must have a system which meets that earlier criteria. While such systems may continue to be produced and installed for retrofit in aircraft, or may continue to be installed in new production aircraft or variants, or future derivatives of those types or variants, any additional credit permitted by this AC for Category II capability may be limited to those aircraft and systems meeting revised provisions of this AC, including those provisions shown in Appendix 3.

- At least 1 autopilot (AFGS) and at least dual flight director systems with an independent display for each pilot is recommended. Dual systems which provide the same information to both pilots, with the second system in "hot standby status" may be acceptable only if suitable comparison monitoring between the systems is available, and timely transfer to standby can be completed, and suitable annunciation to the flightcrew is provided.

**c.** A radar altimeter display for each pilot. (Note: At least 2 independent radar altimeters with a display for each pilot are recommended.)

**d.** Rain removal equipment is required for each pilot (e.g., windshield wiper, bleed air). (Note: hydrophobic coating is recommended for each applicable forward windshield, in lieu of rain repellent, due to environmental considerations.)

**e.** Flight instruments and annunciations which can reliably depict relevant aspects of the aircraft position relative to the approach path, attitude, altitude and speed, and aid in detecting and alerting the pilots in a timely manner to failures, abnormal lateral or vertical displacements during an approach, or excessive lateral deviation (see paragraph 5.9 for details).

**f.** Unless otherwise approved by FAA based on demonstration of acceptable pilot workload, an autothrottle system should be provided.

**g.** For requirements related to equipment inoperative dispatch pertaining to Category II approach capability see paragraph 5.22 below. For situations involving in-flight failure of equipment pertaining to Category II approach capability see paragraph 5.23 below.

**5.3.1. Standard Category II Minima.** Standard Category II minima are a DA(H) of 100 ft. HAT and RVR not less than 1200 ft. (350m).

**5.3.2. Special Category II Authorizations.** Special Category II minima may be authorized for certain qualifying ILS/GLS facilities (e.g., Type I ILS). Minima at these facilities may be restricted as follows depending on NAVAID, airport facility, and obstacle assessments by FAA. Order 8400.13 addresses certain standard provisions applicable to these authorizations. Other provisions may apply when proposed by the applicant, and approved by FAA. Any authorizations issued should be consistent with one or more of the following DA(H) and RVR paired provisions:

- DA(H) 150 ft. HAT RVR 1800
- DA(H) 150 ft. HAT RVR 1600
- DA(H) 100 ft. HAT RVR 1800
- DA(H) 100 ft. HAT RVR 1600
- DA(H) 100 ft. HAT RVR 1200

**5.4. Automatic Flight Control Systems and Automatic Landing Systems.** Automatic Flight Control Systems, Autoland Systems, or Manual Flight Guidance systems (e.g., HUD) are considered acceptable for use and are recommended for Category I or II ILS, MLS, or GLS procedures which do not have NOTAM restrictions on localizer or glide slope or equivalent signals (e.g., Glide Slope unusable below 500 ft. HAT, or Localizer unusable inside threshold).

**5.5. Flight Director Systems.** Characteristics of Flight Director Systems (head down or head up) used for aircraft authorized for Category I or II should be compatible with the characteristics of any autopilot or autoland system used. Flight control systems that provide both autopilot control and flight director information may display, or may not display, flight director commands as appropriate for the system design and operator requirements. Regardless of whether Flight Director commands are provided, situational information displays of navigation displacement must also be provided to both flight crewmembers. To ensure that unacceptable deviations and failures can be detected, the displays must be appropriately scaled and readily understandable in the modes or configurations applicable.

**5.6. Head up Display Systems.** Head up Display systems used as the basis for a suitable Category I or II authorizations must provide guidance for one or both pilots as appropriate for the system design. If information is provided to only the flying pilot, then appropriate monitoring capability must be established for the non-flying pilot. Monitoring tasks must be identified, and the non-flying pilot must be able to assume control of the aircraft in the event of system failure or incapacitation of the pilot using the HUD (e.g., for a safe go-around or completion of rollout). Head up Display Systems acceptable for Category I or II must meet provisions of Appendix 2 or 3 respectively, or acceptable earlier criteria specified by the FAA and referenced in an AFM.

**5.7. Enhanced/Synthetic Vision Systems.** Enhanced/Synthetic Vision Systems based on millimeter wave radar or other such sensors may be used to ensure the integrity of other flight guidance or control systems in use during Category I or II operations. They must be demonstrated to be acceptable to FAA in a proof of concept evaluation and they must otherwise meet the requirements of Appendix 2 or 3 of this AC as applicable. Use of Enhanced/Synthetic Vision Systems for purposes other than establishing the accuracy or integrity of flight guidance system performance must be demonstrated to be acceptable through proof of concept testing prior to identification of specific airworthiness and operation criteria.

**5.8. Hybrid Systems.** Hybrid systems (e.g., a fail passive autoland system used in combination with a monitored HUD flight guidance system) may be acceptable for Category I or II if the system provides the equivalent performance and safety to a non-hybrid system as specified for the minima sought (e.g., Category I or II).

**a.** Hybrid systems with automatic landing capability should be based on the concept of use of the automatic landing system as the primary means of control, with the manual flight guidance system serving as a backup mode or reversionary mode.

**b.** Any transition between hybrid system elements (e.g., control transition from autoland use to manual control HUD use, or for response to failures) must be acceptable for use by properly qualified flightcrews (e.g., qualified IAW part 121, an approved Advanced Qualification Program (AQP), or equivalent JAA criteria, as applicable, and standard industry practices). Transitions should not require extraordinary skill, training, or proficiency.

**c.** For any system which requires a pilot to initiate manual control at or shortly after touchdown, the transition from automatic control prior to touchdown to manual control using the remaining element of the hybrid system (e.g., HUD) after touchdown must be shown to be safe and reliable.

**5.9. Instruments, Systems, and Displays.** The following identifies Flight Instrument, Systems, and Display presentations requirements for Category I and Category II operations:

**5.9.1. Instruments, Systems, and Displays for Category I.**

**a.** Attitude indicators, EADIs or primary flight displays must be provided for each required pilot (pilot flying (PF) and pilot not flying (PNF)), or equivalent electro-mechanical instruments depicting attitude, barometric altitude, airspeed, and vertical speed.

**b.** HSIs, EHSIs, NDs, or other equivalent navigation displays, with pertinent, reliable and readily understandable lateral situation information for both normal and non-normal conditions related to Category I landing and missed approach procedures, must be provided for each required pilot.

**c.** Instrument and panel layouts must follow accepted principles of flight deck design (e.g., basic-T format, conventions for airspeed altitude scales).

**d.** The location and placement of situation information/navigation displays must be appropriate for each required flight crewmember, and must be appropriately scaled and readily understandable in presentations or mode of display used.

**e.** Suitable redundant lateral, and where applicable, vertical path displacement information from the final approach course and specified glide path must be provided.

**(1)** For any operation intended for use with a DA(H) below 250 ft. HAT, lateral and vertical displacement information must be provided on the PFD, EADI, ADI, or equivalent to each pilot independently.

**(2)** For RNP operations with minima below 250 ft. HAT, the lateral and vertical displacement full-scale indication on the PFD, EADI, or attitude indicator should be as shown in Figure 5.9.2-1 and 5.9.2-2, unless otherwise approved by the FAA. It is recommended that these displacement indications be provided for any RNP approach operations.

**(3)** Different display sensitivities may be necessary for steep or shallow angle approaches.

**(4)** The 0.7 degree taper prior to the 100 ft. HAT for vertical display sensitivity is acceptable for most glide path angles. A taper of ¼ the glide path angle is an acceptable alternative, and would be preferred for steep or shallow glide path angles.

**(5)** The display sensitivities that are selected should be validated by simulator or flight evaluation.

**f.** Decision Altitude (Height) or Minimum Descent Altitude (Height) advisory indications that are readily understandable and appropriately distinctive plus marker beacon indications (middle marker, and outer marker), or equivalent, should be provided at each required pilot station.

**NOTE: Unless otherwise approved by FAA, advisory indications should be expressed as either "RH" or "RA" for radar/radio height or altitude, and as "BARO" for barometric altitude. Flightdeck depiction of radio and barometric height or altitude advisories should not typically use the operational designations of "DH" or "MDA."**

**g.** Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided.

**h.** Automatic audio call-outs as described in paragraph 5.11 are recommended.

**i.** A suitable rain removal method is recommended for each pilot for Category I operations. Suitable methods typically include windshield wipers, bleed air windshield rain removal, or hydrophobic coatings.

**5.9.2. Instruments, Systems, and Displays for Category II.**

**a.** Attitude indicators, EADIs or primary flight displays must be provided for each required pilot (PF and PNF), or equivalent electro-mechanical instruments depicting attitude, barometric altitude, airspeed, and vertical speed plus suitable standby attitude information available to each required pilot.

**b.** HSIs, EHSIs, NDs or other equivalent navigation displays with pertinent, reliable, and readily understandable lateral situation information for both normal and non-normal conditions related to Category II landing and missed approach procedures, must be provided for each required pilot.

**c.** Instrument and panel layouts must follow accepted principles of flight deck design (e.g., basic-T format, conventions for airspeed altitude scales).

**d.** The location and placement of situation information/navigation displays must be appropriate for each required flight crewmember, and must be appropriately scaled and readily understandable in presentations or mode of display used.

**e.** Suitable redundant lateral and vertical path displacement information from the final approach course and specified glide path must be provided.

**(1)** Lateral and vertical displacement information must be provided on the PFD, EADI, ADI or equivalent to each pilot independently.

**(2)** Lateral displacement expanded scale information must be provided to confirm that the aircraft position with respect to intended flight path and the landing runway on each PFD, EADI, ADI or equivalent (e.g., for ILS, a full scale sensitivity of 1 Dot (0.0775 ddm)), or the following criteria applicable to RNP.

**(3)** For RNP operations, the lateral and vertical displacement full-scale indication on the PFD, EADI, or attitude indicator should be as shown in Figure 5.9.2-1 and 5.9.2-2, unless otherwise approved by FAA. It is recommended that these displacement indications be provided for any RNP approach operations. Figure 5.9.2-1 and 5.9.2-2 shows that for the point on the approach path where the RNP portion of the path meets the angular portion of display limits, the display limit distance from nominal path (zero deviation) to full scale high or to full scale low display deviation is ± 250 ft. (vertical displacement), and ± 1 x RNP (lateral displacement). At the point on the approach path where the vertical angular display limit converges to a constant value (i.e., nominal path is at 100 ft. HAT), the full-scale displacement is ±24' (vertical displacement). At that point on the approach path where the lateral angular display limit converges to a constant value (i.e., runway threshold), the full scale displacement is ±175 ft. (lateral displacement).

**f.** An autopilot or flight director system suitable for the minima to be authorized.

**g.** Unless otherwise approved by the FAA for Category II operations based on autopilot use alone, flight director(s), or command guidance information, should be provided for each pilot, suitable for the minima to be authorized - at least dual independent system capability must be installed for Category II operations for aircraft which are certificated with more than one required pilot.

**NOTE: For Head Up Display (HUD) operations, availability of the information in items a, b, and e above on a HUD does not necessarily substitute for availability of this information on pertinent head-down displays (HDDs). Configurations found acceptable to FAA include use of a compatible HUD and HDDs at the Crewmember 1 (CM1/Captain) flight deck station, and suitable and comparable HDDs at the Crewmember 2 (CM2 /FO) flight deck station, each with adequate flight path display and failure annunciation. Use of other HUD/HDD configurations for CM1 and CM2 must be evaluated by FAA, and be determined to provide acceptable and equivalent or better capability.**

**h.** Unless otherwise approved by FAA based on demonstration of acceptable pilot workload, an autothrottle system should be provided.

**i.** Decision Altitude (Height) advisory indications that are readily understandable and appropriately distinctive plus a display of radio altitude and marker beacon indications (inner marker, middle marker, and outer marker), or equivalent, should be provided at each required pilot station.

**NOTE: Unless otherwise approved by FAA, advisory indications should be expressed as either "RH" or "RA" for radar/radio height or altitude, and as "BARO" for barometric altitude. Flight deck depiction of radio and barometric height or altitude advisories should not typically use the operational designations of "DH" or "MDA."**

**j.** Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided.

**k.** Automatic audio call-outs as described in paragraph 5.11 are recommended.

**l.** A suitable rain removal method is required for each pilot for Category II operations.

**m.** A demonstration of the suitability of any indications for non-normal configurations for which credit is sought (e.g., electrical configurations, hydraulic power).

**Figure 5.9.2-1**

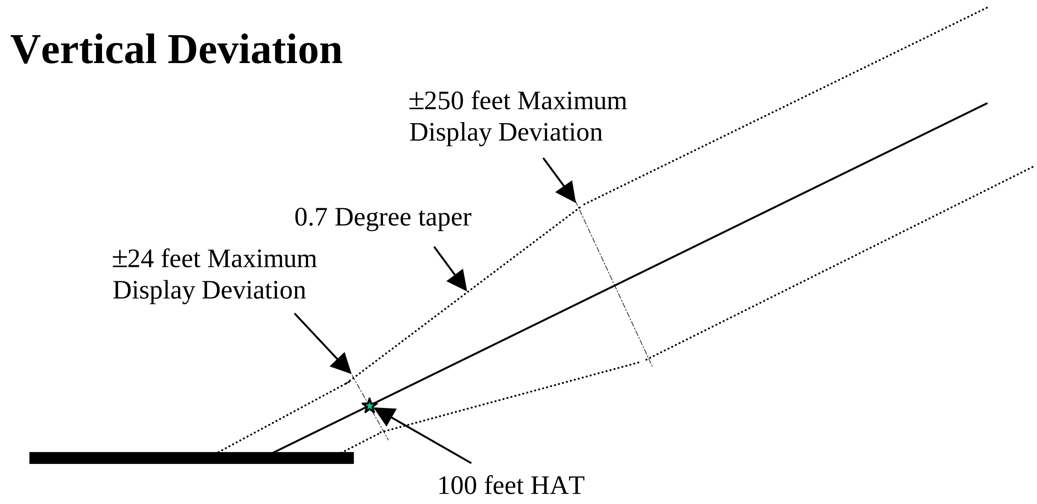
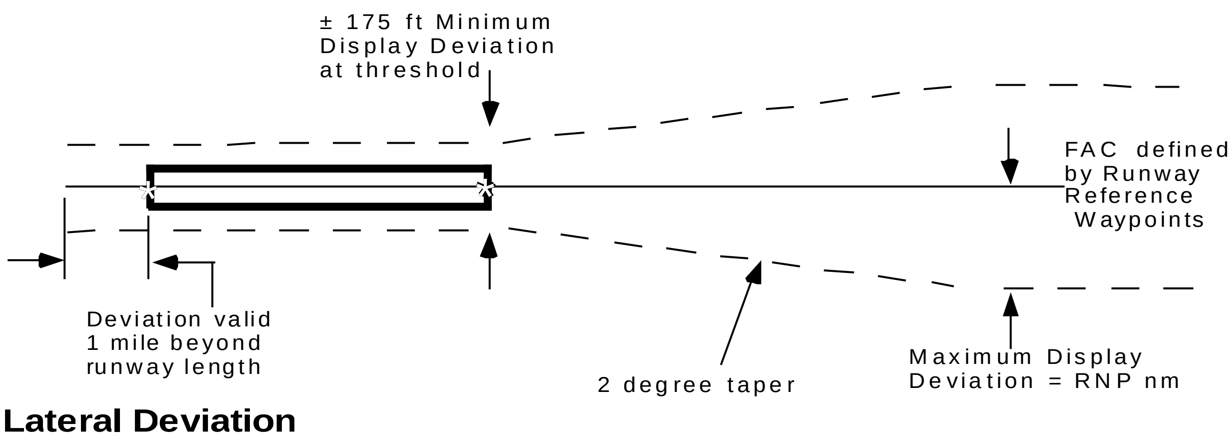



**Figure 5.9.2-2**



**5.10. Annunciations.** Annunciations must be clear, unambiguous, and appropriately related to the flight control mode in use. The mode annunciation labels should not be identified by landing minima classification. For example, APPROACH, LAND 2, LAND 3, Single Land, Dual Land, are acceptable mode annunciation labels, whereas, "Category II," "Category III," etc., should not be used. Aircraft previously demonstrated for Category I or II which do not meet this criteria may require additional operational constraints to ensure the correct use of minima suited to the aircraft configuration.

**5.11. Auto Aural Alerts.**

**a.** Automatic Aural Alerts (automatic call-outs, voice callouts, etc.) of radar altitude, or call-outs approaching landing minimums, or call-outs denoting landing minimums are recommended and should be consistent with the design philosophy of the aircraft in question. However, any automatic call-outs used should not be of a volume or frequency that interferes with necessary flightcrew communications or normal crew coordination procedures. Recommended automatic call-outs include a suitable alert or tone as follows:

**(1)** At 500 ft. (radar altitude), approaching minimums and at minimums, and

**(2)** Altitude call-outs during flare, such as at "50" ft., "30" ft. and "10" ft., or altitudes appropriate to aircraft flare characteristics.

**b.** Low altitude radio altitude call-outs, if used, should appropriately address the situation of higher than normal sink rate during flare, or an extended flare which may be progressing beyond the touchdown zone. Other alerts may be used when approved by the Administrator, if those alerts are consistent with that Operators approved procedures and minima, and do not impair crew communication.

**5.12. Navigation Sensors.**

**a.** Navigation sensors as noted in paragraph 4.3.7.1 through 4.3.7.4 and in 5.12.1 or 5.12.2 below may be used to support Category I or Category II Instrument Approach Procedures.

**b.** Navigation systems, procedures, sensors, or NAVAID signals cited in paragraphs 4.3.7.1 through 4.3.7.4 or in 5.12.1 or 5.12.2 may also use and take suitable credit for various forms of inertial or air data system capability when combined with capability of the sensors cited in the above provisions to improve accuracy, integrity, or availability performance (e.g., position or velocity complementary filtering, or Kalman filtering may be used, and appropriate credit taken for performance improvement).

**5.12.1. Navigation Sensors for (xLS) - ILS, GLS, or MLS.** For ILS, GLS, or MLS, various navigation sensors individually may be acceptable to support Category I or II operations. ILS localizer and glideslope signals are the primary means currently used for the determination of deviation from the desired path for lowest Category I or II operations. Criteria for acceptable ILS and MLS localizer and glide-slope receivers are included in Appendix 2 or 3 or in earlier acceptable criteria used by FAA for previous demonstrations of systems for Category I or II.

**a.** Other navigation information based upon GNSS, or SBAS/GBAS, may be used individually or in combination to satisfy the necessary accuracy, integrity, and availability for Category I or II. Navigation sensors other than ILS must meet equivalent ILS performance or appropriate RTCA or EUROCAE criteria for lowest Category I minima credit, unless otherwise authorized.

**b.** Appropriate marker beacon information, or equivalent, must be displayed to each pilot for the outer, middle and inner markers. The FAA may authorize appropriate substitutes for marker beacons for Category I or II based upon the use of suitable GNSS or SBAS/GBAS capabilities, or DME.

**c.** ADF capability, or equivalent capability, should be available as suitable for the planned route of flight or planned alternates (e.g., 14 CFR sections 91.205 (d)(2) and 121.349). For example, at least 1 ADF should be available for ILS procedures, unless the operator does not use ILS procedures with an NDB facility identified as an approach transition or missed approach NAVAID, or if the operator has available and uses an approved RNAV capability providing equivalent or better performance to that provided by ADF/NDB. RNP-qualified aircraft may be considered to be eligible for ADF/NDB waypoint substitution any time the area navigation system (e.g., FMS) is able to provide RNP.3 or better capability, for each applicable equivalent procedure segment, or for use of an equivalent NDB waypoint. Any other RNAV capability substitution for use of ADF/NDB for instrument procedures should be as determined to be acceptable for that operator by the CMO (e.g., GNSS system substitution IAWAIM provisions).

> **Note: PAR may also be considered to be acceptable for Category I (also see 4.3.4.1.c and 4.3.8.8).**

**5.12.2. Navigation Sensors for Approaches other than ILS, GLS, or MLS.** For approaches other than ILS, GLS, or MLS, the following sensors are considered to be acceptable for providing course guidance for Category I Operations (Note: Category II operations are not authorized exclusively using these sensors.):

- LOC
- LDA
- SDF
- BCRS
- RNAV (e.g., FMS)
- GPS
- VOR
- VOR/DME
- TACAN
- NDB
- NDB/DME
- Dual NDB
- ASR
- KRM (RMS)

**5.12.3. Aircraft Navigation Reference Points, Wheel to Eye Height, and Wheel to Navigation Reference Point Height.** To ensure suitable wheel height and clearance over the threshold of runways when following an electronic path (e.g., glideslope or VNAV) and when using visual references (e.g., VGSI/PAPI) aircraft manuals should specify and Operators should be aware of the height of the pilots eye reference point and the height of the navigation reference point (e.g., glideslope antenna) above the wheel path during landing. This is usually specific to each aircraft type. This information should be available to the operator and pilot, along with any guidance on the minimum acceptable runway threshold crossing height criteria for procedures, if applicable, and any constraints or recommendations for proper VGSI/PAPI use.

**5.12.4. Threshold Crossing Height (TCH).**

**a.** Typically, procedures are designated with vertical path runway threshold crossing height in the range of 50 to 55 ft. The maximum TCH for instrument approaches is usually limited to 60 ft. Unless otherwise accepted by FAA, aircraft should be able to use these standard facilities and any other facilities with a vertical path (glideslope or VNAV path) having a threshold crossing height specified as not less than 48 ft.

**b.** For operations on facilities where a threshold crossing height (glideslope or VNAV) is less than 48 ft., the operator and CHDO should consider the advisability of those operations on a case by case basis. Considerations should include any obstructions in the pre-threshold area, the amount the glideslope or VNAV path is below standard values, aircraft type and aircraft characteristics as proposed for the operation, whether the runway under-run area is a full load-bearing surface, placement of lighting aids (threshold lights/approach lights), availability, and suitability of VGSI/PAPI, weather minima to be used, and any other relevant factors.

**5.13. Supporting Systems and Capabilities.**

**5.13.1. Flight Deck Visibility.** Forward and side flight deck visibility for each pilot should be provided as follows:

**a.** The aircraft should have a suitable visual reference cockpit cutoff angle over the nose for the intended operations, at the intended approach speeds, and for the intended aircraft configurations, as applicable (e.g., flap settings);

**b.** The aircraft's flight deck forward and side windows should provide suitable visibility for taxi and ground operations in low visibility; and

**c.** Placement of any devices or structure in the pilot's visual field which could significantly affect the pilot's view for low visibility operations must be acceptable (e.g., HUD drive electronics, sun visor function or mountings).

**5.13.2. Rain and Ice Removal.**

**a.** Suitable windshield rain removal, ice protection, or defog capability should be provided as specified below:

**(1)** Installation of rain removal capability is recommended for Category I and required for Category II (e.g., windshield wipers, windshield bleed air).

**(2)** Installation of use of windshield hydrophobic coatings, or use of equivalent rain repellent systems which meet pertinent environmental standards are recommended.

**(3)** Installation of suitable windshield anti-ice or de-ice capability is recommended for Category I and required for Category II for aircraft intended to operate in known icing conditions during approach and landing.

**(4)** Installation of at least suitable forward windshield defog capability is recommended for aircraft subject to obscuration of the pilot's view during humid conditions.

**b.** Aircraft subject to obscuration of the windshield due to rain, ice, or fogging of the pilot's view which do not have protection, or which do not have adequate protection may require operational limitations on the conditions in which low visibility operations are conducted.

**5.13.3. Miscellaneous Systems.** Other supporting systems including instruments, radar altimeters, air data computers, inertial reference units, instrument switching, or capabilities such as flight deck night lighting, landing lights and taxi lights, position, turnoff, and recognition lights, flight data recorders, cockpit voice recorders, or other low visibility related aircraft systems must meet any appropriate criteria as specified in Appendix 2 or 3, in basic airworthiness requirements applicable to U.S. certificated aircraft or equivalent, or acceptable earlier criteria authorized by FAA for aircraft previously demonstrated to be acceptable for Category I or Category II operation (See paragraphs 5.20 and 5.21 for GPWS, TAWS and FDR provisions).

**5.14. Go-Around Capability.**

**a.** For aircraft authorized for instrument approaches, and particularly for aircraft intended for operation to Category II minima, evaluation of go-around capability should be based on both normal and any specified non-normal operations, down to the lowest minima expected. Assessment should account for factors related to aircraft geometric limitations (e.g., fuselage attitude and potential for tail strike) during the transition to go around, limited visual cues, autoflight system mode switching if applicable, and any other pertinent factors identified by FAA. For aircraft in which a go-around from a very low altitude may result in an inadvertent touchdown, the safety of such a procedure should be established considering its effect on related systems, such as operation of autospoilers, automatic braking systems, autopilot/flight director mode switching, autothrottle operation and mode switching, reverse thrust initiation and other systems associated with, or affected by, a low altitude go-around.

**b.** If an automatic or flight director go-around capability is provided, it should be demonstrated that a go-around can be safely initiated and completed from any altitude to touchdown. If an automatic go-around mode can be engaged at or after touchdown, it should be shown to be safe. The ability to initiate an automatic or flight director go-around at or after touchdown is not required or appropriate. Inadvertent selection of go-around after touchdown (either an automatic or flight director go-around capability) should have no adverse effect on the ability of the aircraft to safely rollout and stop.

**c.** Regardless of the flight guidance system used, availability of appropriate information to safely go-around should be available to the flightcrew, and the aircraft should have the capability to go-around. The go-around must be able to be initiated at any time during the approach to touchdown. Although flight guidance system go-around capability is not required, if such go-around capability is supported by a flight guidance system, that capability should be able to be selected at any time during the approach to touchdown. If a go-around mode of a flight guidance system is activated at a low altitude where the aircraft inadvertently touches the ground, the flightcrew should have access to adequate information to accomplish a safe go around, and the aircraft or flight guidance system should not exhibit any unsafe characteristic as a result of an inadvertent touchdown.

**d.** The following factors should typically be considered when evaluating the safety of a go-around from any point in the approach before touchdown:

**(1)** Go-around capability should address normal operating conditions, and may include specified non-normal conditions (e.g., engine out) down to the lowest expected operating minimum.

**(2)** Factors related to any geometric limitations (such as tail strike) or configuration changes (such as flap retraction, or allowing for any necessary acceleration segment) of the aircraft during the transition to a go-around should be considered.

**(3)** Factors such as the autopilot, flight director, or autothrottle mode switching or automatic disconnect, minimizing altitude loss during transition to a go-around, and addressing any adverse consequences that might result from autopilot, flight director, or autothrottle malfunction should be considered.

**(4)** If a go-around could result in an inadvertent touchdown, the safety of such an event should be considered. The aircraft design and/or procedures used should accommodate relevant factors. Examples of relevant factors to consider include operation and acceleration characteristics of engines, failure of an engine, the operation of autothrottle, autobrakes, auto-spoilers, autopilot/flight director mode switching, and other systems (e.g., ground sensing logic) which could be adversely affected by an inadvertent touchdown.

**(5)** If the occurrence of any failure condition in the aircraft or its associated equipment could preclude a safe go-around from low altitude, then such failure conditions should be identified. In such a case, a minimum height may be specified from which a safe go-around was demonstrated if the failure occurs. If the failure occurs below the specified height, pilots should be made aware of appropriate procedures to be used, and the effects or consequences of any attempt to go-around.

**e.** If necessary, information should be provided to the flightcrew concerning appropriate procedures for low altitude go-around. If the ability to conduct approach and landing operations with an engine inoperative using low minima are intended (e.g., minima below an MDA(H) or DA(H) of approximately 250 ft. HAT), or if procedures for an engine failure during a low altitude go-around require special consideration or are significantly different than for any other go-around, then flightcrew procedures to safely conduct such an engine-out go-around should be addressed. If necessary, suitable information to safely conduct such a low altitude go-around should be provided to the flightcrew (e.g., flap configurations and flap retraction procedures, appropriate acceleration to a suitable go-around speed, appropriate use of auto-feather capability).

**5.15. Excessive Deviation Alerting.** Some method is recommended for being able to detect excessive deviation of the aircraft laterally and vertically during approach, and laterally during rollout, as applicable. The method used should not require excessive workload or undue attention. This provision does not require a specified deviation warning method or annunciation, but may be addressed by parameters displayed on the ADI, EADI, or PFD. When a dedicated deviation warning is provided, its use must not cause excessive nuisance alerts.

**5.16. Rollout Deceleration Systems or Procedures for Category I or II.**

**5.16.1. Stopping Means.** A means to determine that an aircraft can be reliably stopped within the available length of the runway, considering ambient conditions, is recommended for any operation.

**5.16.2. Antiskid Systems.** Unless otherwise specified by FAA, aircraft authorized for Category I or Category II do not have specific antiskid system installation or use requirements beyond those specified in the applicable AFM, applicable FAA MMEL and MEL, and applicable field length operating rules.

**5.17. Engine Inoperative Category II Capability.** The following criteria are applicable to aircraft systems intended to qualify for "engine inoperative Category II" authorizations. Aircraft demonstrated to meet the provisions of Appendix 2 with an "engine inoperative" and have an appropriate reference to engine inoperative Category II capability in the FAA approved AFM are typically considered to meet the provisions listed below. Other aircraft which have an AFM showing only all-engine Category II capability may be operationally demonstrated for engine inoperative Category II capability IAW paragraph 5.19.1 through 5.19.3 and paragraph 10.5.

**a.** The AFM or equivalent reference (e.g., Operators manual) must suitably describe demonstrated approach and missed approach performance for the engine inoperative configuration, and the aircraft must meet pertinent criteria otherwise required for all-engine Category II or equivalent criteria. Suitable performance information should also be available to the pilot and, if applicable, the aircraft dispatcher, to ensure safe landing capability in the anticipated configuration and with anticipated speeds, and to establish safe go-around capability from DA(H) and, if applicable, for a balked landing from the TDZ (e.g., equivalent to an obstacle clearance takeoff procedure). When assessing engine out Category II capability, the following exceptions to all-engine Category II criteria may be used:

**(1)** The effects of a second engine failure when conducting Category II operations with an engine inoperative need not be considered,

**(2)** Crew intervention to re-trim the aircraft to address thrust asymmetry following engine loss may be permitted,

**(3)** Alternate electrical and hydraulic system redundancy provisions may be acceptable, as suited to the type design (e.g., bus isolation and electrical generator remaining capability must be suitable for the engine out configuration),

**(4)** Requirements to show acceptable approach performance may be limited to demonstration of acceptable performance during engine-out flight demonstrations (e.g., a safe approach to minima), and

**(5)** Approach or Landing system "status" should accurately reflect the aircraft configuration and capability.

**b.** Suitable information about flight guidance system capability must be available to the flightcrew in flight, particularly at the time of a "continuation to destination" or "diversion to alternate" decision. This is to determine that the aircraft can have an appropriate Category II approach capability when the approach is initiated (e.g., Non-normal checklist specification of expected configuration during approach, autopilot or flight director status annunciation of expected mode capability).

**c.** The operator should consider system performance in appropriate weather conditions (e.g., winds, turbulence or wind gradients) to make a determination as to whether any weather related restrictions or limitations are appropriate.

**5.18. Special Airports with Irregular Pre-Threshold Terrain.** Not withstanding the fact that most aircraft systems that have completed airworthiness demonstrations consider irregular terrain in the pre-threshold area, special operational evaluations are nonetheless appropriate for certain airports having difficult pre-threshold terrain conditions. These special evaluations consider each particular aircraft type, the particular flight control system, and may include consideration of particular system elements such as the type of radar altimeters installed or other equipment. The need for such a special evaluation of a part 97 instrument approach procedure is identified by FAA order 8400.8, Procedures for Approval of Facilities for FAR Part 121 & Part 135 CAT III Operations. Criteria for the evaluation of irregular Pre-threshold terrain airports is contained in FAA Appendix 8 of AC 120-28D. Criteria for approval of Operators or procedures regarding operations at runways with irregular Pre-threshold terrain are addressed in paragraphs 6.2.5 and 10.7.

**5.19. Airborne System Evaluation and Approval.** Category I and Category II airborne systems may be IAW the applicable airworthiness criteria contained in Appendix 2 or 3 during type certification or STC approval, or they may be evaluated in conjunction with a FAA-approved program with an air carrier. To be acceptable for Category I or II landing minima, the airborne equipment should meet the criteria in Appendix 2 or 3 of this AC and be able to conduct Category I or II operations IAW the operational concepts discussed in Paragraph 4 above. However, if a determination of compliance with Appendix 2 or 3 has not been made, airborne equipment which is shown to meet the operational demonstration criteria in the applicable subparagraphs below may also be acceptable for Category I (e.g., RNP Operations) or Category II landing minima if it is demonstrated that this equipment permits safe Category I or II operations, as applicable, IAW the operational concepts discussed in Paragraph 4 above.

**5.19.1. "Operator Use Suitability" Demonstrations - Applicability.** The following criteria in paragraphs 5.19.2 through 5.19.3 (also see paragraph 10.5) apply to applicants desiring airborne equipment approval for those systems which do not have a statement in the approved airplane flight manual which indicates that the equipment meets the relevant performance standards of this AC, previous editions of this AC, or equivalent criteria (e.g., either for Category I such as applicable to FTE demonstrations for RNP, or for Category II). The criteria of paragraphs 5.19.2 and 5.19.3 are not intended to apply to those aircraft types or variants which already include a statement in the approved airplane flight manual indicating that the airborne flight guidance system was evaluated IAW criteria of this AC.

**5.19.2. Airborne Equipment Operational Validation.** The applicant should provide an acceptable test and evaluation plan which establishes satisfactory performance of the flight guidance system for either the Category I or Category II operations intended, as applicable. To be acceptable, the applicant should conduct an appropriate number of approaches and missed approaches, or other applicable operations, for representative instrument procedures to be flown. For such assessments under this provision, an applicant may be considered to be an operator, a group of Operators, or an aircraft manufacturer or avionics manufacturer in conjunction with one or more Operators. An aircraft manufacturer or avionics manufacturer seeking to demonstrate alternate levels of FTE without involvement of an operator would normally be expected to do so as part of a TC or STC process, IAW criteria of an Appendix of this AC.

**5.19.2.1. Category II Assessments.** For Category II, the applicant should typically be expected to perform at least 300 successful approaches to appropriate Category II DA(H) minima, in each aircraft type intended. The 300 approaches may be allocated to several variants within a type if the flight guidance systems used by each variant are the same or similar. If a related or similar aircraft type is configured with the same or a similar flight guidance system and is already approved for Category II, or for special case consideration such as consideration of an engine inoperative Category II approach, the number of approaches for a particular type or variant may be reduced by an appropriate amount depending on the degree of system similarity, flight guidance performance similarity, or aircraft similarity, as determined appropriate by the CMO, AEG, or AFS-400. Approaches may be accomplished in line operations, during training flights, or during specific demonstration flights, or in any combination. Not less than ninety percent of the total demonstrated approaches conducted should be successful. No unsafe approaches or missed approaches should occur. (See 5.19.3.3 for a definition of a successful approach). Approaches should be accomplished IAW the following criteria:

**a.** A minimum of three facilities/runways should be used during the demonstrations, unless Category II operations will be conducted only at fewer than 3 facilities by that operator. At least 10 percent of the total number of approaches should be conducted on each of at least three of the facilities selected. The number of approaches conducted on additional facilities may be at the applicant's discretion.

**b.** At least some approaches should be accomplished using facilities approved for Category II or Category III Procedures. However, at the applicant's option, demonstration may be made using facilities used only for Category I Procedures.

**c.** No more than 15 approaches per day should be conducted on a single facility.

**d.** No more than 60 percent of the approaches should be conducted in any single aircraft, unless the operator has 3 or fewer aircraft to be evaluated, and performance of the other aircraft may be considered to be equivalent.

**e.** Where an applicant has different variants of a type aircraft which utilize the same or similar flight guidance system, the applicant should ensure that each of the variants can meet the necessary performance criteria.

**f.** If flight director performance is to be assessed, a representative number of pilots should be used to conduct the necessary approaches. No single pilot should perform more than 20 percent of the approaches, unless a small total number of pilots assigned to the aircraft type requires the use of a greater percentage.

**g.** An acceptable sample of the approaches conducted should be observed by an FAA Aviation Safety Inspector or other suitably qualified evaluator(s) (e.g., a check airman representatives of the operator, an APD or equivalent, or representatives from the aircraft or avionics manufacturer), as determined acceptable by FAA.

**5.19.2.2. Flight Technical Error (FTE) Assessments.** Flight Technical Error (FTE) assessments for approach or missed approach, or other defined operations, may be made by an aircraft manufacturer, an avionics manufacturer, or an operator to establish alternate levels of expected FTE to be used for navigation system or procedure authorization. Alternate levels of FTE may then be applied to instrument procedure development or authorization, in lieu of standard assumed FTE values, when the assumptions or conditions of the alternate FTE levels can be met or satisfied.

**a.** FTE levels may be established by analysis (e.g., of existing data), by simulation (e.g., in a suitable flight training simulator), through flight verification (e.g., data collected from flight demonstration(s) with an appropriately configured aircraft), or in any combination of these methods. Regardless of the method(s) used, sufficient assessment should take place to ensure that any resulting FTE information or values are valid for the navigation conditions or procedures to which they are to be applied. The assessment should key to types of procedures to be flown, appropriately consider normal, non-normal and rare normal operations, should address pilot capability or system variability to the extent necessary, and should have sufficient repeatability to have confidence in the FTE level(s) that result.

**b.** Any FTE assessment related exceptions to industry criteria found in sources such as RTCA DO-236 for RNP should be clearly identified, if necessary (e.g., navigation systems for which 22nm constant radius turns are not intended to be applicable).

**5.19.3. Data Collection and Analysis for an Airborne System Evaluation.**

**5.19.3.1. FTE Data Collection and Analysis.** For an FTE assessment demonstration, sufficient data should be collected to establish the suitability of the levels of FTE sought. The data collection and consequent analysis should match and at least consider the types of procedures to be flown (e.g., representative leg types and leg geometry), aircraft configurations to be used (e.g., map display, flight director, autopilot), representative environmental conditions, pertinent normal or non-normal conditions, and representative pilot qualification and experience. Data collection may be from a dedicated FTE assessment, or from data collected during line operations, if appropriate conditions are experienced (e.g., weather) and assumptions satisfied (e.g., pilot sample variability). FTE data collection and analysis may separately address flight on stabilized portions of straight segments, and flight during curved segments or during leg to leg captures. Use of statistical methods for analysis of data is acceptable, but is not necessarily required (e.g., for treatment of certain rare normal or non-normal conditions). The analysis methods or techniques to be used by the applicant and any demonstration program to be used should be determined to be acceptable to FAA prior to commencement of the FTE assessment program.

**5.19.3.2. Data Collection for a Category II Demonstration.** For a Category II system suitability demonstration, each applicant or designated representative should provide the information listed below, as necessary and as requested by the CHDO. This information should be related to performance of the airborne flight guidance system and display system regardless of whether an attempted approach demonstration is successful, unsuccessful, or discontinued. The information, along with recommendations and any clarifying information regarding unsuccessful or discontinued approaches should be provided to the FAA CHDO:

**a.** Specify the total number of approaches attempted, the number of successful approaches, and the number of and reasons for unsuccessful or discontinued approaches, if known.

**b.** If an approach is discontinued, specify the height above the runway at which the approach was discontinued.

**c.** Specify the acceptability of lateral position, vertical position, track, vertical path/vertical speed, speed error, and pitch trim acceptability at 200 ft. HAT, 100 ft. HAT or at DA(H), and note if the approach was in any way inconsistent with continuing an approach to a normal landing within the touchdown zone.

**d.** Specify the NAVAIDs and runway facilities used and the reported weather and wind conditions in which the assessment was conducted.

**e.** Evaluate the tracking performance stability, and suitability of the flight director or autopilot, as applicable, for the intended operation.

**f.** If not otherwise based on data recording, the evaluator(s) should note and record the lateral and vertical position of the airplane relative to the localizer and glide slope at least at the 200 ft. HAT, 100 ft. HAT or at DA(H), and the estimated runway touchdown point achieved consistent with following the flight guidance system, as applicable to the system used.

**g.** If unable to initiate an approach due to a deficiency in the airborne equipment, note the reason for the deficiency and any recommendation for addressing the deficiency.

**h.** Provide any other relevant associated recommendations or circumstances.

**NOTE: Unsuccessful approaches attributed solely to Air Traffic Service (ATS) circumstances may be excluded from the data (e.g., flights vectored too close to a final fix or at large angles preventing adequate localizer and glide slope capture; termination of an approach at the request of an Air Traffic Facility or due to an amended air traffic clearance; evidence of inappropriate ILS critical area protection). Also, unsuccessful approaches may be excluded from consideration due to faulty NAVAID or non-aircraft sensor signals. Airborne system failures attributed to maintenance failures or maintenance factors should be documented for subsequent joint resolution by FAA and the operator.**

**5.19.3.3. Definition of a Successful Approach for a Category II Demonstration.** For the purpose for the airborne system suitability demonstration for Category II, a successful approach is one in which, at least at the 100 ft. HAT point or DA(H), through touchdown, meets the following criteria:

**a.** The airplane is continuously in a position to complete a normal landing using normal maneuvering. Typically this is considered to require that below 200 ft. HAT the flight deck is positioned within and is tracking to remain within, the lateral confines of the extended runway.

**b.** The deviation from glide slope does not exceed ± 75 microamps (1/2 scale) as displayed on the ILS, MLS, GLS, or equivalent system/indicator at least down to the DA(H). Below the DA(H) a normal approach path is followed and a normal flare occurs, with a landing safely within the touchdown zone at normal sink rates and attitudes.

**c.** The indicated airspeed, track, vertical speed, alignment, and heading are satisfactory. Indicated air speed does not exceed ± 5 knots of planned approach airspeed but may not be less than computed threshold or reference speed.

**d.** No unusual maneuvers or excessive attitude changes or attitude rates occur.

**e.** The airplane is generally in trim so as to preclude any excessive control forces.

**5.20. Ground Proximity Warning System (GPWS) or Terrain Awareness Warning System (TAWS) Interface.** Airborne equipment used for approach should have appropriate interfaces with or compatibility with GPWS and TAWS. This is to ensure nuisance free operation at routine airports. Special procedures may be used for non-normal procedures or at airports with unusually difficult underlying terrain, or other such factors.

**5.21. Flight Data Recorder (FDR) Interface.** Airborne equipment used for approach should have appropriate interfaces with or compatibility with flight data recorders, and if applicable cockpit voice recorders (e.g., alerting audio audibility on CVR).

**5.22. Takeoff, or Dispatch, with Inoperative Navigation Receivers, Instruments, or Displays for Category I or II.** Notwithstanding the airborne equipment installation provisions of paragraphs 5.2 and 5.3 above, and IAW any other FAA applicable MMEL and MEL provisions (e.g., as specified by the FAA FOEB or FSB for the type), a pilot may depart or an operator may dispatch an aircraft for Category I or Category II using the following guidelines (e.g., the operator may address MEL provisions stating "As required by the CFR," or equivalent provisions, as shown below):

**5.22.1. Inoperative System Departure or Dispatch for Category I.** For departure, or dispatch for Category I, if applicable, two navigation receivers are typically required, with each suitable for the route of flight and expected approaches to be conducted (e.g., dual ILS, if flying a route based on expected use of ILS for landing).

**a.** If the flight is based on use of a planned approach procedure that specifically requires dual navigation capability (e.g., /E required, or dual NDB required, or dual VOR required) then two pertinent systems are required for takeoff or dispatch.

**b.** If an approach procedure planned for use is not precluded from being conducted using one navigation source (e.g., one NDB, one FMS, one ILS), a minimum of one navigation receiver, or equivalent, of each type required for the intended flight is required. That navigation receiver's indication, or equivalent, should be able to be displayed at or be visible to each required pilot station, for each type of facility(s) intended for landing. Use of this provision requires considering subsequent failure of the one system intended for use (e.g., the ILS) and the need to be able to safely use any alternate remaining navigation system(s) (e.g., VOR or RNAV) while enroute, during approach, or during missed approach. In any instance, after the first failure in flight, there must still be another suitable navigation capability available to the aircraft to safely land. The other navigation capability required above may be based on use of a different NAVAID type, use of acceptable RNAV capability, or use of an alternate airport with the same or a different type of instrument procedure.

**c.** Instruments, or displays, or display elements may be inoperative if, considering the remaining instruments or displays, each pilot can accomplish that pilot's respective assigned crew duties for flying and monitoring the flight (e.g., failure of an ILS raw data display on the F/O's ADI or PFD may be permissible if that information or equivalent is available by other acceptable means - such as by using the F/O's HSI LOC or ND LOC indication in lieu of the ADI LOC indication). When considering inoperative component(s), subsequent failure of any single additional instrument, or display, or display component must not put the aircraft or crew in an unsafe situation for which the pilots cannot safely compensate (e.g., it is determined to be acceptable in the above example that after a subsequent failure the F/O will be able to acceptably monitor the Captain's corresponding instruments, or standby instruments).

**5.22.2. Inoperative System Departure or Dispatch For Category II.** For departure, or dispatch, for Category II, a minimum of two LOC or GLS navigation receivers of each type to be used are normally required for Category II. The receiver's indications to be used should be able to be independently displayed at or be visible to each respective pilot station, for each type of facility(s) intended for landing (e.g., ILS, MLS, or GLS). For ILS glide slope, only one receiver need be operative for departure or dispatch, if that receiver is a self monitored receiver with reliable failure indication, if the receiver information can be displayed at each pilots station, and if any other systems required for the Category II minima do not depend on having dual glideslope capability available (e.g., autoland, alerting and warning or monitoring systems).

**a.** Use of the "departure or dispatch with a single glideslope receiver" provision requires considering subsequent failure of the one GS system intended for use while enroute or on approach, and the need to be able to safely use alternate remaining navigation system(s) to safely land, after failure of the glideslope receiver in flight.

**b.** Instruments and displays provisions are the same as for Category I, except that at least one operative radar altimeter must be provided, and that one radar altimeter must at least be able to be displayed at each pilot station, or be easily visible to each pilot station.

**NOTE: For Category II minima, if minima are intended to be based on use of an Inner Marker in lieu of a radar altimeter(s), and if the operator is not otherwise precluded from using the Inner Marker as a means to establish Category II minima, the radar altimeter need not be operative for takeoff or dispatch for purposes of establishing landing minima (e.g., for DA(H)). This provision does not address other MMEL/MEL provisions that may otherwise independently apply to radar altimeter availability, however, such as for appropriate GPWS function.**

**c.** In addition to instruments and displays for Category II, there must be acceptable ice and rain removal protection available for the expected conditions during approach (e.g., windshield anti-ice for icing conditions, windshield wipers or equivalent for rain).

**5.22.3. Inoperative System Departure or Dispatch for Either Category I or Category II.**

**a.** For departure or dispatch for either Category I or II, for EFIS aircraft that have capability to switch entire display formats to different flight deck display locations, these systems typically may be dispatched with an inoperative display or with displays in alternate locations. For an alternate location, each pilot must be able to acceptably perform respective PF or PNF duties for approach and missed approach. Following failure of an additional display or display in an alternate position, the aircraft must still be able to be safely flown and landed using available instrument approach NAVAID capability and remaining displays.

**b.** Operators should ensure that planned operations consider any pertinent AFM or FCOM provisions for flight guidance system use that may relate to inoperative components (e.g., altimeter source, navigation source, or instrument source switching, and available flight director or autopilot modes, as applicable).

**5.23. Continuation of Flight after Navigation System Failure Enroute, or During Approach for Category I or II.** Notwithstanding the airborne equipment installation provisions of paragraphs 5.2 and 5.3 above, MMEL and MEL provisions of paragraphs 5.22 above, and any other FAA applicable FSB provisions for the type aircraft, a pilot may continue enroute or initiate an approach to Category I or Category II minima using the following guidelines of 5.23.1 through 5.23.3.

**5.23.1. Continuation of a Flight After Failures For Category I.**

**a.** The operator should establish a policy addressing typical failure conditions for which initiation or continuation of an approach in low visibility conditions is considered acceptable (e.g., failure of a single flight director, FCC, or instrument, for which switching to an alternate or common source still provides adequate information). Operators should also describe typical conditions for which the operator would expect that a pilot would divert to a different airport with better weather conditions, if possible (e.g., for complex engine or hydraulic failures where flight guidance or go-around performance may be significantly degraded).

**b.** Unless dual capability is specifically required for a particular procedure (e.g., /E required, dual NDB required), for initiation or continuation of approach, a minimum of at least one navigation receiver or sensor of each type required for the intended approach procedure is required. If an approach is initiated with only one receiver or sensor, the pilot should, to the extent possible, consider the potential consequence of subsequent failure of that system or sensor.

**5.23.2. Continuation of a Flight after Failures For Category II.** For continuation enroute or initiation of an approach, a minimum of one LOC or GLS navigation receiver of each type to be used is normally required for initiation or continuation of Category II approach. The receiver's displacement indications, if applicable, should, however, be able to be independently displayed at or be visible to each respective pilot station, for each type of facility(s) intended for landing (e.g., ILS, MLS, or GLS). For ILS glide slope, only one receiver need be operative for approach if the receiver information can be displayed at each pilot's station, and if any other systems required for the Category II minima do not depend on having dual glideslope capability available (e.g., autoland, alerting and warning or monitoring systems).

**a.** Instruments and displays provisions are the same as for Category I, except that at least one operative radar altimeter must be provided, and that one radar altimeter must at least be able to be displayed at each pilot station, or be easily visible to each pilot station.

> **NOTE: For Category II minima, if minima are intended to be based on use of an Inner Marker in lieu of a radar altimeter(s), and if the aircraft and crew are not otherwise precluded from using the Inner Marker as a means to establish Category II minima, the radar altimeter need not be operative for approach, for purposes of establishing landing minima (e.g., for DA(H)).**

**b.** In addition to suitable instruments and displays, there must be acceptable ice and rain removal protection available for the expected conditions during approach (e.g., windshield anti-ice for icing conditions, windshield wipers or equivalent for rain).

**5.23.3. Continuation of a Flight after Failures for either Category I or Category II.** If a flight is to be continued to destination and the originally planned instrument approach procedure(s) (IAP) used after a failure enroute, or if an approach is to be continued, the pilot should consider the consequence to and alternatives available for the flight if remaining navigation receiver or sensor capability should subsequently fail.

**a.** For EFIS aircraft that have capability to switch entire display formats to different flight deck display locations following a failure, these systems typically may be switched to an operative display, or display in an alternate location. For a failed display or an alternate location, each pilot must be able to acceptably perform respective PF or PNF duties for approach and missed approach. Following failure of an additional display or display in an alternate position, the aircraft must still be able to be safely flown and landed using available instrument approach NAVAID capability and remaining displays.

**b.** Pilots should ensure that planned operations consider any pertinent AFM or FCOM provisions for flight guidance system use that may relate to inoperative components (e.g., altimeter source, navigation source, or instrument source switching, and available flight director or autopilot modes, as applicable).

**c.** A pilot exercising emergency authority may deviate from the above or any other provisions of this AC to the extent necessary to ensure safe flight and landing.

**6. PROCEDURES.**

**6.1. Operational Procedures.** Appropriate operational procedures based on the approved operator program should be addressed. Operational procedures should consider the pilot qualification and training program, airplane flight manual (AFM), crew coordination, monitoring, appropriate takeoff and landing minima including specification of either a DA(H) or MDA(H), as applicable, for landing, crew call-outs, and assurance of appropriate aircraft configurations. Suitable operational procedures must be implemented by the operator and be used by flightcrews prior to conducting low visibility Category I or II landing operations.

**6.1.1. AFM Provisions.** The operator's procedures for low visibility takeoff or Category I or II landing should be consistent with AFM provisions specified during airworthiness demonstrations. Adjustments of AFM procedures consistent with operator requirements are permitted when approved by the POI. Operators should ensure that no adjustments to procedures are made which invalidate the applicability of the original airworthiness demonstration.

**6.1.2. Crew Coordination.** Appropriate procedures for crew coordination should be established so that each flight crewmember can carry out their assigned responsibilities. Briefings prior to the applicable takeoff or approach should be specified to ensure appropriate and necessary crew communications. Responsibilities and assignment of tasks should be clearly understood by crewmembers. Tasks should be accomplished consistent with the operator's specified provisions for the aircraft type or variant and each crewmember position unless otherwise approved by the POI (duties of each pilot, monitored approach, etc.).

**6.1.3. Monitoring.** Operators should establish appropriate monitoring procedures for each type of low visibility approach, landing, and missed approach. Procedures should ensure that adequate crew attention can be devoted to control of aircraft flight path, displacements from intended path, mode annunciations, failure annunciations and warnings, and adherence to minima requirements associated with DA(H) or MDA(H).

**a.** In the event that a "monitored approach" is used, (e.g., where the first officer is responsible for control of the aircraft flight path by monitoring of the automatic flight system) appropriate procedures should be established for transfer of control to the pilot who will be making the decision for continuation of the landing at or prior to DA(H) or MDA(H).

**b.** Monitoring procedures should not require a transfer of responsibility or transfer of control at a time that could interfere with safe landing of the aircraft. Procedures for calling out failure conditions should be pre-established, and responsibility for alerting other flight crewmembers to a failure condition should be clearly identified.

**6.1.4. Use of the DA(H) and MDA(H).** Decision Altitude (Height) is used for Category I and II operations. Decision Altitude (Height) is used when vertical path guidance is available (e.g., ILS, GLS, MLS, VNAV). Decision Altitude (DA) is used for barometrically determined altitude minima (MSL), typically associated with Category I procedures where vertical guidance is available. If specifically authorized by FAA (rare uses) a DA may in some circumstances be used for Category II.

**a.** Decision Height (DH) is used for Category II operations, except where use of an Inner Marker is authorized in lieu of a DH, or where a DA is authorized (rare use).

**b.** When DAs or DHs are specified, procedures for setting various reference bugs in the cockpit should be clearly identified, responsibilities for DA or DH call-outs should be clearly defined, and visual reference requirements necessary at DA or DH should be clearly specified, so that flightcrews are aware of the necessary visual references that must be established by and maintained after passing DA or DH.

**c.** MDA(H) is typically used for procedures that do not have vertical path guidance (e.g., VOR, NDB, 2D-RNAV, Circling). U.S. Operators are authorized to use MDA. MDH may be used internationally by non-US Operators, and U.S. Operators may need to be aware of its existence and use when operating to international locations even though U.S. Operators are not typically authorized to use MDH. Any request for use of MDH must be coordinated with AFS-400. Also the "height element (H)", used with MDA(H), provides an advisory value for RA relative to the airport or TDZ elevation, and may be used for situation awareness, even if not used to actually define minima. Caution should be noted however, since irregular terrain in the vicinity of the airport may result in observed RA values that are significantly different than expected height (H) derived from the published procedure when not over or near the airport surface.

**d.** Procedures should be specified for call-out of the DA, DH, or MDA(H).

**e.** Procedures should be specified for conversion of the DA or DH to an MDA(H) in the event that the aircraft reverts from or loses vertical path guidance. However, any adjustments to approach minima or procedures made on final approach should be completed at a safe altitude (e.g., above 1000 ft. HAT).

**f.** Any use of QFE procedures for DA or DH for Operators that are not already so authorized (applicable to either Category I or II, whether inside the United States or outside the United States) must be specifically approved by the CHDO, after coordination with AFS-400.

**g.** For Category II, the operator should ensure that at each runway intended for Category II operations, the radar altimeter systems used to define DH provides consistent, reliable, and appropriate readings for determination of DH. In the event of irregular terrain underlying the approach path an alternate method should be used. DH may be based on other means (e.g., inner marker) when specifically approved by FAA.

**6.1.5. Callouts.** Altitude/Height callouts should be developed, implemented, and used for Category I and Category II operations. When more than one Category of operation is used (e.g., Category I or II) callouts should be compatible, consistent, and preferably common to as many Categories of Operation as practicable.

**a.** Callouts may be accomplished by the flightcrew or may be automatic (e.g., using synthetic voice call-outs or a tone system). Typical call-outs acceptable for Category I or Category II include the following:

- "1000 ft." above the touchdown zone,
- "500 ft." above the touchdown zone,
- "approaching minimums,"
- "at minimums," as applicable,
- any pertinent visual reference(s) observed, and resulting crew action, as applicable (e.g., "runway in sight,... landing"),
- key altitudes during flare, (e.g., 50, 30, 10) or AFGS mode transitions (e.g., flare, rollout), and
- as appropriate, auto spoiler, reverse thrust deployment and autobrake disconnect.

**b.** Combinations of these calls may also be used as appropriate. In any event, the calls made by the flightcrew should not conflict with the automatic systems or auto call-outs of the aircraft, and conversely the configuration selected for the aircraft should not conflict with expected call-outs to be made by the flightcrew. Compatibility between the automatic call-outs and the crew call-outs must be ensured. The number of call-outs made automatically, manually or in combination should not be so frequent as to interfere with necessary crew communication for abnormal events.

**c.** Also, call-outs should be specified to address any non-normal configurations, mode switches, failed modes, or other failures that could affect safe flight, continuation of the landing, or the accomplishment of a safe missed approach. Any use of crew initiated call-outs at altitudes below 100 ft. during flare should ensure that the call-outs do not require undue concentration of the non-flying pilot on reading of the radar altimeter rather than monitoring the overall configuration of the aircraft, mode switching, and annunciations. Automatic altitude call-outs or tones are recommended for altitude awareness, at least at and after passing DA(H) or MDA(H).

**6.1.6. Configurations.**

**a.** Operational procedures should accommodate any authorized aircraft configurations that might be required for Category I or Category II approaches or missed approaches. Examples of operational procedures that an operator may need to accommodate include:

**(1)** Alternate flap settings,

**(2)** Use of alternate AFGS modes or configurations (e.g., with or without autopilot(s) or flight director(s), autoland, HUD),

**(3)** Inoperative equipment provisions related to engine(s) inoperative, or the minimum equipment list, such as a non-availability of certain, inoperative instruments (e.g., PFD, radar altimeter), air data computers, hydraulic systems or instrument switching system components,

**(4)** Availability and use of various electrical system components (e.g., generator(s) inoperative), alternate electrical power sources (e.g., APU) if required as a standby source, and

**(5)** If applicable, describing the relationship of approach minima to any decision or commit points for critical aircraft configurations that are identified by the operator (e.g., two engines inoperative procedures for three or four engine aircraft, or abnormal flight control configuration procedures)

**b.** Procedures required to accommodate various aircraft configurations should be readily available to the flightcrew to preclude the inadvertent use of an incorrect procedure or configuration. Acceptable configurations for that operator and aircraft type should be clearly identified so that the crews can easily determine whether the aircraft is or is not in a configuration to initiate a low visibility approach using a pertinent Category I or Category II procedure.

**c.** Configuration provisions must be consistent with, but are not limited to, those provided in the OpSpecs for that operator.

**6.1.7. Compatibility between Category I, Category II, and Category III Procedures.**

**a.** The operator should ensure that to the extent possible, flightcrew and operational procedures for Category I and Category II are consistent with the procedures for that operator for Category III, particularly to minimize confusion about which procedure should be used in variable weather.

**b.** The operator should to the extent practical, minimize the number of procedures that the crew needs to be familiar with for low visibility operations so that, regardless of the landing category necessary for an approach, the correct procedures can be used consistently and reliably.

**6.1.8. Procedure Considerations During Non-Normal Operations.** When procedures or configurations have been specified for non-normal situations, flightcrews are expected to apply those procedures and use good judgment in making the determination of any appropriate adjustments to safely use an instrument approach procedure. This may include identifying any necessary adjustments to DA(H), MDA(H), approach path, missed approach path, or required visibility believed to be necessary (e.g., assessing the climb gradient that can be achieved, identifying a safe engine out lateral and vertical flight path, requesting an appropriate length of final approach). Guidelines for non-normal configurations, situations, or procedures may be provided by the aircraft flight manual or by the operator. Crews are expected to be familiar with these guidelines and apply them to the extent practical.

**a.** Specific guidelines for initiation for a Category II approach with an inoperative engine are provided in paragraph 5.17.

**b.** When procedures or configurations have not been specified for a non-normal situation or configuration, flightcrews are expected to use good judgment and select the safest course of action in making the determination of appropriate configurations or margins for an approach. The decisions to initiate, continue, or to discontinue an approach, divert to an alternate, and any adjustments to minima should be made considering relevant factors such as:

- Seriousness of the emergency
- Failure status of the aircraft
- Potential for unknown damage or further failures
- Navigation system status
- Runway, visual aid, and NAVAID status
- Procedure flight path and minima to be used
- Proximity to high terrain, obstacles, or adjacent approaching aircraft
- Potential altitude loss, flight path required, or cleanup altitude needed to change configuration and accelerate for a missed approach
- Obstacle clearance during transition to a missed approach (including the possible need to reject the landing from below DA(H) or MDA(H)
- Fuel on board
- Distance and suitability of alternate airports
- Likelihood of changing weather, NAVAID, or runway conditions,

**c.** It is not the intent of this AC to comprehensively define guidelines for each circumstance that might be possible (e.g., serious in-flight fire, minimum fuel). It should be noted, however, that flightcrews have both the authority and responsibility to consider relevant factors, such as those identified above, when deciding the safest course of action. If doubt exists on a course of action (e.g., initiating or continuing an approach with conditions potentially below minima), it is the flightcrews responsibility to exercise any necessary emergency authority to ensure safe flight.

**6.2. Category I or Category II Instrument Approach Procedures.**

**6.2.1. Acceptable Procedures for Category I.** Procedures acceptable for a Category I authorization for a U.S. Operator in the Unites States, or internationally, under provisions of part 121, 125, or 135, or for a Foreign Operator under provisions of part 129 at U.S. Airports, are those listed in paragraphs 4.3.1.4, 4.3.2, and 4.3.3, and any others found acceptable to FAA and listed in Standard OpSpecs, Part C.

**6.2.2. Acceptable Procedures for Category II.** Procedures acceptable for a Category II authorization for a U.S. Operator in the United States, or internationally, under provisions of part 121,125, or 135, or for a Foreign Operator under provisions of part 129 at U.S. Airports, are those listed in Paragraphs 4.3.1.4 and 4.3.2 above, and any others found acceptable to FAA and listed in Standard OpSpecs, Part C.

**6.2.3. Standard Obstacle Clearance for Approach and Missed Approach.** Standard approach and missed approach criteria for obstacle clearance for normal operations are as specified in FAA Order 8260.3, United States

Standard for Terminal Instrument Procedures, or as referenced in FAA Air Traffic criteria for terminal procedures (FAA Order 7100.11, Flight Management System Procedures Program), or for non-U.S. airports, ICAO PANS-OPS.

**a.** Standard VNAV criteria may be applied as specified in FAA Order 8260.40, Flight Management System (FMS) Instrument Procedures Development.

**b.** Standard RNP criteria may be applied as specified in Appendix 5 of this AC or pertinent paragraphs of AC 120-28D.

**c.** For non-normal operations (e.g., engine inoperative), criteria equivalent to that specified in 14 CFR for takeoff (e.g., section 121.189) may be applied for those portions of an approach or missed approach not otherwise addressed by procedure design for normal operations (e.g., engine out missed approach gradients, or engine inoperative flap retraction and acceleration segments, or a rejected landing climb back to procedurally protected airspace after loss of visual reference at an airport with significant nearby obstacles or mountainous terrain)

**d.** Regardless of criteria used, the operator should ensure appropriate consistency between obstacle clearance criteria used for takeoff, en route operations, terminal procedures, instrument approach procedures, engine inoperative procedures, and drift down procedures, as applicable.

**6.2.4. Special Obstacle Criteria.** Obstacle criteria for RNP is as identified in Appendix 5.

**a.** Obstacle clearance criteria for Category II procedures is identified in Appendix 6.

**b.** Obstacle clearance criteria to facilitate implementation of VNAV paths for approaches other than xLS are contained in FAA Order 8400.10

**c.** Other obstacle clearance criteria may be requested for use by an applicant and authorized by FAA, for specific applications (e.g., international operations, operations at military facilities, disaster relief). When other criteria are used, related compensating factors are typically considered, to ensure equivalent safe terrain or obstacle clearance.

**6.2.5. Irregular Pre-threshold Terrain Airports.** Irregula*r* pre-threshold terrain airports identified by a 14 CFR part 97 procedure, or by FAA Order 8400.8, must be evaluated IAW FAA approved procedures prior to incorporation in OpSpecs for use by air carriers operating to Category II minima. (See the FAA worldwide web site for Category II/II Status L, for Restricted (irregular pre-threshold terrain) airports:

http://www.faa.gov/avr/afs/afs410/afs410.htm).

Acceptable procedures for evaluation of use of these airports may be found in AC 120-28D, Appendix 8. For aircraft not using autoland, this evaluation consists primarily of ensuring availability of an appropriate method for identification of DA(H) (e.g., assessing acceptable radar altimeter indications approaching and at DA(H), or substituting use of "Inner Marker" in lieu of Radio Altimeter). Assessing acceptable radar altimeter indications is done by ensuring sufficient Radio Altimeter display readout stability and continuity to be able to be easily read the Radar Altimeter when approaching DA(H) and at DA(H), while over-flying the irregular underlying terrain. This assessment may typically be done during operations using minima no lower than Category I, or may be based on operations at that runway by that operator with an equivalent radio altimeter installation (e.g., previously in a B757, for new B767 operations), or may be based on other U.S. Operators who have completed an assessment using the same aircraft type and radio altimeter system combination, or equivalent.

**6.2.6. Airport Surface Depiction for Category I or II Operations.**

**a.** Unless otherwise authorized for a particular airport or series of airports, a suitable airport surface depiction should be available to flightcrews for each regular, provisional, or alternate airport or any airport the operator could reasonably expect operations (e.g., section 121.161 ETOPS diversion airports, designated emergency airports), to ensure appropriate identification of visual landmarks or lighting to safely accomplish taxing from the gate to the runway and from the runway to the gate. Airport depiction should be on an appropriate scale with suitable detailed information on gate locations, parking locations, holding locations, critical areas, obstacle free zones, taxi way identifications, runway identifications, and any applicable taxiway markings for designated holding spots or holding areas. Standard depictions provided by commercial charting services may be acceptable if they provide sufficient detail to identify suitable routes of taxi to and from the runway and gate positions for departure or arrival.

**b.** Electronic presentations of airport diagrams are considered an acceptable substitute for paper (hard copy) depictions if acceptable operational provision is made for failure of the electronic device providing the airport depiction, if each necessary flight crewmember can have access to the depiction when needed, and if equivalent scaling, orientation, chart detail, and information content is provided.

**6.2.7. Continuing Category I or Category II Approaches in Deteriorating Weather Conditions.** The following procedures are considered acceptable in the event that weather conditions are reported to drop below the applicable Category I or II minima after an aircraft has passed the final approach point or final approach fix, as applicable (reference section 121.651).

**a.** Operations based on a DA(H) may continue to the DA(H) and then land, if the specified visual reference is subsequently established by the pilot no later than the DA(H).

**b.** Operations based on an MDA(H) may continue to the MDA(H), and then to the point of intercept of the VNAV path to the runway, to the VDP, or equivalent, or to the MAP, as applicable, then land, if the specified visual reference is established by the pilot no later than point at which descent below the MDA(H) commences.

**NOTE: For wind constraint applicability on final approach see paragraph 6.2.11.**

**6.2.8. "Approach Ban" Applicability.** Sections 121.651, 125.381, and 135.225 generally require that weather conditions be at or above takeoff minima prior to takeoff, and above landing minima prior to initiating the final segment of an instrument approach. However the applicability of these rules can be different for certain Domestic and International Operations (e.g., pilots authority to initiate "Look-See" Approaches at non-U.S. airports when weather is reported below minima). This paragraph explains and clarifies applicability of weather reporting for takeoff minima, and applicability of the "approach ban" provision related to sections 121.651, 125.381, or 135.225 at U.S. and non-U.S. airports.

**a.** Accordingly, an instrument approach should not be continued beyond the applicable outer marker, final approach fix, or equivalent position in the final approach segment unless the reported visibility or controlling RVR is above the specified minimum. If no outer marker, final approach fix, or equivalent fix is available, or if such a fix is not used as the point of application of an approach ban when weather is reported below minima, the aircraft should in no case descend below an altitude of 1,000 ft. above the TDZE for the runway of intended landing, unless weather is reported to be at or above minima. Equivalent positions to the outer marker are considered to be, but are not limited to: DME, VOR, non-directional beacon, or other such fixes authorized in the standard instrument approach procedure (SIAP), which are located at a position similar to an outer marker, outer compass locator, or final approach fix. A corresponding surveillance radar fix may also be used as a point of application of an approach ban, in lieu of an outer marker, final approach fix, or such equivalent fix.

**b.** If, after passing the applicable approach ban fix or point (e.g., outer marker, equivalent fix, or an altitude 1,000 ft. above the TDZ Elevation), and the reported visibility or controlling RVR falls below the specified minimum, the approach may be continued to DA(H) or MDA(H). If suitable visual reference can be established prior to descending below DA(H) or MDA(H), a landing may be completed.

**c.** Controlling RVR means the reported values of one or more RVR reporting locations (touchdown, midpoint, rollout, or equivalent international locations) used to determine whether operating minima are or are not met. Where RVR is used, the controlling RVR is the touchdown RVR, unless otherwise specified by FAA (e.g., through operations specifications).

**d.** Differences in application of the approach ban between U.S. airports and non-U.S. airports stems from the recognition that there may be differences in non-U.S. and U.S. methods to determine and report weather conditions. On a worldwide basis, differences exist in types and characteristics of meteorological devices used, measurement techniques and policies, or processes for categorizing, reporting, or disseminating weather (e.g., different methods of determining and reporting RVR or meteorological visibility).

**e.** An approach ban is applicable at U.S. airports. It may also apply at airports in countries outside the United States where that state or airport authority specifically precludes “look-see” authorization when weather is below minima. Operators should be familiar with such policies of states outside the United States, or for non-US airports, and appropriately apply those states or airports policies.

**f.** 14 CFR and FAA policies require that for airports within the United States and its territories (e.g., Puerto Rico) or at U.S. military airports (e.g., airports at which U.S. military forces manage the facility or have a designated U.S. base or facility) it is necessary to have reported weather at a value at or above landing minima prior to initiating an approach (section 121.651).

**g.** The latest weather report from the most reliable source is considered to be the applicable controlling weather report as follows:

**(1)** Report from a co-located Air traffic Facility (e.g., Tower Local Control, Approach control), or

**(2)** ATIS Report, or

**(3)** Airline or FSS report from NWS or an approved source

**6.2.9. Approach Operations at Non-U.S. Airports, when Weather is Reported “Below Minima.”** This paragraph describes the regulatory basis for executing an instrument approach procedure (IAP) at a non-U.S. airport when it is previously known that the weather at that airport may be, or is below the charted weather minima or approach ban weather criteria for that IAP.

**a.** When an aircraft approaches an airport, a decision typically must be made whether or not to initiate the approach and whether it is permissible to proceed beyond the FAF or FAP on an IAP, based on specified “approach minima.”

**b.** These criteria are not necessarily the same as the charted criteria at the bottom of the approach plate, since in ICAO compliant publications, some States set approach minimums for an IAP by specifying an “approach ban” at weather minima different than that specified on the approach plate or OpSpecs for continuing below or beyond DA(H) or MDA(H).

**c.** The approach initiation minimums for an IAP may or may not be the same as the landing minimums shown on the IAP.

**d.** The following criteria are considered to apply as noted below (reference 14 CFR sections 91.703, 121.11, 135.3, 135.225, 125.23, 125.381).

**(1)** Operations Specifications: Always apply, domestic and international.

**(2)** State of the Aerodrome criteria if promulgated as rules or regulations: Typically always apply in the national airspace of that state, as an agreed sovereign right.

**(3)** 14 CFR parts 121, 125, or 135 always apply to domestic operations, and always apply internationally unless the State of the Aerodrome specifically prohibit use of a particular part or provision of 14 CFR, or promulgates a rule contradicting a regulation, and the FAA agrees to apply the overriding provision of the State of the Aerodrome rather than the regulation. Typically State of the Aerodrome provisions may be more restrictive than the regulation, but may not provide relief from a U.S. regulation that applies to international operation.

(a) Section 121.651, 125.381 and 135.225 address approach minimums. A weather report for that airport is required prior to commencing an IAP. This is required worldwide.

(b) Reported visibility is required to be at least as good as the "visibility minimums prescribed for that approach" prior to commencing an IAP. This visibility requirement applies to airports in the United States, its territories, and U.S. military airports (whether in the United States or outside the United States), and to any airport in a foreign country where the country's operating rules require that the prescribed visibility be available prior to commencing the approach.

(c) Parts 121, 135, and 125 allow the crew to continue an IAP to DA(H) or MDA(H) if a below minimums weather report is received while already on the final segment of the approach.

(d) Part 121 allows an ILS Category I Procedure to be conducted with below minimums weather if both the ILS and a PAR are used simultaneously by the pilot. This does not apply to an operator not authorized for use of PAR, since that operator may not train for PAR approaches.

(e) Accordingly, there is no requirement for an above minimums weather report to commence an IAP in a foreign State (e.g., using a weather source other than the NWS or a source approved by the NWS) unless FAA has specifically precluded use of the look-see provision for a particular State or States. (Note: The State of the Aerodrome or Airport may additionally preclude such below minima operations, and U.S. Operators are expected to abide by such provisions, unless otherwise approved by FAA (e.g., through an emergency authorization in time of conflict or natural disaster).

**(4)** ICAO Standards apply over the high seas (international airspace), and in the airspace of a State which adheres to the ICAO Convention, subject to modification by that State, or ICAO filed "Difference." ICAO Standards and Recommended Practices (e.g., ICAO Annex 2, Annex 6, and PANS-OPS) do not address "approach minimums," or any particular weather criteria applying to the decision whether to initiate or continue an IAP. (Also see "ICAO Manual of All Weather Operations" DOC 9365 AN/910.)

**(5)** Part 91 always applies to domestic operations unless superseded by part 121, 125, or 135 provisions. Internationally certain provisions of part 91 apply when not otherwise superseded by part 121, ICAO, or State of the Aerodrome rules. Section 91.175 does not specifically address minimums related to initiation of an approach, or any weather criteria for initiating an IAP. All references are to landing minimums and the required visual references to continue below DA(H) or MDA(H). For operators conducting operations under part 91 (e.g., training, ferry, aircraft functional flight test), the approach ban provisions of part 121, 125, or 135 may thus not necessarily apply if the particular operation is considered to be conducted under part 91 by the CMO. Also, for flight test and POC demonstration purposes, waivers to provisions of section 91.175 may be requested from FAA (e.g., such as to authorize limited use of reduced weather minima for test or evaluation purposes).

**6.2.10. IFR Approaches or Low Visibility Takeoffs in Class G Airspace.** An operator may be authorized to conduct IFR approaches to Category I or Category II minima, or low visibility takeoffs, in Class G airspace, if the requirements of the applicable OpSpecs are met.

**a.** Nonscheduled Operations. For nonscheduled operations, the CHDO must ensure that the operator's Category I or II operations program provides the policy, and direction and guidance necessary to safely conduct these operations. The CHDO must also ensure that the certificate holder's manuals cover the specific procedures which must be used, and the facilities and services which must be available and operational for the safe conduct of instrument approach operations in Class G airspace (e.g., weather reporting, advisory frequencies, and NAVAID critical area protection, as applicable).

**b.** Scheduled Operations. In addition to meeting the requirements for nonscheduled operations, the CHDO must ensure that the facilities and services necessary for the safe conduct of instrument approach procedures in Class G airspace are available during the times of scheduled operations, and are specified in the OpSpecs.

**c.** Method of Approval. The authorizations to conduct instrument approach procedures in Class G airspace are addressed by issuing Special Non-14 CFR part 97 OpSpecs.

**6.2.11. Wind Constraint Applicability.** When wind constraints apply to Category I or Category II procedures (e.g., an OpSpec 15 knot crosswind component limit) the limit is considered to apply to the point of touchdown. If a report of a crosswind component value greater than the limit is received while on approach, an aircraft may continue an approach, but a subsequent wind report indicating winds are within limits or a pilot determination that actual winds are within limits must be made prior to touchdown.

**a.** The flightcrew should use the most recent, reliable and appropriate information. Acceptable methods for a wind determination may include ATS reports, reports of other aircraft with reliable means of wind determination (e.g., IRS), pilot use of on-board IRS or FMS wind readout capability, data link of recent winds, or pilot confirmation of an acceptable visual indication of winds on the surface by a wind sock, wind indicator or equivalent wind indicating device.

**b.** When an Airplane Flight Manual or other manufacturer's reference (e.g., FCOM) references "Maximum wind component speeds when landing weather minima are predicated on autoland operations," or an equivalent statement, an operator or flightcrew may consider those wind values to apply to "steady state" wind components.

**c.** It is considered acceptable for the flightcrew to land when gust values are reported to exceed the steady state wind limit if the flightcrew considers the gust exceedance to be:

- insignificant in magnitude
- variable in direction
- occasional, or
- the wind report is not applicable (e.g., obviously outdated, measured at a location considered too far from the runway or touchdown zone, or gusts considered not pertinent during the period of touchdown or rollout.)

**6.2.12. Crosswind Component Determination at Airports with Significant Magnetic Variation (Polar Regions).** Operators, flightcrews, and dispatchers (if applicable) of air carriers operating in polar regions or having ETOPS or EROPS alternates in these polar regions should be familiar with appropriate methods to determine wind components and particularly tailwind and crosswind components at airports with significant magnetic variation, or with runways oriented to true north. Due to METAR, TAF, and ATS Tower reported winds and runways potentially having different magnetic or true north reference, caution must be exercised where significant magnetic variation values exist, to correctly determine applicable crosswind and tailwind component limits.

**6.2.13. Unusual or Extreme Temperatures or Pressures.**

**6.2.13.1. General Cold Temperature Considerations.** Appropriate "cold temperature" altitude adjustments for instrument procedure minimum segment altitudes (e.g., initial or intermediate segments) should be made when altitude errors resulting from unusually cold airport surface temperatures are considered significant, and are needed to ensure terrain or obstacle clearance. Instrument procedure designers, airspace planners, Authorities, Air Traffic Service (ATS), Operators or pilots may make appropriate corrections, as necessary. Altitude errors typically may be considered significant in mountainous regions when surface temperatures are below -22F/-30C, when significant terrain or obstacle clearance is a factor, and when temperature considerations have not otherwise been addressed by instrument procedure design. Flightcrews should not additionally make corrections if instrument procedures already address temperature related terrain or obstacle clearance to the degree necessary, or if ATS has addressed cold temperature considerations in their assigned clearance altitudes. Use of any altitude corrections made by flightcrews should be consistent with ATS cold temperature altitude correction policies when such policies are promulgated, and when safe clearance is ensured by those ATS policies. (Also see paragraphs 4.3.1.1 item g, 4.3.4. item c., 7.1.3. items d, and 8, 8.13, and 8.14 for related information).

**6.2.13.2. Temperatures Below Those Used in Procedure Design.** In some countries, cold temperature errors are considered during procedure design, and are addressed in published instrument procedures, MEAs, and Air Traffic Service (ATS) minimum clearance altitudes such as MVAs when necessary. If temperatures are significantly below the reference temperature considered during procedure design, it may be appropriate for pilots or Operators to apply altitude corrections to the specified (published or charted) procedure minimum altitudes while in flight. This may be done using an appropriate altitude correction table as provided in Table 6.2.13-1 below, or through an equivalent table or method, to ensure terrain or obstacle clearance.

**6.2.13.3. Segments which may need to be Corrected for Temperature.** Altitude corrections are particularly important on initial or intermediate approach segments in areas of mountainous terrain when there is a significant difference between true altitude and indicated altitude due to unusually cold surface temperatures. Additionally, the size of any temperature-induced altitude or height error decreases in magnitude as the height above the airport surface decreases. Corrections may also be appropriate for MEAs, MVAs, "driftdown" flight paths in mountainous terrain, or missed approach or takeoff flight paths, when extreme cold temperature effects are not otherwise considered. When a U.S. Air Traffic Facility, or international ATS facility already considers cold temperature effects in clearances, additional corrections by flightcrews should not normally be made (e.g., for a radar vector altitude clearance).

**6.2.13.4. Uncorrected Procedures.** In certain states, cold temperature correction may need to be applied any time temperature is below ISA (e.g., Canada, Northern Europe, when using ICAO criteria). When flying to such states, it is important for the operator and pilots to be aware of that state's cold temperature instrument procedure correction policy, and to operate consistent with that policy. This may be accomplished by an operator applying that state's policy, or by the operator using the operator's own policy, if that policy provides for safe clearance and is suitable for use within that state (e.g., the operator's altitude correction policy for cold temperature is compatible with that state's ATS procedures or requirements).

**6.2.13.5. VNAV Path and Visual Guidance (VGSI) Temperature Considerations.** Pilots and Operators should be aware that temperature-related effects on VNAV path formulation can occur when operating well below or above ISA. For example, in extreme cold temperatures, VNAV descent gradients may be more shallow than usual and visual aids (e.g., VGSI, VASI, PAPI) may not necessarily show "on path" indications when visual reference is first acquired, even though the aircraft is correctly flying the FMS-indicated VNAV path. In such cases, pilots should be alert for the need to adjust and ensure a safe flight path. Similarly, pilots and operators should be aware that unusually shallow VNAV gradients could be lower than "step down" crossing altitudes if temperature considerations have not been addressed. For temperatures well above ISA, VNAV descent angles may be correspondingly steeper than nominal. While obstacle clearance would not be an issue, aircraft descent gradient capability could be a factor if operating near descent gradient limits for the aircraft (e.g., with unusual tailwind conditions at altitude, or with reduced flap settings with an engine inoperative).

**6.2.13.6. Unusual Cold Temperature Operations within the Unites States.** Within the United States, cold temperature factors and related altitude additives should be considered by procedure designers when necessary (e.g., during procedure design) or are considered by airspace planners to the extent necessary (e.g., when establishing MVAs in cold climates and mountainous areas). However, since assessments for cold temperature correction may vary for particular procedures or situations, if an operator has questions as to the suitability of a particular procedure in extreme cold conditions. Operators may consult the appropriate FAA procedure design office through their respective POI or CMO to determine what additional precautions or adjustments may be appropriate in extreme cold temperature conditions, if any.

**6.2.13.7. Unusual Cold Temperature Operations Outside of the Unites States.**

**a.** It is particularly important to note these temperature effects when operating outside of the Unites States. Not all states necessarily address temperature compensation within instrument procedure development or in airspace procedure planning. If a flightcrew or operator is in doubt regarding safe obstacle clearance, additional margin should be provided (e.g., requested from ATS, if applicable). Operators may elect to coordinate with authorities or ATS facilities in countries outside of the Unites States which have unusually cold temperatures to determine which procedure-specified altitudes include extreme cold temperature considerations, if any, and which do not. If a pilot is in doubt as to safe altitude clearance, corrections should be considered and applied, and ATS should be advised of the use of corrected altitudes, if applicable.

**b.** Where temperature constraints are placed on instrument approach procedures, operators and pilots should be familiar with and properly apply those constraints. Pilots and operators should also be familiar with any temperature correction table(s) provided by the “State of the Aerodrome” (ICAO) or aircraft manufacturer. For FMS, pilots should be familiar with any temperature correction methods that apply to proper FMS use, if provided.

**6.2.13.8. Use of Standard Cold Temperature Correction Table (Table 6.2.13-1).** Extreme cold temperature corrections may be made within the United States, or by U.S. operators when flying internationally, IAW the standard temperature correction table shown in Table 6.2.13-1, or through an equivalent table. International operators flying to the Unites States (e.g., part 129) may use methods acceptable to the authority of the State of the operator, or methods equivalent to those found acceptable for U.S. operators by FAA.

**a.** Table 6.2.13-1 provides altitude correction values in feet, related to reported airport surface temperature, to be added to various published instrument procedure-related altitudes. The amount of altitude correction to be applied depends on the height of the published segment above the airport.

**b.** For example, using Table 6.2.13-1, an altitude correction of 280 ft. would apply for (see highlighted values in Table 6.2.13-1):

**(1)** a reported airport surface temperature of -30C, and

**(2)** a published instrument procedure segment altitude of 1500 ft. above the airport elevation,

**6.2.13.9. Use of Other Cold Temperature Correction Tables.** In the event that different cold temperature altitude correction table(s) or methods are provided by a “State of the Aerodrome,” an aircraft manufacturer, ICAO, another authority for that State, or by the operator (e.g., simplified table(s) or methods), pilots or operators may use that alternate table or method in lieu of Table 6.2.13-1. The alternate table(s) or methods should, however, ensure suitable terrain and obstacle clearance, and its use must be compatible with any applicable ATS procedure or clearance.

**6.2.13.10. Altimeter Settings.** Pilots and operators should be familiar with the proper altimeter settings to use and should take necessary precautions to switch altimeter settings at appropriate times or locations, considering possible multiple sources for altimeter settings including ATS-issued altimeter settings, company or airport reported settings, or settings broadcast over ATIS, or automated settings received by radio based on AWOS, or ASOS.

**6.2.13.11. Altimeter Settings (Not Recent).** Pilots and Operators should also take necessary precautions when using altimeter settings that may not be recent, or settings from remote locations, or rapidly varying settings, particular at times when pressure is reported or is expected to be rapidly decreasing.

**6.2.13.12. Precautions for Unusually High or Low Temperatures or High or Low Pressures.** Aircraft performance or procedure adjustments may need to be considered for unusually high or low temperatures or high or low pressures (e.g., temperatures or pressures above or below available AFM data). In such situations, operators may need to request suitable additional information or AFM provisions from the manufacturer, if temperatures or pressures exceed available AFM information or limitations. Data may be provided by the aircraft manufacturer or other approved source (e.g., if the aircraft manufacturer no longer exists or does not support the aircraft type) for such unusual temperatures or surface pressures. In addition to acquiring the necessary data and revised limitations, these situations can also be an important additional consideration for go-around or missed approach assessment.

## Table 6.2.13-1

# Cold Temperature Altitude Corrections

**Note:** Values are to be added to published altitudes.

| **Arpt Temp (°C)** | **Height Above Altimeter Source (feet)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | **1500** | 2000 | 3000 | 4000 | 5000 |
| 0 | 20 | 20 | 30 | 30 | 40 | 40 | 50 | 50 | 60 | 90 | 120 | 170 | 230 | 290 |
| -10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 150 | 200 | 290 | 390 | 490 |
| -20 | 30 | 50 | 60 | 70 | 90 | 100 | 120 | 130 | 140 | 210 | 280 | 430 | 570 | 710 |
| **-30** | 40 | 60 | 80 | 100 | 120 | 130 | 150 | 170 | 190 | **280** | 380 | 570 | 760 | 950 |
| -40 | 50 | 80 | 100 | 120 | 150 | 170 | 190 | 220 | 240 | 360 | 480 | 720 | 970 | 1210 |
| -50 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 450 | 600 | 890 | 1190 | 1500 |

**6.2.14. Metric Altitudes.** When used, the operator should address appropriate flightcrew and dispatch procedures for identification of and appropriate setting and use of altimeters, altitude alert systems, and altitude reference bugs for metric altitude use. This should include emphasis on distinguishing appropriate use of metric versus non-metric units for altimeter settings, change over points, and callouts as used by that operator, and as applicable to the metric altitude routes and procedures used.

**6.2.15. International "Approach Procedure Title" Requirements for or Limitations on NAVAID Use.** The operator should address appropriate flightcrew and dispatch procedures (if applicable) for identification of and appropriate use of international approach procedures which may or may not have all necessary NAVAIDs listed in the "procedure title" (e.g., NDB ILS Runway 16). For some of these procedures, NAVAIDs may be required which are not necessarily shown in the procedure title. For these procedures the operator should ensure that appropriate airborne equipment is operating for dispatch (if applicable), and crews should verify that appropriate navigation equipment is operating to safely conduct the approach and missed approach. Where substitutions are approved for U.S. Operators (e.g., FMS based RNAV for NDB, VOR, or DME, or GPS for NDB) the operator should ensure flightcrews are familiar with substitutions allowable for that region, state, or procedure.

**6.2.16. "U.S. TERPS" or "ICAO PANS-OPS" Obstacle Clearance Procedural Protection Limitations.** The operator should be aware that U.S. Standards for Terminal Instrument Procedures (TERPS) and ICAO PANS-OPS-based instrument procedures principally address normal operations, including flight above DA(H) or MDA(H), and above any specified or assumed climb gradients. Operations in non-normal configurations or at unusual speeds (e.g., operations with an engine inoperative, particularly for twin engine aircraft, or in unusual flap or flight control configurations) do not necessarily ensure compliance with climb gradients assumed for TERPS or PANS-OPS-based standard procedures. Accordingly, operators, flightcrews, and dispatchers (if applicable) should consider any necessary aircraft type specific or weight/altitude/temperature (WAT) specific procedures (e.g., similar to takeoff procedures) that may be necessary to ensure safe obstacle clearance, for at least the following situations:

**a.** Engine failure prior to initiation of or during approach or missed approach,

**b.** Balked landing or go-around from below DA(H) or MDA(H) (e.g., as for inadvertent loss of visual reference)

**c.** Any special precautions that may be needed if a crew follows a published missed approach procedure or ATS instruction for a turn from below DA(H) or MDA(H), and before climbing to a safe altitude protected by the procedure or MVA,

**d.** Any necessary consideration of an associated "IFR departure procedure" as an aid to ensure safe obstacle clearance, if initiating a go-around from below DA(H), MDA(H), or during a circling approach,

**e.** Any special limitations that may be necessary for safe operations into section 121.445 designated airports.(e.g., Reno, NV [KRNO]).

**6.2.17. Navigation Reference Datum Compatibility (e.g.,WGS-84/Other Datum).** Outside the Unites States, it is important for operators using FMS, GPS, and RNAV to be aware of, and where necessary, take precautions to address potential differences in the Navigation Data Base (NDB) "reference datum" used by their aircraft's navigation system, and the datum used locally by States for aeronautical data (e.g., NAVAID locations, runway waypoint locations) and specification of instrument procedures.

**a.** This is important to preclude significant navigation errors. If not appropriately addressed, the actual position of the aircraft may significantly differ from the indicated position. Aircraft may experience incorrect FMS position updating, may fly to an incorrect geographic location for a waypoint, NAVAID, or runway, may violate obstacle clearance during approach or missed approach, or may complete an instrument procedure displaced from the airport or runway intended. Significant map shifts can occur if FMS position estimates are based on use of a NAVAID using a different reference datum than the aircraft's NDB presumes. Similarly, GPS stand alone systems, while accurately flying to locations specified in a WGS-84 coordinate frame, may not necessarily fly the path over the ground intended by the procedure if the specification of that path uses a datum significantly different than WGS-84. This also can be important when flying with a navigation data base using WGS-84 as the basis for a procedure, but the aircraft is not using GPS or GPS updating, and is depending on local NAVAID updating with those NAVAIDs referenced to a different datum (e.g., as for a GPS inoperative MEL dispatch case with FMS).

**b.** For Category I or II procedures, the issue of use of an appropriate Navigation "Reference Datum" principally applies to flying procedures as follows:

- RNAV approach or missed approach procedures
- RNAV Initial or intermediate segments ILS or MLS procedures, or
- RNAV missed approach segments ILS or MLS procedures

**c.** The final approach segment of ILS or MLS typically is not adversely affected by a difference in reference datum.

**d.** GLS or RNP procedures, while depending on specification of an appropriate reference datum for final approach, are protected through other criteria to ensure consistent navigation.

**e.** Information about the Navigation Reference Datum used in a particular location outside of the United States is typically available on the Internet. An example of a web site containing this information is:

http://www.jeppesen.com/wgs84.html

**f.** Accordingly, when outside United States airspace and when WGS-84 is not used as the reference datum locally for NAVAID's or procedures, or a reference datum equivalent to WGS-84 is not used, and RNAV segments are flown as part of an instrument approach or missed approach procedure for:

- FMS-equipped aircraft
- FMS-equipped aircraft using GPS updating, or
- GPS "stand alone" equipped aircraft

Operators should take suitable precautions, as described below:

**(1)** Aircraft Equipped With FMS Having GPS Updating Capability, or Equipped With "GPS Stand Alone" Navigation Systems.

(a) For aircraft having FMS capability with GPS updating, or a "GPS Stand Alone" navigation systems, for each approach outside the United States where the local datum is not WGS-84, or WGS-84 equivalent, or where the operator is uncertain as to whether the local datum is significantly different than WGS-84, the operator should take one or more of the following precautions, as necessary:

i. Verify that the datum is WGS-84, or equivalent,

ii. Conduct an assessment of the difference in the datum used, to determine that any difference is not significant for the procedures to be flown,

iii. Develop and use special RNAV procedure segments or aeronautical data referenced to WGS-84 or equivalent, as necessary,

iv. Manually inhibit GPS updating of the FMS while flying the approach, or segments of the approach affected by the difference in reference datum,

v. Only use FMS or GPS Stand Alone systems to fly pertinent RNAV segments of the approach where it is possible to use other NAVAID raw data to confirm correct aircraft position along the flight path,

vi. Conduct simulation verification, or in-flight verification or confirmation of suitable navigation performance,

vii. Preclude FMS or GPS use on segments of the approach affected by the difference in reference datum, or

viii. Use any other method proposed by the operator, and found acceptable to FAA, to ensure that a difference in the NDB Reference Datum from the local datum does not cause loss of navigation integrity.

(b) For GLS or RNP procedures or procedure segments, since the reference datum is consistent with WGS-84 by procedure design, Operators of aircraft using GPS updating of FMS need not apply the special precautions listed above, unless otherwise advised (e.g., by NOTAM or equivalent).

**(2)** FMS Aircraft That Do Not Have GPS Updating Capability.

(a) While possible, FMS-equipped aircraft that do not have GPS updating capability may be less likely to experience this particular datum reference difference issue. This is because navigation databases, local NAVAIDs, and local instrument procedures typically address and resolve datum issues consistently on a local basis, and in a consistent manner within the locally used coordinate frame of reference. However, even though the datum difference issue may be less likely, it nonetheless may occur. Operators should apply precautions, as necessary, if there is significant doubt as to Navigation Data Base datum differences.

(b) The precautions listed above in item (1) should not be interpreted to discourage GPS installation and use. GPS updating of FMS can significantly increase both navigation accuracy and integrity, and reduce the risk of other types of navigation errors, including map shifts, yielding a significant safety increase.

**6.2.18. Alternative Use of FAA/JAA Harmonized Minima.** This AC provides for use of optional "FAA/JAA harmonized operating minima" when authorized by OpSpecs or an LOA, in lieu of otherwise published minima based on U.S. TERPS or ICAO PANS-OPS. Use of these minima is limited to use within the United States, within any JAA (European) State that authorizes use of these minima or equivalent, or in other States that accept or apply FAA or JAA criteria. These minima have been determined to be acceptable for use by U.S. Operators or JAA supervised Operators within the United States who have implemented applicable provisions and criteria of Appendix 8, or its equivalent.

**a.** Minima based on values provided in Appendix 8 should not be below the lowest minima authorized through a Category I Standard OpSpecs authorization, or below any applicable published foreign aerodrome minima when operating outside the United States.

**b.** These minima provide for a single table for Aerodrome Operating Minima regardless of approach type, and are intended for use by aircraft and procedures which are based on a stabilised descent path to the runway (e.g., using an xLS glide slope, VNAV, or other specifically approved method for maintaining a constant vertical descent path or rate during final approach). Use of minima in this table for other procedures not using a glide slope or constant VNAV descent path to minima is considered only on a case-by-case basis by the FAA.

**c.** The harmonized minima are intended to cover all categories of straight-in approach procedures including xLS (e.g., ILS GLS, MLS) and approaches other than xLS (e.g., RNAV, LOC, BCRS, VOR, NDB). Any procedure based on U.S. TERPS or ICAO PANS-OPS, or special procedures otherwise approved by FAA are eligible to use these harmonized minima.

**d.** Approaches with glide slope angles or VNAV descent paths in excess of 3.77 degrees, or special procedures at certain airports that require specific knowledge or training, are not typically eligible for use of these special approach minima.

**e.** The FAA/JAA Harmonized Approach minima which may alternately be approved through OpSpecs for use by U.S. Operators, or JAA supervised Operators, or equivalent authority/operators determined acceptable by FAA (e.g., Canada), are as listed in Appendix 8.

**6.2.19. Assessment of Threshold Crossing Height (TCH), Approach Descent Gradient, and Runway Slope.**

**a.** Operators should assess instrument procedures to be used at regular, alternate, and provisional airports, and at planned diversion contingency airports to ensure satisfactory Threshold Crossing Height (TCH) for the type of aircraft to be flown (see 5.12.3 and 5.12.4). Typically, TCHs of less than 48 ft. should not be used by wide body air carrier aircraft without special review by the operator.

**b.** Operators should assess instrument procedures to be used at regular, alternate, and provisional airports, and at planned diversion contingency airports to ensure that final approach descent gradients specified are appropriate for the type of aircraft to be flown, and for conditions expected to be encountered (e.g., engine-out flap settings and speeds, anti-ice operating). For facility, obstacle, or terrain constraints, certain airports served by air carrier aircraft have unusually steep gradients (Stephenville, Newfoundland. - CYJT) or unusually shallow gradients (Kodiak, Alaska - PADQ) that may have operational consequence for certain aircraft types.

**c.** Under extreme cold temperature conditions certain VNAV paths may be more shallow than normal, and under extreme high temperatures these VNAV paths may be steeper than normal (see paragraph 6.2.13). In either case the paths may not closely align with fixed visual aids such as VGSI/PAPI.

**d.** Certain runways have unusual general slope, or complex varying slope that should be assessed by the operator for pilot awareness, or for operational consequence (e.g., operator specifies that the aircraft must touchdown by a certain point on the runway, or the last portion of the runway is not visible during flare in the TDZ due to changing slope).

## 7. TRAINING AND CREW QUALIFICATION.

**a.** Training and crew qualification programs pertinent to Category I, Category II, or lower than standard takeoff minima should include appropriate ground training (e.g., knowledge assurance) and flight training (e.g., skill or maneuver experience in simulation or an aircraft) to ensure safe aircraft operation for instrument procedures and low visibility operations in normal, rare normal (e.g., winds, turbulence, restricted visibility), and specified non-normal conditions (e.g., engine or various systems inoperative). Although training is not required for part 125, Operators are encouraged to prepare a training and qualification program for all flight crewmembers IAW this paragraph.

**b.** This is typically accomplished through appropriately addressing initial qualification, recurrent qualification, upgrade qualification, differences qualification, recency of experience, and re-qualification. The Operator's program should provide appropriate training and qualification for each pilot in command (PIC), second in command (SIC) and any other pilot or flight crewmember expected to have knowledge of or perform duties related to Category I or Category II landing operations (e.g., Flight engineer, augmented flight crewmember).

**c.** Each PIC, and each other pilot or dispatcher, if applicable, having duties related to flight planning or use of Category I or Category II instrument procedures is expected to have comprehensive knowledge of areas described in paragraph 7.1 below. Each pilot expected to perform instrument procedures in normal or specified non-normal operations or perform duties associated with those procedures, should have successfully demonstrated the necessary skills in accomplishing those designated maneuvers or procedures as shown in paragraphs 7.2 through 7.4 below. Demonstration of skill in performing instrument procedures typically is accomplished through simulator training, checking, or during line operating experience or evaluations. Pilots other than a PIC or SIC may only be expected to perform those relevant duties, procedures or maneuvers related to instrument procedures that are applicable to their own crew position or assigned duties (e.g., international relief officers).

### 7.1. General Knowledge (Ground) Training for All Weather Operations (AWO).

**a.** Appropriate ground training should be conducted suitable for the "All weather Operations," instrument procedures, aircraft type(s) or variants, crew positions, airborne systems, NAVAIDs, and ground systems used.

**b.** Topics should be addressed to include at least those listed in paragraphs 7.1.1 through 7.1.3, and be addressed or tailored to suit application to initial qualification, recurrent qualification, re-qualification, upgrade, or differences qualification, as applicable.

**c.** Topics should be addressed for each PIC and any other pilots having assigned duties (e.g., SIC) as a PF or PNF during conduct of IAP. When duties are specifically assigned to a PF or PNF (e.g., monitored approach, Category II), only those duties applicable to the assigned crew position need be addressed for that crew position. When instrument approach-related duties are specifically assigned to other than the PIC or SIC, such as a flight engineer or relief pilot duties applicable to the assigned crew position should be addressed. When flight crewmembers other than a PIC or SIC are not assigned duties associated with an IAP but are expected to be present on the flight deck during an instrument approach, it is recommended, but not required, that they also receive suitable academic training.

**d.** Acceptable methods to address ground training topics include classroom instruction, self guided slide/tape presentation, or computer-based instruction, or self-instruction using appropriate reference materials.

**e.** If the method of satisfying ground training requirements is exclusively through self guided learning or review from appropriate reference materials (e.g., flightcrew operating manual, Aeronautical Information Manual, and commercially available instrument procedure charts), the operator should use some clearly identified method (e.g., periodic written examination) to verify that each pilot has acquired or has retained the necessary knowledge.

**7.1.1. Ground Systems and NAVAIDs for Category I or Category II.**

**a.** Ground systems and NAVAIDs are considered to include characteristics of the airport, electronic navigation aids, lighting, marking, and other systems (e.g., RVR) and any other relevant information necessary for safe Category I or Category II landing or low visibility takeoff operations.

**b.** The training and qualification program should appropriately address the operational characteristics, capabilities and limitations of at least each of the following:

**(1) NAVAIDs.** The navigation systems or NAVAIDs to be used, such as the instrument landing system (ILS) with its associated critical area protection criteria, GPS Landing System (GLS), or Microwave Landing System (MLS) characteristics, as applicable, marker beacons, VOR, DME, NDB, DME, compass locators or other relevant systems should be addressed to the extent necessary for safe operations. If area navigation systems, or other non-ground based NAVAID systems (e.g., GNSS, LORAN) are used, any characteristics or constraints regarding that method of navigation or associated supporting elements (e.g., GBAS, WAAS), must be addressed.

**(2) Visual Aids.** Visual aids include approach lighting system, TDZ, centerline lighting, runway edge lighting, taxiway lighting, standby power for lighting and any other lighting systems that might be relevant to a Category I or Category II environment, such as pilot control of lighting aids, or coding of the center line lighting for distance remaining, and lighting for displaced thresholds, land and hold short lighting, or other relevant configurations should be addressed.

**(3) Runways and Taxiways.** The runway and taxi way characteristics concerning width, safety areas, obstacle free zones, markings, hold lines, signs, holding spots, runway slope, suitability of TCH, unusual friction, grooving, or PFC characteristics, critical area protection areas, or taxi way position markings, runway distance remaining markings and runway distance remaining signs should be addressed.

**(4) Meteorological Information.** METARs, TAFs, visibility reporting, Transmissometers systems, including RVR locations, readout increments, sensitivity to lighting levels set for the runway edge lights, variation in the significance of reported values during international operations, controlling and advisory status of readouts, and requirements when transmissometers become inoperative; appropriate use of Temperatures in C or F, conversion of temperatures between C and F; appropriate use of pressure information including altimeter settings in units of HPa or inches, QNE, QNH, QFE (if applicable); appropriate use of Transition Level and Transition Altitude; appropriate interpretation and use of reported wind and gust information, in true or magnetic direction, as applicable to the source and circumstance.

**(5) NOTAMs and other Aeronautical Information.** Facility status, proper interpretation of outage reports for lighting components, standby power, or other factors and proper application of NOTAMs regarding the initiation of Category I or Category II approaches or initiation of a low visibility takeoff.

**(6) Flight Planning and Flight Procedures Related to Inoperative or Unsuitable NAVAIDs.** When NAVAID position updating is used in support of area navigation position determination (e.g., VOR, VOR-DME, DME-DME, GNSS updating), Operators and flightcrews should be aware of when and how to disable use of an unsuitable NAVAID or updating method within the airborne navigation system. This is especially true for NAVAID failure conditions that are probable to cause a significant map (position) shift (e.g., movement of a NAVAID to a new location without corresponding update of the NAVAID position in a database, significant numbers of space vehicle outages, or areas of interference).

**7.1.2. The Airborne System.**

**a.** The training and qualification program should address the characteristics, capabilities, and limitations of each appropriate airborne system element applicable to Category I or Category II landing including the following:

**(1) Flight guidance system.** The flight guidance system, including appropriate modes to be used for different circumstances or procedures (e.g., APPROACH, HDG, V/S, LNAV/VNAV), and any associated landing system or landing and roll out system, or go-around capability, if applicable (e.g., autopilot, autoland);

**(2) Flight director system.** The flight director system, including appropriate modes to be used for different circumstances or procedures (e.g., APPROACH, HDG, V/S, LNAV/VNAV), and including any associated landing or landing and roll out capability, or go-around capability, if applicable (e.g., HGS);

**(3) Automatic throttle.** The automatic throttle control system, if applicable. Mixed mode autoflight/autothrottle operation should be addressed (e.g., manual flight, but with autothrottles on, or vice versa), if pertinent to the aircraft type,

**(4) Displays.** Situation information displays, as applicable, including any applicable limits for acceptable approach performance to continue an approach, flare, rollout, or go-around (e.g., typically 1/2 dot or less lateral or vertical displacement below 500 ft. HAT down to DA(H), and

**(5) Status, Alerting and Warning Displays.** Other associated instrumentation and displays, as applicable, including any monitoring displays, status displays, mode annunciation displays, failure or warning annunciations, and associated system status displays that may be relevant.

**(6) Means for determining DA(H) or MDA(H).** The means for determining DA(H) or MDA(H) as follows:

(a) DA(H) as applicable to the particular Category I ILS, GLS, or MLS procedure (e.g., as an applicable DA, or Marker Beacon substitute for a DA when authorized);

(b) DA(H) as applicable to the particular Category I RNAV or RNAV RNP procedure with VNAV (e.g., as an applicable DA);

(c) MDA(H) as applicable to the particular Category I procedure other than ILS, GLS, or MLS (e.g., as an applicable MDA, and any associated missed approach point); and

(d) DA(H) as applicable to the particular Category II ILS, GLS, or MLS procedure (e.g., as an applicable DH, or Marker Beacon substitute for a DH, when authorized).

**(7) Other Flight Deck Systems.** Other flight deck systems operations or use, as may be related to low visibility operations (e.g., autobrakes, autospoilers), and any associated limitations, characteristics, or constraints (e.g., touchdown pitch up or pitch down tendency of certain autospoiler or autobrake settings or non-normal conditions, time delays, auto-deactivation features with go-around).

**(8) Other aircraft characteristics.** Any system or aircraft characteristics that may be relevant to Category I or Category II operations, such as cockpit visibility cutoff angles and the effect on cockpit visibility of proper eye height, seat position or instrument lighting intensities related to transition through areas of varying brightness visual conditions change. Crews should be aware of the effects on flight deck visibility related to use of different flap settings, and approach speeds. Minimum usable TCH and minimum or maximum final approach descent gradients should be addressed, if applicable.

**(9) Lighting.** Proper use of various landing, taxi, turnoff, wing, logo, or strobe lights for approach visibility, taxi, or collision avoidance conspicuity.

**(10) Rain Removal and De-fog.** Proper procedures for use of rain removal/defog (e.g., windshield wipers). If windshield defog, anti-ice, or de-icing systems affect forward visibility, crews should be aware of those effects and be familiar with proper settings for use of that equipment related to low visibility landing.

**(11) Course and Frequency Selection.** For automatic or manual systems which require crew input for parameters such as inbound course or automatic or manually tuned navigation frequencies, the crew should be aware of the importance and significance of any incorrect selections or settings, if not obvious, to ensure appropriate system performance.

**(12) Environmental Limits.** Description of the limits to which acceptable system performance has been demonstrated for headwind, tailwind, crosswind, and wind shear as applicable, and recognition of unacceptable performance in the case of adverse weather (e.g., windshear, turbulence).

**(13) Non-normal or Failure Conditions.** Recognition and response to pertinent non-normal or failure conditions, and related non-normal procedure and checklist use for flight guidance, instrument, and supporting systems (electrical, hydraulic, and flight control systems).

**(14) Go-Around.** Proper airborne system use for go-around, including consideration of height loss during transition to a go-around, performance assurance for obstacle clearance, management of any necessary mode changes, and assurance of appropriate vertical and lateral flight path tracking.

**b.** As applicable, the operator may consult the CHDO/POI to ensure that information presented by the operator about any training or qualification items or issues referenced above, or any additional issues pertinent to the type aircraft or system used, are consistent with the pertinent FAA Flight Standardization Board (FSB) Report for the applicable aircraft type.

**7.1.3. Flight Procedures, Operations Specifications, and Other Information.**

**a. Regulations and OpSpecs.** Pilots, and dispatchers if applicable, should be familiar with FAA regulations pertinent to their operation (e.g., sections 91.175, 121.651, 125.381 and 135.225) and OpSpecs applicable to Category I or Category II landing, or lower than standard takeoff minima, as applicable.

**b. Crew Duties.** Pilots should be familiar with appropriate crew duties, monitoring assignments, transfer of control during normal operations using a “monitored approach” appropriate automatic or crew initiated call-outs to be used, proper use of standard IAPs, special IAPs, applicable minima for normal configurations or for alternate or failure configurations and reversion to higher minima in the event of failures.

**c. Visibility and RVR.** Pilots, and dispatchers if applicable, should be familiar with proper application of meteorological visibility, METARs, TAFs, RVR, RVV (if applicable), including their respective use and limitations, the determination of controlling RVR and advisory RVR, required transmissometers, appropriate light settings for correct RVR readouts and proper determination of RVR values reported at foreign facilities. Pilots should be familiar with any authorized methods for pilot assessment and reporting of visibility at non-U.S. facilities.

**d. Procedures and Charts.**

**(1)** Pilots, and dispatchers if applicable, should be familiar with the proper use of instrument procedures and charts including application of DA(H) and MDA(H), and when to use DA, DH, or an equivalent (e.g., OCA (H)), or MDA as applicable, including proper use and setting of barometric or radar altimeter bugs, use of the inner marker where authorized or required due to irregular underlying terrain and appropriate altimeter setting procedures for the barometric altimeter consistent with the Operators practice of using either QNH or QFE, and if applicable.

**(2)** Pilots should be aware of when to make suitable cold weather temperature corrections for altimeter systems and procedures, if necessary.

**e. Visual references.** Pilots should be familiar with the availability and limitations of visual references encountered, both on approach before and after DA(H), if a DA or DH is applicable. Pilots should be familiar with the expected visual references likely to be encountered. Pilots should be familiar with procedures for an unexpected deterioration of conditions to less than the minimum visibility specified for the procedure during an approach, flare or roll out including the proper response to a loss of visual reference or a reduction of visual reference below the specified values when using a DA(H) or MDA(H) and prior to the time that the aircraft touches down. The operator should provide some means of demonstrating the expected visual references where the weather is at acceptable minimum conditions and the expected sequence of visual queues during an approach in which the visibility is at or above the specified landing minimums. This may be done using simulation, video presentation of simulated landings or actual landings, slides showing expected visual references, computer based reproductions of expected visual references or other means acceptable to the FAA.

**f. Visual Transition.** Procedures should be addressed for transitioning from non-visual to visual flight for both the PIC, SIC, as well as the pilot flying and pilot not flying, during the approach. For systems that include electronic monitoring displays, as described in item e above, procedures for transitioning from those monitoring displays to external visual references should be addressed.

**g. Unacceptable Displacements.** Pilots should be familiar with the recognition of the limits of acceptable aircraft position and flight path tracking during approach, flare and, if applicable, roll out. This should be addressed using appropriate displays or annunciations for the aircraft type.

**h. Environmental Effects.** Environmental effects should be addressed. Environmental effects include appropriate constraints for head winds, tail winds, cross winds, and the effect of vertical and horizontal wind shear on automatic systems, flight directors, or other system (e.g., HGS) performance. For systems such as head up displays which have a limited field of view or synthetic reference systems (e.g., EVS or SVS) pilots should be familiar with the display limitations of these systems and expected crew actions in the event that the aircraft reaches or exceeds a display limit capability. Extreme temperature or pressure effects should be considered, if necessary.

**i. Operator Policies.** Pilots, and dispatchers if applicable, should be familiar with the Operators policies and procedures concerning any constraints applicable to Category I or Category II landings, or low visibility takeoff including constraints for operations on contaminated or cluttered runways. Procedures to be used when obscuring of appropriate lighting or markings occurs, and limits should be noted for operations on slippery or icy runways regarding both directional control and stopping performance. Pilots, and dispatchers if applicable, should be familiar with appropriate constraints related to use of braking friction reports. Pilots, and dispatchers if applicable, should be familiar with the method of providing braking friction reports applicable to each airport having instrument landing operations.

**j. Response to Aircraft or System Failures.** Pilots should be familiar with the recognition and proper reaction to significant aircraft system failures experienced prior to and after reaching the final approach fix and experienced prior to and after reaching DA(H), as applicable. Expected crew response to failures prior to touchdown should be addressed, particularly for Category II operations.

**k. Ground or Navigation System Faults.** Pilots are expected to appropriately recognize and react to ground or navigation system faults, failures, or abnormalities at any point during the approach, before and after passing DA(H) and in the event an abnormality or failure which occurs after touchdown. Pilots should be familiar with appropriate go-around techniques, systems to be used either automatically or manually, consequences of failures on go-around systems which may be used, the expected height loss during a manual or automatic go around considering various initiation altitudes, and appropriate consideration for obstacle clearance in the event that a missed approach must be initiated below DA(H).

**l. Navigation Anomalies or Discrepancies.** Pilots, and dispatchers if applicable, should be familiar with the need to report navigation system anomalies or discrepancies, or failures of approach lights, runway lights, touchdown zone lights, center line lights or any other discrepancies which could be pertinent to subsequent Category I or Category II operations.

**m. International Procedures.** Pilots, and dispatchers if applicable, should be familiar with any applicable international procedures including application of OCA, OCH, the applicable State AIP, or regional supplements (if not otherwise addressed by the operator in the FCOM or equivalent), pertinent excerpts from ICAO references (e.g., Manual for All Weather Operations - ICAO DOC 9365AN/910). Regulatory requirements and responsibilities at non-U.S. international airports (e.g., approach ban and "look see" provisions).

**n. Performance and Obstacle Clearance.** Pilots, and dispatchers if applicable, should be familiar with any applicable aircraft performance or weight limit information to ensure safe obstacle clearance for "all engine," or "engine inoperative" missed approach, or rejected landing. Applicable performance information should consider applicable flap settings to be used, go-around procedures, acceleration segments if applicable, transition at any time following an engine failure between the specified "all-engine lateral flight path" (or radar vectors) and any specified "engine-inoperative lateral flight path," using acceptable flap retraction and cleanup height procedures.

**o. Flight Plans and Equipment Classification.** Pilots, and dispatchers if applicable, should be familiar with use of appropriate flight plan equipment classifications (e.g., Required System Performance (RSP)) affecting eligibility for various takeoff or landing procedures (e.g., flight plan /F, /E designations), and proper alternate airport identification and use, including any takeoff, en route ETOPS, or destination alternates, as applicable.

**p. EVS, SVS, or ILM.** When a synthetic reference system such as a "synthetic vision system" (SVS) or "enhanced vision system" (EVS) or "Independent Landing Monitor" (ILM) system is used, pilots should be familiar with the interpretation of the displays to ensure proper identification of the runway and proper positioning of the aircraft relative to continuation of the approach to a landing. Pilots should be briefed on the limitations of these systems for use in various weather conditions and specific information may need to be provided on a site-specific basis to ensure that misidentification of taxiways or other adjacent runways does not occur when using such systems.

**7.2. Maneuver or Procedure (Flight) Training for All Weather Operations (AWO).**

**a. Aircraft or Flight Simulator Use.** Maneuver/Procedure (Flight) training and evaluation should be provided, and should use appropriate simulation capability. If simulation capability is not available, training or evaluation may be accomplished partially with training devices, or partially or completely in an aircraft. However, when training or evaluation is done using training devices, or with simulators with limited capability (e.g., not Level C or D), or with an aircraft, additional factors or techniques (e.g., use of CBT) may need to be considered by the operator to ensure effective training.

**b. Addressing Applicable Regulations.** Maneuver or procedure training should generally address applicable part 121 Appendix E or F provisions, an approved AQP Program as applicable, approach and landing events specified in part 61, relevant FAA Order 8400.10 airman certification takeoff and landing provisions, FAA Order 8700.1 for part 125 competency or instrument checks, or FAA ATPC Practical Test Standards (PTS) as applicable, as described or credited below.

**c. Types Of Procedures and Conditions to be Addressed.** Maneuvers and procedures trained should be keyed to the types of instrument procedures used by the operator, the environment in which they are flown, and any special considerations that may apply to their safe application. Operating policies, procedures, and documentation representative of that applicable to the particular operator should be used. Maneuver and Procedure Training and any necessary evaluation should ensure that instrument procedures can be safely flown considering at least the following factors, as applicable to the specific operator:

**(1)** Types of instrument procedures used (standard and special, if applicable);

**(2)** That operator's manuals, charts, and checklists;

**(3)** Aircraft type(s) and variants flown;

**(4)** Flight guidance system(s) used;

**(5)** NAVAID(s) and visual aids used;

**(6)** Flightcrew procedures used (e.g., PF/PNF duties, monitored approach, callouts);

**(7)** Airport characteristics typically experienced (e.g., Visual aids, transition level, air traffic procedures, meteorological procedures, signs and markings, unusual airport features (elevations, slope) as applicable);

**(8)** Runway characteristics typically experienced (e.g., representative field lengths, grooving, marking);

**(9)** Nearby critical terrain or obstruction environment, if applicable;

**(10)** Relevant environmental conditions (e.g., wind, turbulence, shear, visibility and ceiling conditions, slippery runways, rain or snow effects on visibility);

**(11)** Lowest Category I or Category II straight-in, or Category I circling minima as applicable; and

**(12)** Other relevant AWO characteristics (e.g., special instrument procedures).

**d. Use of Part 121.Appendix H Level C or D Simulators.**

**(1)** When simulation (e.g., part 121, Appendix H level C or D) is the primary method used for flight training or evaluation for takeoff, approach and landing procedures, appropriate normal, non-normal, and environmental conditions (relevant wind, turbulence, visibility, and ceiling conditions) should be simulated. In this instance, training and evaluation need only be conducted using applicable landing minima and relevant and representative procedures and conditions (e.g., a representative mix of day, night, dusk, variable/patchy conditions, representative temperatures, landing runway altitudes, precipitation conditions, turbulence, and icing conditions). Multiple requirements for maneuvers may be combined at the discretion of the POI/APM/CMO/CMU, subject to the constraints below (e.g., to preclude the need to repeat various Category I/II/III, approach scenarios for normal approaches, approaches with an engine(s) out, missed approach, landing, rejected landing, and various go-around events). The training benefit of realistic simulation is acknowledged, and credit for use of a representative sample of conditions to be flown, directly using pertinent minima, is considered to be acceptable. Accordingly, when level C or D simulation is used, only a sample of procedural types, environmental conditions, successful crew performance, and other factors listed in c. above need be assessed. However, when such credit for combining events is permitted, the operator and CMO/CMU/POI/APM should nonetheless ensure that the program used leads to flightcrews reliably performing the necessary low visibility procedures under both normal and anticipated non-normal conditions in line service. Acceptable numbers and types of training or demonstration instrument approach procedure events for various types of training or checking or qualification programs are listed in paragraphs 7.2.1 through 7.2.7 below.

**(2)** In instances where Level C or D simulation is typically used IAW this provision, but the level of simulation capability is temporarily degraded to Level A or B, the operator with CMO concurrence may nonetheless apply provisions of this paragraph on a temporarily basis, until the simulation capability can be returned to level C or D status.

**e. Use of Simulators other than Part 121 Appendix H Level C or D, use of Training Devices, or use of an Aircraft.** When part 121, Appendix H level C or D simulation (or equivalent) is not used for All Weather Operations (AWO) Qualification (e.g., when an aircraft is used, or a training device(s) level 2 through 7, or visual simulator, or non-visual simulator, or Level A or B simulator, or a simulator qualified for Level C or D but used as an FBS is used) certain restrictions and additional provisions may apply to training or qualification, as follows:

**(1)** The POI or CMO/CMU may require that during training or evaluations the flightcrew demonstrate satisfactory lateral and vertical flight path tracking performance, to an appropriate tolerance, and to ensure flight path stability after passing DA(H). This is to address the possible lack of visual reference or external environmental disturbances that may exist in real operations but that may be minimal or absent during training or testing in limited capability simulators or simulation devices (e.g., due to lack of visual reference, turbulence or other disturbances being faithfully represented).

**(2)** The POI or CMO/CMU may require that additional procedures or combinations of procedures be demonstrated, or that limitations apply to credits allowed by this AC in terms of credit for combining maneuvers or types of procedures trained, maneuvers demonstrated, or other events evaluated (e.g., for combinations of various Category I, II, or III procedures for ILS, VOR, VOR/DME, NDB, Back Course Localizer, or engine inoperative missed approach or landing procedures).

**(3)** The POI or CMO/CMU may require additional training or checking event items beyond those identified in this AC below, or those addressed only generically in part 121 Appendix E or F, or in part 61 if applicable (e.g., providing for HUD or autoland qualification where part 121 or 91 only make general reference to items like other special characteristics as necessary).

**(4)** When using an aircraft for training or testing, the POI or CMO/CMU may require that provision be made for use of a view limiting device for any necessary competency demonstrations. This is particularly applicable to any evaluation of a pilot that has not previously qualified to fly a similar class of aircraft (e.g., large turbojet aircraft), or for a pilot that does not have significant instrument experience beyond that necessary to satisfy minimums for issuance of an FAA commercial pilot's license with instrument rating.

**(5)** For use of Level A or B Simulation in lieu of Level C or D Simulation that is temporarily not available, see paragraph 7.2 d. above.

**f. Flight Training Maneuvers for Category I or II Landings.** Maneuvers may be addressed individually as a respective Category I or Category II maneuver, or an appropriate sample of Category I and Category II maneuvers may be trained and evaluated, if crews are to be both Category I and II qualified. When flightcrews are authorized to use minima for Category III, as well as Category II, samples of maneuvers selected to be performed for training and evaluation may be from appropriate combinations of Category I, II, and III procedures. When found acceptable to the CHDO/POI, each maneuver need not be repeated for each Category of landing weather minima to be authorized. Flight training for Category I or Category II landing should address at least the following maneuvers:

**(1) Normal landings.** Normal landings at the lowest applicable Category I or Category II minima, using representative autoflight configurations or combinations of configurations authorized for use (e.g., flight director, autopilot, autothrottles);

**(2) Missed approach.** A missed approach from the lowest applicable DA(H) and MDA(H), (may be combined with other maneuvers);

**(3) Balked landing.** A balked landing or missed approach from a low altitude that could result in a touchdown during go-around (balked landing or rejected landing - may be combined with other maneuvers);

**(4) System or NAVAID Failures.** Appropriate aircraft and ground system NAVAID failures (may be combined with other maneuvers);

**(5) Engine Failures.** Engine failure prior to or during approach (if specific flight characteristics of the aircraft or operational authorizations require this maneuver);

**(6) Low Visibility Rollout.** Manual roll out with low visibility at applicable minima (may be combined);

**(7) Realistic Environmental Conditions.** Landings (in simulation) with environmental conditions at a representative sample of limiting values authorized for applicable Category I or II minima for that operator (e.g., regarding wind magnitude, headwind and crosswind components, turbulence, and runway surface friction characteristics (wet, snow, slippery) may be combined); and

**(8) Non-normal configuration approaches and landings.** Representative non-normal configuration approaches and landings in instrument conditions should be demonstrated. For these approaches, the simulated weather minima may be above, or well above, the lowest Category I or Category II minima authorized. Minima should be at levels that might typically be experienced in line operations, for a landing with the non-normal condition used. During these approaches, representative autoflight, instrument, and aircraft system configurations or combinations of configurations should be demonstrated (e.g., flight director, autopilot, autothrottles, raw data, inoperative electrical or hydraulic components).

**(9) Basic Airmanship Skills.** In accomplishing items (1) through (8) above, each pilot should demonstrate competence, or be judged to have the necessary competence in “basic airmanship skills” to adequately address:

**(a) Manual Control.** Manual control, or reversion to manual control of the aircraft, if necessary, (for FBW aircraft, normal law or configuration is acceptable)

**(b) Automation.** Proper use of automation,

**(c). Situation Awareness**. Appropriate planning and situation awareness, including terrain awareness,

**(d) Detection and coping with adverse environmental factors.** Ability to detect and cope with adverse environmental conditions (e.g., applicable crosswinds, turbulence, windshear, convective weather, or adverse airport conditions (e.g., slippery runways)),

**(e) Detection and coping with adverse NAVAID factors.** Detection Ability to detect and cope with adverse ground system, space system, or NAVAID failures or anomalies), and

**(f) Crew coordination and CRM.** Proper crew coordination, and crew resource management.

**(g) Flight Training Maneuvers for Takeoffs.** For low visibility takeoff (RVR less than 2400 RVR), the following maneuvers and procedures should be addressed (may be combined):

i. Normal takeoff,

ii. Rejected takeoff from a point prior to V1 (including an engine failure),

iii. Continued takeoff following failures including engine failure, and any critical failures for the aircraft type which could lead to lateral asymmetry during the takeoff, or

iv. Limiting conditions. The conditions under which these normal and rejected takeoffs should be demonstrated include appropriate limiting cross winds, winds, gusts, and runway surface friction levels authorized. A demonstration should be done at weights or on runways that represent a critical field length.

**h. Demonstration of Appropriate PF or PNF Duties By Each Pilot.** During each of the specified maneuvers or procedures, flight crewmembers are expected to perform their respective assignments or duties (e.g., Captain, First Officer, PIC, SIC, Pilot-Flying (PF), Pilot-Not-Flying (PNF)), as applicable. However, PICs and SICs should typically be able to perform either PF or PNF duties, unless otherwise limited by the Operators policies or aircraft characteristics (e.g., if F/Os are precluded by operator policy or system installation (HUD) from serving as PF during certain adverse weather takeoffs or landings). In situations where flight crewmembers are being qualified other than as part of the complete flightcrew (e.g., when two pilots in command are being qualified) or when a pilot other than the PIC is also to be authorized to serve as the PF for low visibility operations, each flight crewmember should individually demonstrate the required maneuvers or procedures, or an acceptable sample of procedures. Relevant procedures are those involving manual control of the aircraft, rather than procedures such as autoland, which may not involve significant differences in PF or PNF skills.

**7.2.1. Initial Qualification.** Prior to maneuver or flight training, Initial General Knowledge (Ground) Training for “All Weather Operations (AWO)” should be addressed. Coverage of those subjects specified in 7.1 should typically be completed for each pilot having assigned AWO responsibilities.

**a.** Maneuver or Procedure (Flight) Training addressing suitable for that operator’s Initial Qualification for “All Weather Operations (AWO)” should be conducted. While the number of procedure types covered, number of simulator periods, number of training flights, if any, or other factors may vary, coverage should at least address the expected initial assignment of the flight crewmember receiving the initial training. AWO training may be combined with the initial aircraft type qualification training program or it may be done separately as AWO qualification. Regardless, the operator is expected to provide sufficient initial training to assess knowledge and skills of each new flight crewmember, address any individual area of weakness, ensure each flight crewmember can perform to applicable AQP, PTS, or other relevant standards, and ensure that each crewmember can competently perform the maneuvers or procedures specified in 7.2 above.

**b.** If weaknesses are identified, the Operator is to provide sufficient remedial training to ensure that any new flight crewmember can perform to applicable FAA Commercial Pilot, Instrument, Multiengine, or ATPC standards, for the applicable aircraft type or variant, and can acceptably use that operator's policies, manuals, and procedures, before releasing that flight crewmember to IOE or to serve in line operations.

**c.** When Category I or II minima are based on manual operations using systems like head up displays or flight directors, a number of repetitions of the maneuvers specified in 7.2 above may be necessary to ensure that each of the required maneuvers can be properly and reliably performed.

**d.** Operators should also ensure that flight crewmembers receiving initial training have appropriate basic airmanship skills related to AWO (e.g., crosswind takeoff and landing skills, ability to fly to an adequate level using raw data, ability to assess and safely cope with adverse runway friction, make adverse weather avoidance judgments), or are provided relevant remedial training.

**e.** Guidance for acceptable programs related to a particular aircraft type can be found in FAA FSB reports for specific aircraft types. Operators should adhere to FSB guidelines when published, unless otherwise authorized by AFS 400. Sufficient assessment should take place to ensure that the operator has determined that above objectives have been met for each flight crewmember, and that the resulting evaluation or assessment can be documented.

**7.2.2. Recurrent Qualification.**

**a.** Recurrent General Knowledge (Ground) Training for All Weather Operations (AWO). Recurrent General Knowledge (Ground) Training for All Weather Operations (AWO) should provide any remedial review of topics specified in 7.1 to ensure continued familiarity with those topics. Emphasis should be place on any program modifications, changes to aircraft equipment or procedures, and review of any occurrences or incidents that may be pertinent. Also, emphasis may be placed on re-familiarization with topics such as mode annunciations for failure conditions or other information which the pilots may not routinely see during normal line operations. Topics to be addressed for each PIC, SIC, or other flight crewmember, or dispatcher if applicable, are those topics necessary for the performance of the assigned duties for each respective flight crewmember or dispatcher in the current assignment.

**b.** Recurrent Maneuver or Procedure (Flight) Training for All Weather Operations (AWO). Recurrent Maneuver or Procedure (Flight) Training for Category I or II landings and low visibility takeoffs, as applicable, should be provided to ensure competency in each of the maneuvers or procedures listed in 7.2 above.

**c.** Recurrent Maneuver or Procedure (Flight) Training should be conducted using an approved simulator with an appropriate visual system. In the event that simulation is not available, recurrent flight training may be accomplished in the aircraft, as approved by the CHDO/principal operations inspector considering factors identified in paragraph 7.2 e.

**d.** Recurrent flight training should include at least assess a "sample" of the applicable Category I or Category II procedures to be used by the Operator. The assessment should emphasize any rare or critical procedures used by that operator which have not otherwise been flown routinely or may not have been flown recently by a flight crewmember, but which may otherwise need to be reviewed. Emphasis may be placed on any critical non-normal procedures (e.g., engine inoperative, system failure cases), and any special emphasis procedures or items found to require attention due to in-service feedback by the operator (e.g., excessively high descent rates near the surface, proper VNAV use). At least some procedures should be sampled at or near limiting adverse weather conditions (e.g., at minimum RVR or limiting wind components or with windshear, or to runways with minimum operationally used field lengths, or at critical terrain airports or at airports having operator-unique special airport procedures). Repetition of maneuvers frequently accomplished successfully in line operations (e.g., normal ILS, normal autoland) may be de-emphasized by limited sampling and limited assessments of those conditions and procedures.

**e.** Recurrent flight training maneuvers may be accomplished individually or may be integrated with other maneuvers required during proficiency training or during proficiency checking. If minima are authorized using several methods of flight guidance and control such as FMS, autopilot, flight director, or head up display, then the training program should ensure an appropriate level of proficiency using each authorized mode or system. Where Category I or II minima are based on manual control using flight guidance such as provided by a head up flight guidance system, appropriate emphasis should be placed on failure conditions which a pilot does not normally experience in line operations.

**f.** When takeoff minima are below RVR2400 are approved, recurrent flight training must include at least one rejected takeoff at the lowest approved takeoff minimum used, with an engine failure near but prior to V1.

**g.** Numbers of maneuvers or procedures to be performed during recurrent training or checking should be sufficient to ensure appropriate flight crewmember performance, but not less than the following:

**(1)** An engine inoperative approach to a landing and a go around.

**(2)** Appropriate aircraft or ground system NAVAID failures.

**(3)** Approaches and landing(s) with environmental conditions at a representative sample of limiting values authorized for applicable Category I or II minima for that operator (e.g., wind components, turbulence, windshear or limiting runways or adverse runway surface friction).

**(4)** Any special emphasis procedures or items identified by the operator or CHDO/POI.

**(5)** A low visibility takeoff with critical performance or a suitable failure condition.

**7.2.3. Qualification in Conjunction with Advanced Qualification Programs (AQP).** Appropriate re-qualification or recurrent qualification programs may be adjusted as necessary when incorporated in AQP or other single visit training programs. With such programs, however, each of the areas of knowledge specified by paragraph 7.1 and each of the areas of competency specified in paragraph 7.2 must be ensured.

**7.2.4. Re-qualification.**

**a.** Credit for previous Category I or II qualification in a different aircraft type or variant, or previous qualification in the same type or variant at an earlier time may be considered in determining the type of program, length of program, required maneuvers to be completed or the repetition of maneuvers for re-qualification for Category I or II operations. Any re-qualification program should ensure that the pilots have the necessary knowledge of the topics specified in paragraph 7.1, and are able to perform their assigned duties for Category I or II or low visibility takeoff considering the maneuvers or procedures identified in paragraph 7.2.

**b.** For programs which credit previous Category I or II qualification in a different type aircraft, the transition program should ensure that any subtle differences between aircraft types which could lead to pilot misunderstanding of appropriate characteristics or procedures in the new type must be suitably addressed.

**7.2.5. Upgrade Qualification.**

**a.** Credit for previous Category I or II qualification in a different crew position in the same type or variant at an earlier time may be considered in determining the type of program, length of program, required maneuvers to be completed or the repetition of maneuvers for upgrade qualification for an aircraft type authorized for Category I or II operations. Any upgrade program should ensure that the pilot has the necessary knowledge of the topics specified in paragraph 7.1, and are able to perform the new or additional assigned duties for the new crew position for Category I or Category II or low visibility takeoff considering the maneuvers or procedures identified in paragraph 7.2.

**b.** Credit may also be permitted, as determined appropriate by the CMO, for prior pilot experience with a similar flight deck and flight guidance system (e.g., A330 and A340; B757 and B767). (Also see FAA AC120-53).

**7.2.6. Differences Qualification - Addressing Cockpit or Aircraft System Differences.** For Category I and II programs using aircraft which have several variants, training programs should ensure that pilots are aware of any differences that exist and appropriately understand the consequences of those differences. Guidelines for addressing differences can be found in AC 120-53 and FSB reports applicable to a particular type.

**7.2.7. Recency of Experience.** Recency of experience requirements specified by section 121.439 or IAW AC 120-53 normally provides an assurance of the necessary level of experience for Category I or II landing or low visibility takeoff operations. In the event that special circumstances exist where flight crewmembers may not have exposure to particular aspects of the flight guidance system used for long periods of time beyond that permitted by section 121.439 or AC 120-53, then the operator should ensure that the necessary recency of experience is addressed prior to pilots conducting Category I or II landings, or low visibility takeoff operations below RVR 2400.

**a.** For FMS/RNAV or RNP approaches or automatic landing systems, pilots should specifically be exposed to use of these systems and procedures during training or checking if the crew has not otherwise conducted frequent relevant similar line operations with those systems since the previous training cycle or event.

**b.** For manual flight guidance landing or takeoff systems (e.g., HUD) a pilot flying should typically be afforded an opportunity to use such systems or procedures in the aircraft or in simulation once each 90 days. If the pilot has not otherwise had an opportunity to conduct line approaches or landings using the manual flight guidance system within the previous 90 days, a simulator refresher, recurrent training or checking event, line operational use in weather conditions better than basic VFR, flight with a check airman, or other similar method acceptable to the POI may be used to re-establish recency of experience with that system.

**7.3. Checking or Evaluations.**

**7.3.1. Checking For Category I Qualification.** Testing, checking or evaluation for Category I is basic to qualification for IFR operations, and should be accomplished in conjunction with basic aircraft type or variant qualification for each crew position. Testing or evaluation, if necessary and as necessary, should be keyed to assuring that each pilot has the necessary knowledge and skill appropriate to the type of qualification being completed (e.g., Initial, transition, upgrade, differences, or re-qualification programs) IAW applicable regulations (e.g., SFAR 58 Approved AQP program, part 121 appendix F, part 61, and applicable FAA ATPC Type Rating Practical Test Standards). (Also see initial, transition, upgrade, or differences paragraphs above.)

**7.3.2. Checking For Category II Qualification.** Specific testing or evaluation should be completed for Category II qualification. Flight crewmembers should demonstrate proper use of Category II-related aircraft systems and correct procedures including any provisions otherwise specified by an applicable FSB report. If not otherwise addressed by Category I or Category III qualification, pilots should demonstrate proficiency in performing duties related to conduct of Category II approaches including at least the following conditions individually, or in any combination:

**a.** A normal approach to a landing and to a go-around at or near Category II minima;

**b.** Approaches with related aircraft system, navigation system, or flight guidance failures;

**c.** An engine-inoperative approach (if authorized for engine-inoperative Category II capability);

**d.** For initial qualification which includes use of an automatic landing system, at least one automatic landing , and if applicable, one automatic go-around from a low approach (at or after DA(H) but before touchdown). The approach or go-around may be conducted in either normal or non-normal conditions, as determined appropriate by the operator and CHDO;

**e.** For continuing qualification which includes use of an automatic landing system, at least one automatic landing or low altitude automatic go-around (if applicable), with a relevant non-normal condition;

**f.** For manual flight guidance and control systems (e.g., HUD) one landing at the lowest applicable minima and one go-around from low altitude below DA(H), and at least one response to a failure condition during the approach or missed approach; and

**g.** Recognition and proper response to other representative non-normal conditions or adverse weather situations (e.g., Outage NOTAM, NAVAID failure, variable or below minima weather, ILS critical area protection anomaly).

**7.3.3. Combined Checking for Simultaneous Category I/II or I/II/III Qualification.** When qualification programs simultaneously address Category I and Category II, or Category I, II, and Category III, testing events may be appropriately combined, and the FAA or operator need not repetitively test each type of approach at each landing Category.

**7.3.4. Checking for Low Visibility Takeoff Qualification.**

**a.** For new low visibility takeoff authorizations, and unless otherwise qualified for low visibility takeoff IAW FAA AC 120-28D, before using any takeoff minima below RVR 1200, pilots should have successfully demonstrated in simulation at least one takeoff at the lowest applicable minima with an engine failure at or after V1, and one rejected takeoff with an engine failure or other appropriate failure prior to V1.

**b.** If an acceptable simulator is not available, the demonstration may be conducted in the type of aircraft to be authorized for use of takeoff minima below RVR 1200. Representative failure speeds and conditions may be used that do not risk or adversely affect the aircraft or its systems (e.g., tires and brake energy). Use of a view limiting device for the pilot being evaluated is not necessary.

**7.4. Experience with Line Landings.** For Category II, unless otherwise specified by an applicable FSB report for the aircraft type, when a qualification program has been completed using a simulator program other than Level C or D, at least the following experience should be required before initiating Category II operations:

**a.** For automatic systems at least one line landing using the auto flight system approved for Category II minima should be accomplished in weather conditions at or better than Category II.

**b.** For manual systems such as head up flight guidance system for Category II, the pilot in command must have completed at least ten line landings using the approved flight guidance system and procedures, in the configuration specified for Category II, at suitable runways and using suitable landing NAVAIDs.

**7.5. Crew Records.** The operator should ensure that records suitably identify initial and continued eligibility of pilots for Category I or II operations. Records should note the appropriate completion of training and any necessary checking for both ground qualification, flight qualification, initial qualification, recurrent qualification, differences qualification, upgrade qualification, or re-qualification, or recency of experience for takeoffs or landings, or other tracked events (e.g., AQP), as applicable.

**7.6. Multiple Aircraft Type or Variant Qualification.**

**a.** In the event that flight crewmembers are multiply qualified as either captain or first officer, or for performing the duties of the PIC or SIC (e.g., International relief officers), or for flight crewmembers dual qualified between several aircraft types or variants, appropriate training and qualification must be completed to ensure that each flight crewmember can perform the assigned duties for each crew position and each aircraft type or variant.

**b.** For programs involving dual qualification, principal inspectors should approve the particular operator's program considering the degree of differences involved in the Category I or II aircraft systems, the assigned duties for each crew position and criteria such as described in AC 120-53 related to differences. If a pilot serving as second in command is not expressly restricted from performing the duties of the pilot in command during Category I or II approaches or low visibility takeoffs below 2400 RVR, then that pilot must satisfactorily complete the requirements for a pilot-in-command regarding those low visibility related maneuvers specified in paragraph 7.2.

**7.7. Aircraft Interchange.** When aircraft interchange is involved between Operators, flight crewmembers must receive sufficient ground and flight training or qualification assessment to ensure familiarity and competency with respect to the particular aircraft system or systems of the interchange aircraft. Guidelines for differences should be consistent with those specified in AC 120-53 and any applicable FAA FSB reports.

**7.8. Training Regarding Use of Foreign Airports for Category I or Category II Operations.** Operators authorized to conduct Category I or II operations or low visibility takeoffs below RVR1200 at foreign airports, which require procedures or limitations different than those applicable within the United States, should ensure that flight crewmembers, and dispatchers if applicable, are familiar with any meteorological reporting, airport, visual aid, NAVAID, or ATS clearance or procedure differences appropriate to operations at those foreign airports.

**7.9. Initial Operating Experience (IOE)/Supervised Line Flying (SLF).** Any Initial Operating Experience (IOE) or Supervised Line Flying (SLF) conducted by the operator should be consistent with and ensure compliance with applicable provisions of the AWO program of the operator.

**7.10. Line Checks, Route Checks, LOE, LOS, or LOFT.** Any "Line Checks," "Route Checks," LOS, LOE, or LOFT (or other equivalent AQP events) conducted by the operator should be consistent with, and ensure compliance with applicable provisions of the AWO program of the operator.

**7.11. Special Qualification Requirements for Particular Category I or Category II Operations.** Certain authorizations may require additional Category I or II training or qualification such as specified in paragraph 7.11.1 through 7.11.5 below. Additionally, special qualification may be required for particular instrument procedures, particular types of procedures, or particular airports as determined appropriate by the operator or CMO.

**7.11.1. HUD or Autoland.** Use of Certain RVR 1800 Authorizations based on HUD or Autoland. Use of lower than standard Category I minima based on use of HGS guidance or Autoland may be authorized. Such authorizations may be requested from the CHDO, and are approved on a case by case basis by AFS-400.

**7.11.2. Use of Lowest Category I Minima at Certain Obstacle Limited or Restricted ILS Facilities.** Operators may receive an authorization to use the lowest Category I minima at runways otherwise restricted to use higher minima due to near-in obstacles (e.g., KDTW RW21R). Such authorizations may be requested from the CHDO, and are approved on a case by case basis by AFS-400.

**7.11.3. Simultaneous Operations Using PRM Radar.** For pilot procedures regarding Simultaneous Operations using PRM Radar, see the Aeronautical Information Manual. When these procedures are used by an operator, flightcrews should be suitably briefed on their appropriate use, and how and when to decline their use.

**7.11.4. Simultaneous Operations with Converging Approaches and Coordinated Missed Approaches.** Simultaneous Operations with Converging Approaches should be addressed if used by the operator. Pilots should be familiar with how to determine if such operations are in effect, how to program the procedure in the FMS, if applicable, how to determine if their aircraft can comply with an applicable missed approach clearance for that particular landing, how to determine if there are any special SIAP or airport procedures to be used, what to do in a contingency, and circumstances in which it may be appropriate to decline such a clearance.

**7.11.5. Simultaneous Runway Operations.** Simultaneous Operations with land and hold short (LAHSO) ATS clearances should be addressed if used by the operator. Pilots should be familiar with how to determine if such operations are in effect, if their aircraft can comply with a LAHSO clearance for that particular landing, how to determine if there are any special airport markings or lighting to be used, what to do in a contingency if the other aircraft does not respond as expected or cannot stop in the allocated distance, if a failure occurs on either aircraft, or if either or both aircraft must reject the landing, and circumstances in which it may be appropriate to decline such a clearance.

**7.11.6. Special Qualification Airports.** The operator may identify certain airports as requiring special flightcrew qualification regarding instrument procedures, in conjunction with section 121.445, or in addition to section 121.445 (e.g., due to unusual terrain, obstructions, or weather).

**7.11.7. Special Qualification Instrument Procedures or Types of Instrument Procedures.** The operator may identify certain instrument procedures or types of procedures as requiring special flightcrew qualification (e.g., due to use of particular flight guidance systems or procedures, or requirements for FTE management, or procedure complexity)

**7.12. Special Qualification Requirements for Category II Operations at Certain U.S. Type I ILS Facilities.** Qualification Requirements for Category II Operations at Certain U.S. Type I ILS Facilities requires that flightcrews, and dispatchers if applicable, be familiar with any operational aspects of the applicable OpSpecs for these special operations, the DA(H) and RVR minima to be used, required visibility reports necessary to be used, controlling visibility or RVR to be applied, lighting aids required, and any precautions necessary that may be unique to the airport or Type I ILS facility used.

**7.13. Simultaneous Training and Qualification for Category I and II.** Training and qualification may be completed individually for Category I and II or may be combined. When combined Category I and Category II training is completed, pilots must clearly be aware of responsibilities for each Category of approach 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 with normal configurations, and response to typical failure cases appropriate for each Category of approach.

**7.14. Simultaneous Training and Qualification for Category I, II, and III.** See AC 120-28D for provisions addressing Category III.

**a.** Training and qualification may be completed individually for Category I or II, or may be combined for Category I, II, and III.

**b.** When combined Category I/II/III training is completed, pilots must clearly be aware of responsibilities for each Category of approach 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 with normal configurations, and response to typical failure cases appropriate for each Category of approach.

**7.15. Credit for "High Limit Captains" (Reference Sections 121.652, 125.379, 135.225).** When authorized by the POI, credit for high landing weather minimum limits and required turbojet experience may be authorized consistent with provisions of exemptions authorized for Category I or II qualification credit. Among other provisions of the FAA exemptions, crews eligible for this credit must meet applicable provisions of paragraph 7.1 and 7.2 above.

**7.16. Particular Approach System/Procedure Qualification.**

**7.16.1. Autoland Qualification.** Unless otherwise specified by FAA in OpSpecs, autoland qualification for Category I or II may be completed through use of Level A, B, C, or D simulation, or by observation of an autoland during IOE. When using simulation, at least one normal autoland and one autoland with a failure or non-normal condition requiring pilot intervention or takeover should be completed.

**7.16.2. Head Up Display Qualification.**

**a. Category I or II, or Category I and II.**

**(1)** An acceptable list of flight training events for Category I, or Category II, or Category I and II qualification is shown below.

**(2)** For qualification, the PF (usually the Captain) and PNF (usually the F/O) should each accomplish their respective duties. It is desirable but not required that the PNF receive at least some exposure to use of the HUD as PF, in order to be familiar with its operation, its characteristics, and its limitations.

Takeoffs:

- Two Takeoffs (RVR at lowest authorized minima - e.g., RVR 300)
- One with an engine failure leading to continuation
- One with any failure leading to an RTO
- One windshear event during takeoff

Landings:

- Five for the lowest Category I or Category II qualification as applicable (three with, two without failures)
- Five Missed Approaches/balked landings due to a failure
- One Circling approach (non ILS/GLS/MLS)

**b. Simultaneous Category I/II/III qualification (also see AC120-28D).**

**(1)** An acceptable list of flight training events for Simultaneous Category I/II/III qualification is shown below.

**(2)** The PF / PNF should each accomplish respective duties as in paragraph a. above. In addition, it is appropriate that the PNF receive at least limited exposure to use of the HUD as PF. The number of events for the PNF, however, may be determined by the operator considering the experience and familiarity of the PNF with HUD operations.

Landings:

- Two Category I (one with, one without failure)
- One Category II (with or without a failure)
- Five Category III (three with, two without failures)
- Five Missed Approaches/balked landings due to a failure
- One Circling approach (non ILS/GLS/MLS), if applicable for that operator

**7.16.3. RNAV Approach Qualification.**

**a.** Requirements to conduct RNAV approaches (e.g., for /E or /F qualified airplanes, or RNP qualified aircraft) that already routinely use LNAV/VNAV autoflight modes, are as follows:

**(1)** The flightcrew must know how to properly use the applicable navigation system(s) for the particular types of approaches to be flown. This is typically addressed in training as a flight crewmember initially qualifies to fly a particular type or variant.

**(2)** The flightcrew should have, know, or be able to do each of the items below.

(a) Have access to the appropriate instrument chart(s) (e.g., SID, STAR, or approach plates) for the applicable procedures,

(b) Know how to properly load the procedure(s) and any associated transitions, string related waypoints, address discontinuities, enter associated data (e.g., path constraints, altitude constraints, speed constraints, winds, anti-ice initiation altitudes), and

(c) Know how to properly fly the procedure(s) (e.g., operate the aircraft to properly stay on the designated LNAV and VNAV path, and meet constraints, regardless of autoflight mode(s) selected for use, or unexpected mode changes or reversions).

**(3)** The flightcrew must know how to properly apply applicable flight information (e.g., NOTAMs), if any, for the navigation system and route of flight (e.g., to properly deselect relevant NAVAIDs that are out of service, or could otherwise cause a problem such as a map shift, if they could adversely and significantly degrade navigation system performance).

**(4)** The flightcrew must know how to apply or accomplish any routine or special flight deck procedures specified by the operator for the approach type used or for the particular approach to be flown, including:

(a) Tuning or setting associated radios, altimeters, radar altimeters,

(b) Setting reference bugs and MCP altitudes, speeds, or headings,

(c) Selecting or arming appropriate AFDS modes,

(d) Performing any necessary navigation performance/map validity verification checks, using some acceptable method to the operator, to ensure suitable navigation performance. Examples of acceptable verification methods typically include:

i. A crosscheck of FMS position with raw data prior to passing a FAF or FAP,

ii. A crew assuring that the FMS is using an acceptable updating mode during the descent check (e.g., DD IRS (3)), and no map shift is evident prior to passing the FAF or FAP,

iii. Periodically monitoring raw data navigation information for consistency with RNAV position information that is displayed on the PFD or ND, or

iv. Comparison of RNAV position or other parameters (e.g., radio altitude at a known waypoint or position) with other independent sources of acceptable position information (e.g., Crosscheck an LNAV path with a path depicted by radar or TAWS, if applicable) which ensures the validity of the navigation system position estimate (e.g., cross checking VNAV with radio altitude, if applicable).

v. Know how to verify navigation data base loads for currency, and verify waypoint and critical waypoint validity, if applicable. Know how to verify appropriate levels of RNP, ANP, EPE, as applicable. Know how to verify suitable sensor performance if applicable (e.g., Acceptable IRS drift rate performance, DME-DME, VOR-DME or GPS updating).

(e) Configuring the aircraft at appropriate times, or in conjunction with ATS clearances (speed intervention adjustments), and addressing or otherwise appropriately responding to related aircraft or system status annunciations, advisories, alerts, cautions, or warnings.

**(5)** The flightcrew must be familiar with any unique issues particular to a specific approach or family of approach procedures (e.g., proper use of RNP (if applicable) for each particular approach or missed approach segment, or any special flight guidance procedures or actions necessary to accomplish the procedure(s) such as with the flight director, autopilot, autothrottle, or FMS).

**(6)** The operator must have the pertinent OpSpecs paragraph and the flightcrew must be aware of any operationally significant OpSpec provisions that relate to the procedures to be flown.

**b.** The above provisions may be addressed through initial or revised FCOM material, briefing bulletins, demonstrations, having crews accomplish typical procedures during scheduled PC/PT or AQP events, or as briefing emphasis items during IOE.

**c.** Each operator should ensure that effective methods are used to implement applicable RNAV or RNAV/RNP procedures to ensure that in line operations each pilot can perform assigned duties reliably, and expeditiously for each procedure to be flown, both in normal circumstances, and for probable non-normal circumstances (e.g., engine failure and other representative QRH, or equivalent, non-normals).

**d.** The best method or method(s) to be used by a particular operator to ensure competency in flying RNAV or RNAV/RNP procedures may vary significantly from operator to operator. Methods, level, and extent of training and checking, and recency may depend on the type of procedures used by the operator, the aircraft/FMS types and any autoflight systems used, level of familiarity or experience of crews with the FMS, autoflight, and the RNAV or RNAV/RNP procedures used, the complexity and criticality of procedures to be flown, and the environment in which the procedures are flown.

**e.** The CHDO (assigned POI/APM) may determine any credit allowed for an operator, or additional constraints determined necessary for that operator based on the above factors, and considering any provisions described in the applicable FSB report for the type.

**7.16.4. Category I or II Operations with an Engine Inoperative.**

**a. Category I.**

**(1)** For a Category I approach with inoperative engine(s), appropriate training should be completed to ensure that pilots, and dispatchers if applicable, can properly identify and select the nearest adequate or suitable airport (2 engine aircraft), or a safe airport (3 or more engine aircraft) pertinent to OpSpecs and Federal Aviation Regulations, to safely conduct an engine(s) inoperative landing. The flightcrews, and dispatchers if applicable, should have and demonstrate knowledge of factors influencing selection of a suitable airport for landing and safe completion of the approach considering factors such as the following:

(a) Engine (or engines) inoperative aircraft configuration (e.g., degree of thrust asymmetry, appropriate flap settings, adjusted reference speeds, remaining reverse thrust capability and use),

(b) Other potentially affected aircraft systems (e.g., electrical or hydraulic),

(c) Weather Conditions (winds, turbulence, ceiling and visibility, RVR, icing, windshear, crosswind or tailwind components, recency and accuracy of weather information),

(d) Use of appropriate minima for the configuration and possible need for adjustment of approach and landing minima to suit the particular circumstances,

(e) Special minima considerations that might be appropriate (e.g., engine-out missed approach obstacle or terrain assurance and balked landing obstacle avoidance considerations, consideration of subsequent engine failure (aircraft with more than 2 engines)),

(f) Selection of most favorable NAVAIDs, runway, or runway conditions (e.g., regarding braking friction, clutter),

(g) Availability of emergency services,

(h) Airport and procedure familiarity,

(i) Nearby terrain or obstruction considerations,

(j) MEL status, and

(k) Pilot recency of experience.

**(2)** Operators should at least be familiar with the factors listed above, and should provide the necessary training to flightcrews, and dispatchers if applicable, to address the above factors or issues considering that an engine failure may occur during or after takeoff, while en route, prior to approach, after passing the final approach fix, at or below MDA(H) or DA(H) leading to either a landing or go-around, or during missed approach.

**b. Category II.** For Category II the factors listed above for training and qualification for Category I should be considered, and in addition the following should be addressed. For crews authorized to initiate a Category II approach with an inoperative engine either through Category II flight planning or dispatch procedures or for engine failures which occur en route, appropriate training should be completed to ensure that crews can properly apply the provisions of paragraphs 5.17.1 or 5.17.2. For airlines that do not authorize the initiation of a Category II approach with an engine inoperative as an approved procedure, crews should at least be familiar with the provisions above for Category I and provisions of paragraphs 5.17.3, 5.17.4, and 5.17.5 regarding an engine failure after passing the final approach fix.

**7.16.5. Enhanced Vision Systems (EVS), Synthetic Vision Systems (SVS), or Independent Landing Monitor (ILM).** Training required for enhanced vision systems or synthetic vision systems, or independent landing monitor may be specified by FAA based on successful completion of proof of concept testing, as applicable. Pertinent requirements are as specified in the applicable FSB report.

**8. AIRPORTS, NAVIGATION FACILITIES, AND METEROLOGICAL CRITERIA.** U.S. and non-U.S. airports and runways authorized for Category I and II are those either having published part 97 SIAPS, or as otherwise specified on the FAA AFS-400 "Category II status checklist" (Order 8400.8). Requests for authorization to use other airports/runways should be coordinated with AFS-400, through the operator's CHDO.

**8.1. Use of Standard Navigation Facilities.**

**a.** U.S. Category I approaches may be approved as published by part 97 SIAPS or as special procedures in OpSpecs

**b.** Category II operations may be approved on standard U.S. or ICAO navigation facilities as follows:

**(1)** U.S. ILS facilities for which part 97 Category II procedures are published;

**(2)** Other U.S. ILS facilities deemed acceptable by AFS-400 for the type of aircraft equipment and minima sought;

**(3)** Non-U.S. facilities meeting ICAO criteria (ICAO Annex 10, ICAO Manual of All Weather Operations DOC 9365/AN910, etc.) and which are promulgated for use for Category II by the "State of the Aerodrome;" and

**(4)** Category II operations require facilities assessed and classified at least through point D (e.g., II/T/2).

**8.2. Use of Other Navigation Facilities or Methods.** Category I or II operations may be approved using other types of navigation facilities or using other acceptable position fixing and integrity assurance methods, if proof of concept demonstrations acceptable to FAA are successfully completed:

**a.** Other U.S. facilities approvable for Category I and II (MLS, DGPS, or ILS used in conjunction with an acceptable aircraft integrity assurance system, etc.) are as determined acceptable by AFS-400;

**b.** Non-U.S. ILS facilities meeting acceptable criteria other than ICAO (e.g., JAA) may be used as determined to be acceptable by AFS-400;

**c.** Operations may be approved using other types of navigation facilities or using other acceptable position fixing and integrity assurance methods, if proof of concept demonstrations acceptable to FAA are successfully completed;

**d.** Other U.S. facilities approvable for Category II (e.g., MLS, DGPS, Type I ILS used in conjunction with an acceptable aircraft integrity assurance system) are as determined acceptable by AFS-400; and

**e.** Non-U.S. ILS facilities meeting acceptable criteria other than ICAO (e.g., JAA), may be used as determined to be acceptable by AFS-400.

**8.3. Lighting Systems.** Lighting for Category I is as specified by Standard OpSpecs, part 97 SIAPS, or any special provisions or procedures identified in OpSpecs.

**a.** Lighting used for Category II must include the following systems, or ICAO equivalent systems, unless approved by AFS-400 (e.g., special provisions for Non-U.S. airports) or specific aircraft systems such as HUD or autoland:

- U.S. Standard ALSF 1 or ALSF 2 approach lights;
- U.S. Standard Touchdown Zone Lights;
- U.S. Standard Runway Centerline Lights; and
- U.S. Standard High Intensity Runway Lights.

**b.** Exceptions to the above lighting criteria may be authorized only if an equivalent level of safety can be demonstrated by an alternate means (e.g., substitution for required approach lighting components due to use of an approved aircraft system providing equivalent information or performance, such as use of an autoland system, head up display (HUD) with inertially augmented flight path vector display), or availability of redundant, high integrity, computed or sensor based (e.g., high resolution radar) runway information, suitably displayed to a pilot.

**8.4. Marking and Signs.** Marking and signs for Category I procedures with visibilities less than 3/4 statute mile (RVR 4000) are as specified by the FAA for precision approach runways in the 150/5300 series ACs, except as otherwise authorized by AFS-400.

**a.** Airports approved for Category II must include the following runway and taxiway markings and airport surface signs, or ICAO equivalent, unless approved by AFS-400 (e.g., for Non-U.S. airports):

**(1)** U.S. Standard Precision Instrument Runway Markings,

**(2)** U.S. Standard Taxiway edge and centerline Markings, and

**(3)** Runway signs, taxiway signs, hold line signs, taxiway reference point markings (if required by SMGCS), and NAVAID (ILS) critical area signs and markings.

**b.** For Category II, markings and signs must be in serviceable condition, as determined by the operator or FAA CHDO. Markings or signs found in an unacceptable condition by an operator should be reported to the appropriate airport authority and CHDO. Operators should discontinue Category II use of those areas of airport facilities or runways where unsafe conditions are known to exist due to markings or signs being inadequate, until remedial actions are taken by the airport authority (e.g., snow removal, rubber deposit removal on runway touchdown zone markings or centerline markings, critical area hold line or runway centerline marking repainting, runway hold line sign snow removal).

**8.5. Low Visibility Surface Movement Guidance and Control System (SMGCS) Plans.**

**a.** Surface movement guidance and control plans are recommended for operations below Category I. Where such plans are used, Operators intending authorization for Category II should coordinate with the airport authority regarding the use of a SMGCS plan prior to OpSpec authorization for that airport. Equivalent coordination should also be completed at non-U.S. airports if such a plan is used by that airport.

**b.** U.S. airports conducting takeoff or landing operations below 1,200 ft. RVR are required to develop a Surface Movement Guidance and Control System (SMGCS) plan. SMGCS operations facilitate low visibility takeoffs and landings and surface traffic movement by providing procedures and visual aids for taxiing aircraft between the runway(s) and apron(s). Specific low visibility taxi routes are provided on a separate SMGCS airport chart. SMGCS operations also facilitate the safety of vehicle movements that directly support aircraft operations such as aircraft rescue and fire fighting (ARFF), follow-me services, towing, and marshaling.

**c.** AC 120-57 describes the standards and provides guidance in implementing SMGCS operations such as aircrew training, etc. An operator intending authorization for Category III operations should coordinate with the airport authority regarding their SMGCS plan. Equivalent coordination is also applicable at non-U.S. airports if such a plan is used by that airport.

**d.** For low visibility operations requiring a SMGCS plan, separation of at least 500 ft should typically exist between the centerline of any runway to be used and the centerline of any adjacent taxi way. When this runway to taxiway distance is less than 500 ft, an on-site evaluation on a case by case basis may be appropriate to establish SMGCS procedures.

**8.6. Meteorological Services and RVR.**

**8.6.1. Meteorological Services.** For Category I, standard meteorological reporting required by part 121 and 135 is acceptable. For Category II, appropriate meteorological service (e.g., RVR, RVV, METAR, TAF, Braking Action, NOTAM, etc., reports, as applicable) are necessary for each airport/runway intended for use by an operator for Category II, unless otherwise approved by AFS-400. Non-U.S. facilities should meet criteria of ICAO Doc 9365/AN910, second edition, or later.

**8.6.2. RVR Availability and Use Requirements.**

**8.6.2.1. RVR Availability.**

**a.** For Category II, RVR availability requirements for touchdown zone (TDZ), mid runway (MID), and ROLLOUT RVR (or a corresponding international equivalent location) should be provided for any runway over 8000 ft in length. TDZ and ROLLOUT RVR should be provided for runways less than 8000 ft. Exceptions to this requirement for U.S. Operators at international locations may be approved on a case by case basis by AFS-400, if an equivalent level of safety can be established. Factors considered due to local circumstances at foreign airports may include minima requested, landing field length requested, characteristics of prevailing local weather conditions, location of RVR sites or RVR calibration, availability of other supporting weather reports on nearby runways, etc.

**b.** Aircraft requiring a landing or takeoff distance in normal operation (using operational braking techniques) less than 4000 ft may be approved to use a single TDZ, MID, or ROLLOUT RVR report as applicable to the part of the runway used. For such operations, RVR values not used are optional and advisory, unless the aircraft operation is planned to take place on the part of the runway where a MID or ROLLOUT RVR is located.

**8.6.2.2. RVR Use.** In general, the controlling RVR for Takeoff, Landing and Rollout are as follows:

**a.** Take-off:

**(1)** Where visibility minima are applicable, visibility must be reported sufficiently close to the takeoff runway to be considered valid or applicable. The determination of acceptability, if not otherwise addressed by FAA, may be determined by the operator or CHDO.

**(2)** Where RVR minima are applicable, RVR must be reported, and the RVR minimum value is considered to be controlling at each relevant RVR reporting point. The RVR/Visibility representative of the initial part of the take-off may be replaced by pilot assessment. For take-off operations the relevant RVR refers to any portion of the runway that is needed for takeoff roll, including that part of the runway that may be needed for a rejected take-off.

**b.** Landing.

**(1)** Where visibility minima are applicable, visibility must be reported sufficiently close to the landing runway to be considered valid or applicable. The determination of acceptability, if not otherwise addressed by FAA, may be determined by the operator or CHDO. Where RVR is used, the controlling RVR for all Category I operations is the touchdown RVR. All other readings, if any, are advisory.

**(2)** The controlling RVR for Category II (for Category III see AC 120-28D) with or without rollout guidance control system is the TDZ RVR or equivalent. Mid and rollout RVR are advisory, unless otherwise specified in OpSpecs.

> **NOTE: An acceptable alternate set of OpSpecs specifying minimum values for MID and ROLLOUT RVRs may be provided for airplanes without a rollout guidance or control system. If determined appropriate by the FAA, and agreed to by the operator, TDZ, MID, and ROLLOUT may be specified as controlling. MID RVR, if relevant, may not be less than 400-ft. (125-meters). ROLLOUT RVR, if relevant, may not be less than 300-ft. (75-meters). For landing operations, the relevant RVR refers to the portion of the runway that is needed for landing down to a safe taxi speed (typically below 60-knots for large turbojet aircraft).**

**(3)** "Inoperative RVR" requirements for dispatch or continuation of a particular flight operation are as specified in standard OpSpecs Part C, or any special OpSpec provision unique to a particular operator. Unless otherwise approved, in special OpSpecs provisions, the controlling RVR must be operating for all operations based on RVR minima.

**c.** RVR use by Operators and pilots (controlling and advisory RVR reports) is as specified in standard OpSpecs Part C (see Appendix 7). Since RVR reports can be influenced by runway light step settings, Operators should be familiar with and pilots should be familiar with and appropriately request adjustments to light step settings if necessary, to ensure best visual reference and to appropriately affect RVR reported values.

**8.6.2.3. Alternate RVR Requirements for Short Field Length Operations.** When approved as an exception in OpSpecs, aircraft capable of certificated landing or takeoff distance of less than 4000 ft (using operational braking techniques) may be approved to use a single TDZ, MID, or ROLLOUT RVR as applicable to the part of the runway used. For such operations, RVR values not used are considered to be optional and advisory, unless the aircraft operation is planned to take place on the part of the runway where a MID or ROLLOUT transmissometer is located.

**8.6.2.4. International RVR Reporting and Use Equivalence Considerations.** For RVR reporting and use outside of the United States, where international transmissometer locations may be specified by terms or locations other than TDZ, MID, or ROLLOUT as is done in the United States (e.g., International transmissometer locations A, B, C, D, or 1, 2, 3, 4), the operator may appropriately equate international transmissometer locations and reports to equivalent U.S. transmissometer positions and reports for the purpose of applying OpSpecs provisions. This applies to transmissometers installed, available, reports, or controlling minima determinations. Unless specifically precluded from doing so by the State of the Aerodrome, Airport Authority, or FAA, where the number of transmissometers available on a runway is different internationally than typically is available in the United States (e.g., 4 RVR locations on a runway internationally versus 3 in the United States), the operator may determine equivalent suitability of RVR availability, reporting, or minima controlling locations. The operator may correspondingly specify suitable equivalent RVR provisions for flightcrew use. When making such a determination the operator should consider the applicable portions of the runway used by the aircraft type(s) in question for touchdown and landing rollout. For takeoff, the operator should consider portions of the runway used both for a continued takeoff and for a rejected takeoff. The operator may also specify acceptable RVR substitutions that may be made for inoperative transmissometers or missing reports. However, for any such determinations, RVR coverage and reporting should be available that is at least equivalent to that which would be otherwise be permitted at authorized U.S. airports.

**8.6.3. Pilot Assessment of Takeoff Visibility Equivalent to RVR. (See also 4.2. b and c).** In special circumstances, provisions may be made for pilot assessment of takeoff visibility equivalent to RVR to determine compliance with takeoff minima. Provisions to authorize pilot assessed RVR is provided through Standard Operations Specifications. A pilot may assess visibility at the take off position in lieu of reported TDZ RVR (or equivalent) IAW the requirements detailed below:

**a.** TDZ RVR is inoperative, or is not reported (e.g., TDZ RVR inoperative, ATS facility is closed); or

**b.** Local visibility conditions as determined by the pilot indicate that a significantly different visibility exists than the reported RVR (e.g., patchy fog, blowing snow, RVR believed to be inoperative or inaccurate); and

**c.** Pertinent markings, lighting, and electronic aids are clearly visible and in service (e.g., no obscuring clutter); and

**d.** The assessment is made using an accepted method regarding identification of an appropriate number of centerline lights, or markings, of known spacing visible to the pilot when viewed from the flight deck when the aircraft is at the take-off point; and

**e.** Pilot assessment of visibility as a substitute for TDZ (takeoff) RVR is approved for the operator, and observed visibility is determined to be greater than the equivalent of 300 RVR (90m); and

**f.** A suitable report of the pilot's determination of visibility is forwarded to ATS or to the operator, as applicable (e.g., if an ATS facility is available and providing ATS services, or if the operator elects to receive such reports).

**NOTE: A suitable report of a pilot's determination of visibility provided to ATS or to the operator is intended to facilitate other operations and timely distribution of meteorological information. It is not intended to be a verification of minima or limit or restrict minima for the aircraft making the report.**

**8.7. Critical Area Protection.** Airports and runways used for Category I and II must have suitable NAVAID (e.g., ILS) critical area protection, as applicable to the ground and aircraft systems used. Procedures equivalent or more stringent than those in the U.S. AIM and FAA Order 7110.65 are required. Procedures consistent with ICAO DOC 9365/AN910 are acceptable for non-U.S. facilities. Where uncertainty regarding acceptability of non-U.S. airport procedures is a factor, Operators or CHDOs should contact AFS-400 (e.g., for non-U.S. airports and runways listed on the FAA Category II status checklist where doubt exists regarding adequacy of procedures encountered in routine operations) for follow-up.

**8.8. Operational Facilities, Outages, Airport Construction, and NOTAMs.** For operations to be initially authorized, operations to continue to be authorized, an aircraft to be dispatched with the intention of using a facility described above, or an aircraft to continue to its destination or an alternate with the intent of completing a Category I and II instrument approach procedure, Operators must consider the status of components identified in 8.1 through 8.7 above, as necessary for Category I or II (NAVAIDs, standby power, lighting systems, etc.) and take appropriate action for inoperative components. The following guidelines are considered acceptable unless otherwise precluded in OpSpecs:

**a.** Outer, Middle, or Inner marker beacons may be inoperative unless a Category I or II operation is predicated on their use (e.g., a DH is predicated on use of an Inner Marker due to irregular terrain, the aircraft system requires use of a marker beacon for proper function).

**b.** Lighting systems are in normal status except that isolated lights of an approach light, or runway light system may be inoperative; approach light components not necessary for the particular operation such as REIL, VGSI, RAIL, etc. may be inoperative; lights may not be completely obscured by snow or other such contaminants if necessary for the operation (e.g., night).

**c.** Operations may be continued at airports at which construction projects affect runways, taxiways, signs, markings, lighting, or ramp areas only if the operator has determined that low visibility operations may be safely conducted with the altered or temporary facilities that are provided. In the event of uncertainty as to the suitability of facilities, the operator should consult with their CHDO.

**d.** NOTAMs for NAVAIDs, facilities, lighting, marking, or other capabilities must be appropriately considered for both dispatch, and for continued flight operations intending to use a Category I or II procedure. Operators and flightcrews must respond appropriately to NOTAMs that could adversely affect the aircraft system operation, or the availability or suitability of Category I or II procedures at the airport of landing, or any alternate airport intended for Category I and II.

**e.** An operator may make the determination that a NOTAM does not apply to the aircraft system and procedures being used for a particular flight if the safety of the operation can be ensured, considering the NOTAM and situation.

**8.9. Use of Military Facilities.** Military facilities may be used for Category I and II if authorized by DOD, and if equivalent criteria are met as applicable to U.S. civil airports.

**8.10. Special Provisions for Facilities Used for ETOPS or EROPS Alternates.** In addition to criteria specified above, an airport used as an ETOPS or EROPS Category II engine-out alternate should meet the following criteria:

**a.** Sufficient information about pre-threshold terrain, missed approach path terrain, and obstructions must be available so that an operator can ensure that a safe Category II landing can be completed, and that an engine-out missed approach can be completed from the specified DH.

**b.** Sufficient meteorological and facility status information must be available so that a diverting flightcrew, and dispatcher if applicable, can receive timely status updates on facility capability, weather/RVR, wind components, and braking action reports (if applicable), if conditions could or would adversely affect a planned Category II landing during the period of an ETOPS or EROPS diversion.

**c.** For any alternate airports not routinely used in normal operations by that operator's flightcrews (e.g., Keflavik, Iceland - BIKF), sufficient information should be provided for flightcrews, or dispatchers if applicable, to be familiar with relevant low visibility and adverse weather characteristics of that airport that might have relevance to an engine-out diversion operation (e.g., unique lighting or markings, any nearby obstructions or frequently encountered local windshear or turbulence characteristics, meteorological report, braking report, and NOTAM interpretation, appropriate ground taxi route and gate location information, emergency services available).

**8.11. Alternate Minima.** Use of alternate minima are specified in Standard OpSpecs Part C paragraph C055. For applicability of "engine inoperative Category II" capability see paragraph 10.8.

**a.** Paragraph C055 is issued to all part 121 and part 135 Operators who conduct IFR operations with airplanes. This paragraph provides a three-part table from which the operator, during the initial dispatch or flight release planning segment of a flight, derives alternate airport IFR weather minimums in those cases where it has been determined that an alternate airport is required.

**b.** The first part of the table is for airports with at least one operational navigational facility providing a straight-in non precision approach procedure, or a straight-in precision approach procedure, or, when applicable, a circling maneuver from an instrument approach procedure. The required ceiling and visibility is obtained by adding 400 ft. to the Category I HAT or, when applicable, the authorized HAA and by adding 1 sm to the authorized Category I landing minimum, etc.

**c.** Special provisions for Category II and Category III engine-out capability are listed in the third part of the table for airports with at least two operational navigational facilities, each providing a straight-in precision approach, including a precision approach procedure to Category II DA(H) or Category III. The required ceiling and visibility is obtained by adding 200 ft. to the respective lowest Category II or Category III touchdown zone elevation of the two approaches used and by adding RVR 1200 to the lowest authorized minimum.

**8.12. Dispatch or Release to Airports that are Below Landing Minima.**

**a.** In certain instances, an operator may dispatch or release an airplane under instrument flight rules when conditional language of the weather forecast states that the weather at the destination and/or alternate airport could be below the authorized weather minimums. This is to permit aircraft to begin a flight if there is a reasonable expectation that at or near the expected time of arrival at the destination airport, weather conditions are expected to permit a landing at or above landing minima.

**b.** Dispatch or release to such airports is typically authorized by exemption and is considered acceptable under the terms and limitations of the exemption and if the following conditions are met:

**(1)** All requirements are met to use the landing minimum at the destination airport and at each alternate airport on which the dispatch or release is predicated (e.g., aircraft, crew, airport facilities, NAVAIDs).

**(2)** If Alternate minima credit is applied based on availability of Category II capability, or engine inoperative Category II capability, then each of the airborne systems otherwise applicable to the use of that capability must be available at the time of dispatch or release (e.g., flight guidance system, thrust reverse capability, as applicable to the aircraft type and Category II authorization for that operator)

**(3)** ETA at the destination airport considers any necessary holding fuel that may be required while the aircraft waits for weather improvement.

**(4)** Air Traffic conditions are considered for potential delay due to other aircraft arrivals or departures at the destination airport and at each alternate airport.

**(5)** At least two qualifying alternates are available, the first of which considers the aircraft flying to the below minima intended destination, then holding for a time as determined by the operator awaiting approach or weather improvement, then flying to the closest alternate, then completing an approach and missed approach at that airport, and then flying to the second alternate and landing with appropriate reserve fuel.

**8.13. Temperatures and Temperature Extremes.**

**a.** The operator should address appropriate flightcrew and dispatch (if applicable) use of temperature in degrees C, degrees F, and conversion between C and F, if necessary.

**b.** The operator should address appropriate flightcrew and dispatch (if applicable) use of procedures to compensate for extremely cold temperatures, if necessary (e.g., below -22F/-30C - See also paragraphs 4.3.1.1 item g, 4.3.4. c., 6.2.13, and 7.1.3. items d and h).

**c.** The operator should address appropriate flightcrew and dispatch procedures (if applicable) for use of temperatures near or possibly beyond the AFM range, if operations are necessary or are reasonably expected to be conducted at or near AFM limits (e.g., runway temperatures near or above 120 degrees F or near or below -54 degrees F).

**8.14. Pressures and Unusually High or Low Pressures.**

**a.** The operator should address appropriate flightcrew and dispatch procedures (if applicable) for identification of and appropriate setting and use of QNH, QNE, and QFE (if used). This should include emphasis on distinguishing appropriate use of metric versus non-metric units for altimeter settings as used by that operator (e.g., hectopascals (HPa), millibars (MB), or inches (in)). Emphasis should be placed on assuring use of proper settings for easily confused values for altimeter settings, particularly when abbreviated settings are used in ATS radiotelephony, ATIS messages, or checklists (e.g., “altimeter 993” being mistakenly confused for 29.93 inches instead of 0993 HPa when the appropriate units are metric).

**b.** The operator should address any appropriate flightcrew and dispatch procedures (if applicable) for unusually low pressures if necessary for safe operations (e.g., unusable altitudes or flight levels of instrument procedures).

**c.** The operator should address appropriate flightcrew and dispatch procedures (if applicable) for use of transition Level and transition altitude.

**d.** If applicable, the operator should address appropriate flightcrew and dispatch procedures or limitations, as necessary, for use of VNAV in states using QFE for approach.

## 9. CONTINUING AIRWORTHINESS / MAINTENANCE.

**9.1. Maintenance Program General Provisions.** As approved by FAA, each operator should have an approved continuous airworthiness maintenance program (CAMP) in place. The approved CAMP should include any necessary provisions to address lower landing minima (LLM), or low visibility takeoff, IAW the operator's intended operations and the manufacturers recommended maintenance program. An LLM program may be an extension of a CAMP. A maintenance program should consider any applicable MRB requirements or equivalent requirements (e.g., AD's, mandatory service bulletins) that may relate to low visibility operations. Emphasis should be on maintaining and ensuring total system performance, accuracy, availability, reliability, and integrity for the intended low visibility operations.

**9.2. Maintenance Program Requirements.** The maintenance program should be compatible with an operator's organization and ability to implement and supervise the program. Maintenance personnel should be familiar with the Operators approved program, their individual responsibilities in accomplishing that program, and availability of any resources within or outside of the maintenance organization that may be necessary to ensure program effectiveness (e.g., getting applicable information related to the manufacturer's recommended maintenance program, getting information referenced in this AC such as service bulletin information).

**a.** Provision for low visibility operations may be addressed as a specific program or may be integrated with the general maintenance program.

**b.** Regardless of whether the maintenance program is integrated, or is designated as a specific program for LLM, the maintenance program should at least address the following:

**(1)** Maintenance procedures necessary to ensure continued airworthiness relative to low visibility operations.

**(2)** A procedure to revise and update the maintenance program.

**(3)** A method to identify, record, or designate personnel currently assigned responsibility in managing the program, performing the program, maintaining the program, or performing quality assurance for the program. This includes identification of any contractor or sub-contractor organizations, or where applicable, their personnel.

**(4)** Verification should be made of the lower landing minima systems and configuration status for each aircraft brought into the maintenance or lower minimum program. Unless otherwise accepted by FAA, each aircraft should meet relevant criteria specified by the applicable aircraft manufacturer or avionics manufacturer for associated systems and equipment (e.g., Valid U.S. Type Certificate (TC), appropriate Supplementary Type Certificate (STC) records and compliance, assessment of status of any engineering orders, Airworthiness Directives (AD), service bulletins or other compliance).

**(5)** Identification of modifications, additions, and changes which were made to qualify aircraft systems for the intended operation or minima, if other than as specified in the AFM, TC or STC.

**(6)** Identification of maintenance requirements and log entries necessary to change minima status.

**(7)** Any discrepancy reporting procedures that may be unique to the low visibility program. If applicable, such procedures should be compatibly described in maintenance documents and operations documents.

**(8)** Procedures that identify, monitor, and report lower minimum system and component discrepancies for the purpose of quality control and analysis.

**(9)** Procedures that define, monitor, and report chronic and repetitive discrepancies.

**(10)** Procedures that ensure aircraft remain out of lower minimum status until successful corrective action has been verified for chronic and repetitive discrepancies.

**(11)** Procedures that ensure the aircraft system status is placarded properly and clearly documented in the aircraft log book, in coordination with maintenance control, engineering, flight operations, and dispatch, or equivalent.

**(12)** Procedures to ensure the downgrade of an aircraft low visibility capability status, if applicable, when maintenance has been performed by persons other than those trained, qualified, or authorized to use or approve procedures related to low visibility operations.

**(13)** Procedures for periodic maintenance of systems ground check, and systems flight check, as applicable. For example, following a heavy maintenance, suitable checks may need to be performed prior to return to service.

**(14)** Provisions for an aircraft to remain in a specific low visibility capability status (e.g., Category II, Fail-Operational, Fail Passive) or other designated operational status used by the operator.

**(15)** Provision should be made for periodic operational sampling of suitable performance. Typically, at least one satisfactory approach should have been accomplished within a specified period approved for that operator, unless a satisfactory systems ground check has been accomplished. A recording procedure for both satisfactory and unsatisfactory results should be included. Fleet sampling is not typically acceptable in lieu of specific aircraft assessment. Typically at least one satisfactory low visibility system operational use, or a satisfactory systems ground check, should be accomplished within 6 months, or within a period as specified by the aircraft or avionics manufacturer for an aircraft to remain in Category II status.

**NOTE: Maintenance programs meeting requirements for and approved for Category III typically are also considered acceptable for Category II. Aircraft low visibility systems status, however, must be clearly identified for pilots, maintenance, and dispatch, when combined programs are used.**

**9.3. Initial and Recurrent Maintenance Training.**

**a.** Maintenance personnel should be knowledgeable regarding the information contained in this AC and 14 CFR related to any significant aspects of LLM that may pertain to maintenance. Operator and contract maintenance personnel including mechanics, maintenance controllers, avionics technicians, personnel performing maintenance inspection or quality assurance, or other engineering personnel if applicable, should receive initial and recurrent training as necessary for an effective program. The training curriculum should include specific aircraft systems and operator policies and procedures applicable to low visibility operations. Recurrent training should typically be accomplished at least annually, or when a person has not been involved in the maintenance of the specified aircraft or systems for an extended period (e.g., greater than 6 months). Training may lead to a certification or qualification (e.g., for lower landing minima “LLM”) if the operator so designates such qualification in that operator’s approved program.

**b.** The training should at least include, as applicable:

**(1)** An initial and recurrent training program for appropriate operator and contract personnel. Personnel considered to be included are maintenance personnel, quality and reliability groups, maintenance control, and incoming inspection and stores, or equivalent organizations. Training should include both classroom and at least some “hands-on” aircraft training for those personnel who are assigned aircraft maintenance duties. Otherwise, training may be performed in a classroom, by computer based training, in simulators, in an airplane or in any other effective combination of the above consistent with the approved program, and considered acceptable to FAA.

**(2)** Subject areas for training should include: Operational concepts, aircraft types and systems affected, aircraft variants and differences where applicable, procedures to be used, manual or technical reference availability and use, processes, tools, or test equipment to be used, quality control, methods for testing and return to service, signoffs required, proper Minimum Equipment List (MEL) application, general information about where to get technical assistance as necessary, necessary coordination with other parts of the operator's organization (e.g., flight operations, dispatch), and any other maintenance program requirements unique to the operator or the aircraft types or variants flown (e.g., human factors considerations, problem reporting).

**(3)** Procedures for the use of outside vendors or vendor's parts that ensures compatibility to program requirements and for establishing measures to control and account for parts overall quality assurance.

**(4)** Procedures to ensure tracking and control of components that are "swapped" between systems for trouble shooting when systems discrepancies can not be duplicated. These procedures should provide for total system testing and/or removal of aircraft from lower minimum status.

**(5)** Procedures to assess, track, and control the accomplishment of changes to components or systems pertinent to low visibility operations (e.g., ADs, service bulletins, engineering orders, 14 CFR requirements).

**(6)** Procedures to record and report lower minimum operation(s) that are discontinued/interrupted because of system(s) malfunction.

**(7)** Procedures to install, evaluate, control, and test system and component software changes, updates, or periodic updates.

**(8)** Procedures related to the minimum equipment list (MEL) remarks section use, which identify low visibility-related systems and components, specifying limitations, upgrading, and downgrading.

**(9)** Procedures for identifying and addressing performance assurance for any necessary low visibility-related components and systems, such as for use of "built in test" features, for required inspection items, and for providing quality assurance, whether performed in-house or by contract vendors.

**9.4. Test Equipment/Calibration Standards.** Test equipment may require periodic re-evaluation to ensure it has the required accuracy and reliability to return systems and components to service following maintenance. A listing of primary and secondary standards used to maintain test equipment that relate to low visibility operations should be maintained. It is the operator's responsibility to ensure these standards are adhered to by contract maintenance organizations. Traceability to a national standard or the manufacturer's calibration standards should be maintained.

**9.5. Return To Service Procedures.**

**a.** Procedures should be included to upgrade or downgrade system status concerning low visibility operations capability. The method for controlling operational status of the aircraft should ensure that flightcrews, maintenance and inspection departments, dispatch, and other administrative personnel as necessary are appropriately aware of aircraft and system status.

**b.** The appropriate level of testing should be specified for each component or system. The manufacturer's recommended maintenance program or maintenance instructions should be considered when determining the role built-in-test-equipment (BITE) should play for return to service (RTS) procedures, or for use as a method for low visibility status upgrade or downgrade.

**c.** Contract facilities or personnel should follow the operator's FAA-approved maintenance program to approve an aircraft for return to service. The operator is responsible for ensuring that contract organizations and personnel are appropriately trained, qualified, and authorized.

**9.6. Periodic Aircraft System Evaluations.**

**a.** The operator should provide a method to continuously assess or periodically evaluate aircraft system performance to ensure satisfactory operation for those systems applicable to Category II. An acceptable method for assuring satisfactory performance of a low visibility flight guidance system (e.g., autoland or HUD) is to periodically use the system and note satisfactory performance. A reliable record such as a logbook entry or computer ACARS record showing satisfactory performance within the previous 6 months for Category II is typically an acceptable method for assuring satisfactory system operation.

**b.** Periodic flight guidance system/autoland system checks should be conducted IAW procedures recommended by the airframe or avionics manufacturer, or by an alternate procedure approved by the FAA. For periodic assessment, a record should be established to show when and where the flight guidance/autoland system was satisfactorily used, and if performance was not satisfactory, to describe any remedial action taken.

**c.** Use of the flight guidance/automatic landing system should be encouraged to assist in maintaining its availability and reliability.

**9.7. Reliability Reporting And Quality Control.**

**9.7.1. Reliability Reporting - Category I.** No special "Reliability Reporting or Quality Control" requirements are applicable to Category I.

**9.7.2. Reliability Reporting - Category II.** For a period of 1 year after an applicant has been authorized for Category II, a monthly summary should be submitted to the certificate holding office. The following information should be reported:

**a.** The total number of approaches tracked, the number of satisfactory approaches tracked, by aircraft/system type, and visibility (RVR), if known or recorded.

**b.** The total number of unsatisfactory approaches, and reasons for unsatisfactory performance, if known, listed by appropriate category (e.g., poor system performance, aircraft equipment problem/failure; ground facility problem, ATS handling, lack of critical area protection, or other).

**c.** The total number of unscheduled removals of components of the related avionics systems.

**d.** Reporting after the initial period should be IAW the Operators established reliability and reporting requirements.

**9.8. Configuration Control/System Modifications.** The operator should ensure that any modification to systems and components approved for low visibility operations are not adversely affected when incorporating software changes, service bulletins, hardware additions, or modifications. Any changes to system components should be consistent with the aircraft manufacturer's, avionics manufacturer's, industry, or FAA accepted criteria or processes.

**9.9. Records.**

**a.** The operator should keep suitable records (e.g., both the operator's own records and access to records of any applicable contract maintenance organization). This is to ensure that both the operator and FAA can determine the appropriate airworthiness configuration and status of each aircraft intended for Category II operation.

**b.** Contract maintenance organizations should have appropriate records and instructions for coordination of records with the operator.

**9.10. Part 129 Foreign Operator Maintenance Programs.**

**9.10.1. Maintenance of Part 129 Foreign Registered Aircraft.** For part 129 Operators of Foreign registered aircraft (e.g., section 129.14 is not applicable), the cognizant Civil Aviation Authority (CAA) is the CAA of the operator. For those situations, FAA may implicitly accept that the maintenance program is considered to be acceptable if the cognizant CAA has approved it, and if the operator or CAA indicates that the program meets U.S.

criteria, U.S. equivalent criteria (e.g., criteria such as JAA criteria), or ICAO criteria (e.g., Annex 6 and Doc 9365/AN910 “Manual of All Weather Operations”), and the cognizant CAA has authorized Category II U.S. operations. FAA then issues the pertinent part 129 Category II OpSpec based on the other CAA’s approval for that operator. However, FAA reserves the prerogative to ensure competence of both the operator and authorizing and supervising CAA, depending on whether the CAA or operator are considered to be from a category 1, 2, or 3 country (safety classification, not a low visibility landing classification), and if there have been any reported problems with the operator or CAA. Evidence of the operator satisfying or being consistent with the manufacturer’s recommended maintenance program should serve as evidence of an acceptable maintenance program, regardless of the capability of the CAA or the operator, unless FAA has specifically addressed maintenance requirements beyond those of the manufacturer for that aircraft type (e.g., required service bulletin compliance or Airworthiness Directive compliance related to the flight guidance system).

**9.10.2. Maintenance of Part 129 Foreign Operated U.S. “N” Registered Aircraft.** Foreign Operators of U.S. “N” Registered Aircraft (e.g., those Operators to which section 129.14 is applicable) should have maintenance programs equivalent to that required for a U.S. part 121 operator. Use of the part 91 provisions for General Aviation are not applicable or appropriate. POI Approval of Category II OpSpecs for a section 129.14 operator may implicitly be considered to also accept the maintenance program adequacy. Accordingly, coordination between the applicable POI and PMI is necessary before part 129 OpSpec authorization is completed. FAA is ultimately the cognizant CAA for the maintenance program in this instance, if the aircraft is N registered. However, FAA may accept the oversight of the operator’s CAA if that CAA is judged by FAA to have equivalent processes, criteria and procedures for oversight of maintenance programs (e.g., JAA countries). The basis for any such maintenance program should be the recommended airframe manufacturer (or avionics vendor) program, considering any adjusted MRB requirements.

**10. APPROVAL OF U.S. OPERATORS.**

**a.** Approval for Category I and II is through issuance of, or amendments to, OpSpecs. The authorizations, limitations, and provisions applicable to Category I and II operations are specified in Part C of the OpSpecs. Sample OpSpecs are provided in Appendix 7.

**b.** OpSpecs authorizing reciprocating and turbo-propeller-powered airplane Category I operations that use ICAO standard NAVAIDs and ASRs, and PARs are normally approved by the certificate holding district office without further review and concurrence, following satisfactory completion of the pertinent items below. Category I turbojet, turbofan, and prop-fan normally require regional flight standards review and concurrence before approval. All Category II operations and operations using NAVAIDs which are not ICAO-standard NAVAIDs (e.g., Loran C, ARA, OSAP, and TLS) normally require both regional flight standards and AFS-400 review and concurrence before approval.

**10.1. Operations Manuals and Procedures.** Appropriate flightcrew operating manuals, aircraft flight manuals, policy manuals, aircraft checklists, quick reference checklists, maintenance manuals, training manuals or other equivalent operator documents (as necessary), must satisfactorily incorporate pertinent Category I and II provisions prior to Category I and II approval.

**a. Manuals.**

**(1)** Prior to approval, appropriate flightcrew operating manuals, flight manuals, airline policy manuals, maintenance manuals, training manuals, and related aircraft checklists, quick reference handbooks, or other equivalent operator information, must satisfactorily incorporate provisions pertinent to each category of operation.

**(2)** Information covered in ground training, and procedures addressed in flight training should be available to flightcrews, and to dispatchers as applicable, in an appropriate form for reference use.

**b. Procedures.** Prior to approval of Category I or II operations, provisions of paragraph 6 of this AC that cover procedures, duties, instructions, or any other necessary information to be used by flightcrews, or dispatchers as applicable, should be implemented by the operator.

**(1)** Flight crewmember duties during the approach, flare, rollout, or missed approach should be described. Duties should at least address responsibilities, tasks of the pilot flying the aircraft and the pilot not flying the aircraft during all stages of the approach, landing, rollout, and missed approach. The duties of additional flight crewmembers, if required, should also be explicitly defined.

**(2)** Specification of flight crewmember duties should address any needed interaction with dispatch or maintenance (e.g., addressing resolution of aircraft discrepancies and return to Category II/III service).

**(3)** The applicant’s qualification program should incorporate specific procedural responsibilities, appropriate to each category of landing minima being implemented, for the pilot in command and second in command in each of the ground training subject areas listed in paragraph 7.1, and each of the flight training subject areas listed in paragraph 7.2.

**10.2. Training Programs and Crew Qualification.**

**a.** Training programs, AQP programs (if applicable), crew qualification and checking provisions and standards, differences qualification (AC 120-53) if applicable, check airmen qualification, line check, route check, and IOE programs should each satisfactorily incorporate necessary Category I and II provisions, as applicable (see paragraphs 7.1 through 7.9). An acceptable method to track pertinent flight crewmember Category I and II qualification must be established.

**b.** For manually flown Category I and II systems (HUD, FDs, etc.,) ensure that provisions are made for each flight crewmember to receive the appropriate training, qualification, and line experience before that particular flight crewmember is authorized to use the pertinent Category I and II minima.

**10.3. Dispatch Planning (e.g., MEL, Alternate Airports, ETOPS).** Appropriate provisions for MELs and CDLs should be made as necessary to address Category I and II operations. Dispatch procedures to ensure appropriate weather, field condition, facility status, NOTAM information, engine-out MAP performance, crew qualification, aircraft system status, and fuel planning pertinent to Category I and II should be implemented. For ETOPS operations, a satisfactory method to address item 8.10 above should be demonstrated.

**10.4. Formulation of Operations Specification Requirements (e.g., RVR limits, DA(H) or MDA(H), equipment requirements, field lengths).** Proposed OpSpecs should list pertinent approved airports/runways, RVR limits, required transmissometers, DA(H) use provisions, “Inner Marker based DH” provisions (if applicable), aircraft equipment provisions for “normal” and, if applicable, “engine-out” operations, landing field length provisions, and any other special requirements identified by the CHDO or AFS-400 (ETOPS Category II, etc.). The operator’s manuals, procedures, checklists, QRHs, MELs, dispatch procedures etc. must be shown to be consistent with the proposed OpSpecs.

**10.5. Operational/Airworthiness Demonstrations.** Appropriate “aircraft system suitability” and “operational use suitability” demonstrations must be completed as described in 10.5.1 and 10.5.2, unless otherwise specified by AFS-400. The purpose of these operational demonstrations is to determine or validate the use and effectiveness of the applicable aircraft flight guidance systems, training, flightcrew procedures, maintenance program, and manuals applicable to the program being approved. Operators of aircraft having FAA approved AFMs referencing this AC as the criteria used as the basis for Category I or II airworthiness demonstration already are considered to meet provisions of 10.5.1, and typically need only address provisions of 10.5.2. for verification of operational use suitability.

**10.5.1. Aircraft System Suitability Demonstration.** FAA regulations addressing low visibility takeoff and landing requirements and Category I and II are primarily operating rules addressed by parts 61, 91, 97, 121, 125, and 135. These provisions apply continuously, as defined at the time of a particular operation. Airworthiness rules (part 23, 25, etc.) primarily apply at the time a “certification basis” is established for TC or STC and do not necessarily reflect “present” requirements, except through issuance of ADs. Accordingly, operationally acceptable demonstrations addressing suitability of aircraft systems for Category II, as applicable, must be successfully completed initially, and acceptable system status must be maintained by an operator to reflect compliance with current operating rules, to initially operate or continue to operate to Category II minima.

**a.** To minimize the need for repeating initial aircraft system operational suitability demonstrations for each operator, aircraft system suitability is usually demonstrated in conjunction with airworthiness approval (TC or STC) of aircraft system components such as flight guidance systems, autoland, flight directors, HUDs, flight instrument and alerting systems, radio altimeters, inertial systems, and air data systems. This approach to determination of aircraft system suitability is taken to optimize use of analysis and flight demonstration resources for Operators, aircraft manufacturers, avionics manufacturers, and FAA. Accordingly, aircraft system suitability is normally demonstrated through an initial airworthiness demonstration meeting applicable provisions of appendices to this AC (or combined airworthiness/operational evaluation for new systems or concepts, or where otherwise necessary).

**b.** However, if such a demonstration has not been conducted during airworthiness certification, or the AFM accordingly does not reflect completion of such a Category II demonstration, then the operator may propose and the FAA may approve an assessment and demonstration program by the operator to establish Category II capability of an aircraft or flight guidance system. In such instances, criteria of Appendix 2 may be used as a guideline to formulate the operators assessment and demonstration program. For such a program, the numbers of approaches conducted by the operator and the data collected to establish suitable performance and reliability should be equivalent to that which otherwise would be provided by an airworthiness demonstration IAW Appendix 2.

**c.** Airworthiness demonstration to an acceptable earlier version of AC 120-29, or equivalent criteria, may continue to be used for demonstration of aircraft/aircraft systems initially type certificated prior to issuance of this revision and having the earlier criteria as the type certification basis. However, previously demonstrated aircraft or aircraft systems seeking Category I or Category II credits specified only in provisions of this revised AC 120-29A (e.g., for HUD, or GNSS credit) must meet criteria specified in this AC.

**d.** Acceptable results of such airworthiness evaluations are usually described in AFM Section 3 (Normal and Non-Normal Procedures) of the FAA approved AFM or AFM Supplement.

**e.** For ILS approaches, basic type certification of an aircraft for "IFR" is considered to satisfactorily demonstrate Category I. For other systems or sensors, (HUD, GNSS etc.), other demonstrations per the appendices of AC 120-29A may be requested for Category I. CHDOs should ensure that aircraft proposed for Category II have completed an appropriate aircraft system operational suitability demonstration, and that result should normally be reflected in the approved AFM or AFM Supplement, unless operationally demonstrated as described above, or as otherwise specified by AFS-400.

**f.** For aircraft certified by FAA through section 21.29, certain Non-U.S. manufactured aircraft, any AFM provisions applicable to Category I may be assessed for suitability for an operators' programs by AFM or equivalent Flight Operations Manual review. Assessment of provisions for Category II may vary and may require coordination between the CMO and AFS-400. In certain instances, AFM provisions may not be consistent with U.S. policy (Order 8400.10 or rules (Op-Specs)) applicable to Category II. In such instances, CHDO coordination with AFS-400 is appropriate to provide appropriate guidance to Operators regarding applicability of various AFM provisions (e.g., DH and RVR limitations, acceptable NAVAID use, alerting system use, required versus recommended crew procedures). As a general guideline, AFMs meeting airworthiness standards recognized by or harmonized with the FAA (e.g., JAA, Canada - DOT etc.) may typically be accepted without further demonstration.

**g.** In the event of consideration of an AFM of an aircraft certificated by a Non-U.S. airworthiness authority other than as described above, or for additional credit for existing systems based on uncertain foreign AFM provisions, operational assessments IAW criteria in this AC, or equivalent criteria, may be necessary. In such instances, the applicable AEG or AFS-400 should be consulted. If necessary, AFS-400 may specify suitable criteria to apply.

**10.5.2. "Operator Use Suitability" Demonstration.** For Category I, unless a CHDO otherwise specifies that approach demonstrations are necessary due to unusual circumstances or special situations, or as noted in 10.5.3 below for special systems such as "Autoland," Operators may conduct Category I operations without need for special demonstrations, if the aircraft type AFM does not preclude the intended operation.

**a.** For Category II, at least one hundred (100) successful landings should be accomplished in line operations using the Category II or Category III system installed in each aircraft type, unless fewer approaches are determined to be appropriate by the CHDO. Examples of situations where fewer approaches than 100 may be authorized by the CHDO include credit for an operator also experienced in Category II or III operations, addition of a different or new aircraft type for an operator when that aircraft type already has successful Category II or III experience with a similar operator, or where the CHDO has consulted with AFS-400 and AFS-400 has determined that fewer approaches may apply (e.g., certain long range aircraft using Category III procedures and training, but with interim limitations to use Category II minima).

**b.** Regardless of credit permitted by the CHDO, if an operator is not aware of current Category II operations at a particular runway by some other operator and similar aircraft type, it is a good practice for the operator to have conducted at least one approach using the Category II or III system to each runway intended for Category II operations in weather better than that requiring use of Category II minima. Such demonstrations may be conducted in line operations, during training flights, or during aircraft type or route proving runs.

**c.** If an excessive number of failures (e.g., unsatisfactory landings, system disconnects) occur during the landing demonstration program, a determination should be made for the need for additional demonstration landings, or for consideration of other remedial action (e.g., procedures adjustment, wind constraints, system modifications).

**d.** The system should demonstrate reliability and performance in line operations consistent with the operational concepts specified in paragraph 4. In unique situations where the completion of 100 successful landings could take an unreasonably long period of time due to factors such as a small number of aircraft in the fleet, limited opportunity to use runways having appropriate procedures, and equivalent reliability assurance can be achieved, a reduction in the required number of landings may be considered on a case-by-case basis. Reduction of the number of landings to be demonstrated requires a justification for the reduction, and prior approval fromAFS-400.

**e.** Landing demonstrations should be accomplished on U.S. facilities or international facilities acceptable to FAA. However, at the operator's option, demonstrations may be made on other runways and facilities if sufficient information is collected to determine the cause of any unsatisfactory performance (e.g., critical area was not protected). No more than 50 percent of the demonstrations may be made on such facilities.

**f.** If an operator has different models of the same type of aircraft utilizing the same basic flight control and display systems, or different basic flight control and display systems on the same type of aircraft, the operator should show that the various models have satisfactory performance, but the operator need not conduct a full operational demonstration for each model or variant.

**10.5.2.1. Data Collection For Airborne System Demonstrations.** Each applicant should develop a data collection method to record approach and landing performance (e.g., a form to be used by flightcrew). The resulting data and a summary of the demonstration data should be made available to the CHDO for evaluation. The data should, at a minimum, include the following information:

**a.** Information regarding the inability to initiate an approach or identify deficiencies related to airborne equipment.

**b.** Information regarding abandoned approaches, stating the reasons the approach was abandoned and the altitude above the runway at which the approach was discontinued or the automatic landing system was disengaged.

**c.** Information regarding any system abnormalities which required manual intervention by the pilot to ensure a safe touchdown or touchdown and rollout, as appropriate.

**10.5.2.2. Data Analysis.** Unsatisfactory approaches using facilities approved for Category II or Category III where landing system signal protection was provided should be fully documented. The following factors should be considered:

**a.** ATS Factors. ATS factors that result in unsuccessful approaches should be reported. Examples include situations in which a flight is vectored too close to the final approach fix/point for adequate localizer and glide slope capture, lack of protection of ILS critical areas, or ATS requests for the flight to discontinue the approach.

**b.** Faulty NAVAID Signals. NAVAID (e.g., ILS localizer) irregularities, such as those caused by other aircraft taxiing, over-flying the NAVAID (antenna), or where a pattern of such faulty performance can be established should be reported.

**c.** Other Factors. Any other specific factors affecting the success of Category II operations that are clearly discernible to the flightcrew should be reported. An evaluation of reports discussed in subparagraphs 10.5.2.1(1), (2), and (3) will be made to determine system suitability for further Category II operations.

**10.5.3. Use of Autoland or Head up Guidance at U.S. Type I Facilities or Equivalent (e.g., Type I ILS).** For Category I, unless a CHDO otherwise specifies that autoland or HGS may not be used due to unusual circumstances or special situations, systems such as "Autoland" or "HGS" may typically be used at runways with facilities other than those with published Category II or III Instrument approach procedures. This is to aid pilots in achieving stabilized approaches and reliable touchdown performance to improve landing safety in adverse weather; for Category II or III training; to exercise the airborne system to ensure suitable performance; for maintenance checks; or for other such reasons. Use of this capability may be particularly important for: pilot workload relief in stressful conditions of fatigue after long international flights; night approaches; cross winds or turbulence; when there may be other aircraft non-normal conditions being addressed; or to aid safe landing performance in otherwise adverse weather, restricted visibility, or with cluttered runways. This is true even though reported visibility may be well above minima (e.g., heavy rain distorting view out the windshield, snow covered runways where markings are not easily visible).

**a.** Operators may conduct autoland or HGS operations at such facilities without need for special demonstrations, if the aircraft type AFM does not preclude the intended operation, and if for "Autoland" systems, Operations Specification Paragraph C061 is issued. Precautions to be taken for such operations include the following:

**(1)** The runway and associated instrument procedure should have no outstanding NOTAMs or other applicable "Notes" concerning the procedure precluding the use of the autoland or HGS system (e.g., it should not have notes such as "Localizer unusable inside the threshold," or "Glide Slope unusable below xxx ft."),

**(2)** Suitable ILS "Critical Area protection" (or equivalent) should be requested from ATS, if applicable. Similar to precautions for a Category II or III procedure, the crew should remain alert to detect any evidence of unsuitable system performance, whether or not critical protection is being provided,

**(3)** The published ILS glide slope threshold crossing height (or equivalent) should be at least equal to or greater than that required for the aircraft type, and

**(4)** The particular runway or procedure should not be precluded for "Autoland or HGS operations" by the operator due to known performance anomalies (e.g., not on a list of runways ineligible for or precluded from autoland or HGS operations as determined by that operator).

**b.** For minima credit for "Category II on Type I facilities," airborne systems including autoland or HGS are assessed for each particular aircraft type and specific runway, IAW 10.5.2 above.

**10.6. Eligible Airports and Runways.** For Category I, Airports and Runways are eligible as specified in part 97 SIAPs, ICAO accepted international procedures at foreign airports, or special procedures in OpSpecs. For Category II, an assessment of eligible airports, runways, and aircraft systems must be made in order to list appropriate runways on OpSpecs. For Category II, runways authorized for particular aircraft IAW existing operations listed on the AFS-400 Category II status checklist may be directly incorporated in OpSpecs, or incorporated by reference if published part 97 SIAPS are available. Aircraft type/runway combinations not shown should be verified by aircraft system use in line operations at Category I or better minima, prior to authorization for Category II. Airports/aircraft types restricted due to special conditions (e.g., irregular underlying terrain) must be evaluated IAW Appendix 8, prior to OpSpec authorization.

**a.** If applicable, the operator should identify any necessary provisions for periodic demonstration of the aircraft system on runways other than those having Category II or III procedures (e.g., periodic autoland performance verification, using runways served only by a Category I procedure).

**b.** A status checklist for facilities that have special Category I and II provisions and published Category II or III procedures can be viewed on the Internet using the following address:

FAA Category II/ III Status List -- http://www.faa.gov/avr/afs/

**c.** To access this list, scroll down to the Organizations/Other Links menu and select AFS-410, Flight Operations Branch, then scroll down to the Category II/III Status List.

**10.7. Irregular Pre-Threshold Terrain and Other Restricted Runways.** Airports/runways with irregular pre-threshold terrain, or runways restricted due to NAVAID or facility characteristics (see FAA Category II/Category III Status Checklist in Paragraph 10.6) may require special evaluation, or limitations. CHDOs of Operators desiring operations on these runways should contact AFS-400 to identify pertinent criteria and evaluation requirements. Various procedures used by FAA to assess irregular pre-threshold terrain are described in Appendix 8.

**10.8. Category II Engine-Inoperative Operations and ETOPS or EROPS Alternates based on Category II.**

**a.** Low visibility landing minima are typically based on normal operations. For non-normal operations, flightcrews and aircraft dispatchers are expected to take the safest course of action to resolve the non-normal condition. The low weather minima capability of the aircraft must be known and available to the flightcrew and, if applicable, aircraft dispatcher.

**b.** In certain instances, sufficient airborne system redundancy may be included in the aircraft design to permit use of an alternate configuration such as “engine inoperative capability” for alternate planning or initiation of a Category II approach. Use of an engine inoperative configuration is based on the premise that the engine non-normal condition is an engine failure that has not adversely affected other airborne systems. Systems that should be considered include systems such as hydraulic systems, electrical systems, or other relevant systems for Category II that are necessary to establish the appropriate flight guidance configuration.

**c.** An alternate engine inoperative configuration is also based on the premise that catastrophic engine failure has not occurred which may have caused uncertain, or unsafe collateral damage to the airframe or aerodynamic configuration.

**d.** In instances when AFM or operational criteria are not met, and a Category II approach is necessary because it is the safest course of action, (e.g., in-flight fire), the flightcrew may use emergency authority. The flightcrew should determine to the extent necessary the state of the aircraft and other diversion options to ensure that an approach in weather conditions less than Category I is the safest course of action.

**e.** Four cases are useful in considering engine inoperative Category II capability, and engine inoperative approach authorization:

**(1)** Flight planning (e.g., dispatch consideration of takeoff, destination, or ETOPS or EROPS alternates) is based on aircraft configuration, reliability, and capability for “engine inoperative Category II” (see Paragraph 10.8.2).

**(2)** An engine fails en route, but prior to final approach (see Paragraph 10.8.3).

**(3)** An engine fails during the approach after passing the final approach fix, but prior to reaching the Decision Altitude (Height) (see Paragraph 10.8.4).

**(4)** An engine fails during approach after passing the Decision Altitude(Height) (see Paragraph 10.8.5).

**f.** Paragraph 5.17 provides criteria for demonstration of Category II engine out capability for the aircraft. Paragraphs 10.8.1 through 10.8.5 below address criteria for use of an aircraft with “engine inoperative Category II” capability.

**10.8.1. General Criteria for Engine-Inoperative Category II Authorization.** Aircraft capability for “engine-inoperative Category II” should be approved IAW the provisions of paragraph 5.17, and if applicable, Appendix 2.

**a.** Regardless of whether an operator is or is not operationally authorized for “engine inoperative Category II,” it must be clear that having this aircraft capability should not be interpreted as requiring a Category II landing at the “nearest suitable” airport in time (e.g., does not require landing at the nearest suitable Category II qualified airport - 14 CFR section 121.565).

**b.** POIs should ensure that the following conditions are met:

**(1)** Operations must be IAW the “engine inoperative Category II” AFM provisions (e.g., within demonstrated wind limits, using appropriate crew procedures), or within operationally determined equivalent provisions and procedures, if not specified in the AFM.

**(2)** Demonstrated/acceptable configurations must be used (e.g., AFDS modes, flap settings, electrical power sources, MEL provisions).

**(3)** Engine-inoperative missed approach obstacle clearance from the TDZ must be ensured. Suitable information should be readily available for flight planning (e.g., to the pilot or aircraft dispatcher, if applicable).

**(4)** Appropriate training program provisions for the Category II engine inoperative approaches must be provided (see paragraph 7.2.6).

**(5)** Pilots must be aware that they are expected to take the safest course of action, in their judgment, in the event that unforeseen circumstances or unusual conditions occur that are not addressed by the “engine-inoperative” Category II demonstrated configuration (e.g., uncertain aircraft damage, possible fire, weather deterioration).

**(6)** OpSpecs should identify the type of “engine-inoperative” Category II operations authorized. Types of operations are described in paragraphs 10.8.2 through 10.8.5 below.

**10.8.2. Category II Engine Inoperative “Flight Planning.”**

**a.** The operator (e.g., pilot or if applicable, aircraft dispatcher) may consider “engine inoperative Category II” capability in planning flights for a takeoff alternate, en route (ETOPS or EROPS) alternate, re-dispatch alternate, destination, or destination alternate only if each of the following conditions are met:

**(1)** The operator (e.g., pilot or aircraft dispatcher, if applicable) has determined that the aircraft is capable of engine inoperative Category II.

**(2)** Appropriate procedures, performance, and obstacle clearance information must be provided to the crew to be able to safely accomplish an engine inoperative missed approach at any point in the approach. If applicable, similar information must also be readily available to the aircraft dispatcher.

**(3)** Appropriate operational weather constraints must be considered and specified as necessary regarding cross wind, head wind, tail wind limits considering the demonstrated capability specified in the AFM, or equivalent operationally demonstrated or specified provisions.

**(4)** Weather reports or forecast must indicate that specified alternate minimums or landing minimums will be available for the runway equipped with appropriate NAVAID and lighting systems and Category II procedures. The Operators use of engine inoperative capability credit should consider both the availability and reliability of meteorological reports and forecasts, the time factors involved in potential forecast accuracy, the potential for variability in the weather at each pertinent airport, and the ability for the crew and, if applicable, aircraft dispatcher to obtain timely weather reports and forecast updates during the time the flight is en route. Flight planning considerations must account for any expected ATS delays that might be experienced during arrival due to weather, snow removal, or other factors.

**(5)** Notices to airmen or equivalent information for airport and facility status should be reviewed to ensure that they do not preclude the accomplishment of a safe engine inoperative approach on the designated runway using approved Category II procedures (e.g., temporary obstructions). Any change in NOTAM status of facilities related to use of landing minima or alternate minima must be provided to the crew in a timely manner while en route.

**(6)** If the engine inoperative configuration is different than a normal landing configuration, a means to determine that a safe landing distance is achievable should be addressed, considering the pertinent engine inoperative aircraft configuration. This assessment is to ensure that sufficient runway is available consistent with the expected flap setting(s), speeds, and reverse thrust available configuration, or other factors that could pertain to an inoperative engine landing (e.g., reduced flap settings may be necessary for an engine inoperative approach).

**(7)** The expectation for runway surface condition based on pilot and operator (e.g., aircraft dispatcher) interpretation of the available weather reports, field conditions, and forecasts is that the applicable runway is likely to be free from standing water, snow, slush, ice, or other contaminants at the time of landing. The flightcrew must be advised of any adverse change in this expectation while en route.

**(8)** Criteria otherwise applicable to "all engine" Category II, such as flightcrew or dispatcher training, crew qualification, and availability of suitable procedures must also be addressed for the engine inoperative landing case, if they are not the same as for the "all engine" case.

**(9)** The operator is approved for operations based on engine inoperative Category II capability. In addition, operator responsibilities for engine inoperative credit should be equivalent to that of current normal operations when an en route landing system failure causes degraded landing capability. If an in-flight failure causes further degradation of engine inoperative landing capability, the flightcrew (if applicable, in conjunction with the aircraft dispatcher) should determine an acceptable alternative course of action (e.g., specification of different en route diversion options, revised fuel reserves plan, or revised flight plan routing).

**(10)** When engine inoperative Category II provisions are applied to identification of any destination or destination alternate, more than one qualifying destination alternate is required. This is to provide for the possibility of adverse area wide weather phenomena, or unexpected loss of landing capability at the first designated alternate airport.

**(11)** An appropriate ceiling and visibility increment is added to the lowest authorized minimums when credit for an alternate airport or airports is sought (e.g., 200 ft. DA(H) additive and appropriate RVR additive; see Appendix 7, Standard Operations Specification).

**(12)** The airborne system should be shown through "in-service" performance that from takeoff to 500 ft. HAT on approach, system availability is at least 95%.

**b.** It should be noted that even if the aircraft, flightcrews, and operator are authorized for engine inoperative Category II, flightcrews are not required to use Category II approach minima to satisfy requirements of section 121.565 regarding in-flight diversions. Not withstanding section 121.565, pilots may elect to take a safe course of action by landing at a more distant airport than one at which a Category II approach may be available. Conversely, pilots may elect to conduct the Category II approach as a safe or the safest course of action.

**10.8.3. Category II Engine Inoperative En Route.** For engine failure en route, a pilot may initiate an "engine inoperative" Category II approach under the following conditions:

**a.** The airplane flight manual normal or non-normal sections, or an equivalent provision of an Operators manual specifies that engine inoperative approach capability has been demonstrated and procedures are available.

**b.** The pilot and, if applicable, aircraft dispatcher have taken into account the landing runway length needed for the inoperative engine configuration and corresponding approach speeds, and obstacle clearance can be maintained in the event of a missed approach.

**c.** The pilot and, if applicable, aircraft dispatcher have determined that the approach can be conducted within the wind, weather, configuration, or other relevant constraints demonstrated for the configuration.

**d.** The pilot and, if applicable, aircraft dispatcher have determined from interpretation of the best available information that the runway is expected to be free from standing water, snow, slush, ice, or other contaminants.

**e.** The pilot is confident that the aircraft has not experienced damage related to the engine failure that would make an engine inoperative Category II approach unsuccessful or unsafe.

**f.** The operator is approved and the pilot is qualified to conduct a Category II engine inoperative approach.

**g.** The pilot and, if applicable, aircraft dispatcher consider that conducting a Category II approach is a safe and appropriate course of action.

**10.8.4. Category II Engine Failure During Approach, Prior to Decision Altitude (Height) (DA(H)).**

**a.** If the aircraft, operator, and crew meet paragraphs 5.17 for the aircraft and paragraphs 10.8.2 or 10.8.3 for operational use, a Category II approach may be continued if an engine failure is experienced after passing the final approach fix.

**b.** In the event that an aircraft has not been demonstrated for engine inoperative Category II approach capability, or the operator or crew have not been authorized for Category II engine inoperative approaches, then, regardless of flight phase, continuation of an approach in the event of an engine failure is permitted only IAW the emergency authority of the pilot to select the safest course of action.

> **NOTE: For some aircraft configurations, it may be necessary to discontinue the approach after passing the final approach fix or final approach point, re-trim the aircraft for an inoperative engine, and then re-initiate the approach in order to be able to appropriately complete a satisfactory Category II approach and landing.**

**10.8.5. Category II Engine Failure After Passing Decision Altitude (Height) (DA(H)).** If an engine fails after passing the DA(H), the procedure specified in the airplane flight manual or a procedure specified by the operator in the operator's manual for normal or non-normal operations should be followed. Any Category II approval must consider the case of engine failure at, or after, DA(H). Standard OpSpecs are considered to address this case. “Engine inoperative Category II capability” is not specifically a factor in determining response to this situation.

**10.8.6. Operators using Combined Category II and Category III Engine-Inoperative Approach Provisions.** Unless otherwise specified by FAA, Category II and Category III engine inoperative authorizations and procedures may combined when the operator meets the more stringent criteria of AC120-28D for Category III. Separate demonstrations for AC 120-29A and AC 120-28D is not necessary beyond any inherent differences between Category II and III operations (e.g., application of a DA(H) for Category II versus an Alert Height for certain Category III operations). Operational suitability demonstration programs, qualification programs, and operational provisions may be simultaneously established and used as long as procedures and systems applicable to the respective Category II and Category III capability and minima are appropriately applied. Eligible minima for any particular engine-inoperative operation should be no lower than the highest applicable authorized minima for the aircraft, crew, airport, procedure, or applicable OpSpecs limitation.

**10.9. New Category II Operators.**

**a.** New Operators should follow demonstration period provisions of 10.5.2. Additionally, typical acceptable minima step down provisions approvable by FAA are as follows:

**(1)** Starting from “limited Category I” (e.g., 300 ft. DA(H) and 3/4 mile visibility) to lowest Category I minima (e.g., 200 ft. DA(H) and RVR 1800): First 250 ft. DA(H) and RVR3000, and then DA(H) 200 ft. and RVR 1800.

**(2)** Starting from Category I to Category II: First DH 100/RVR1600, then DH 100 and RVR 1200.

**(3)** Starting from Category I for Category III: See AC120-28D.

**b.** Each runway/procedure not already being used by any operator of a similar type aircraft should be successfully demonstrated by a line service or an evaluation approach using the Category II system and procedures, in Category I or better conditions, for each applicable aircraft/system type (e.g., B767, L1011). In addition, the operator must address special airports/runways as noted in the FAA Category II/III Status List.

**10.10. Experienced Category II or Category III Operators for New Category II Authorizations.**

**a.** Experienced operators are considered to be those operators having successfully completed their initial 6 month / 100 Category II or III approach or landing demonstration period, and have current OpSpecs authorizing use of lowest applicable or intended Category II minima.

**b.** Paragraphs 10.10.1 through 10.10.3 below address examples of program changes where "experienced operator" credit may apply.

**c.** Operators authorized for Category II using one class of system (e.g., autopilot) but who are introducing a significantly different class of system as the basis for a Category II authorization (e.g., manually flown Category II approaches using a HUD) are typically considered to be "New Operators" for the purposes of demonstration period provisions and acceptable minima "step down" provisions for that class of system (see paragraph 10.9).

**10.10.1 Category I or II at New Airports/Runways.** For ILS or MLS, Category I or II operations may be conducted at facilities with a published part 97 SIAP, or equivalent, or with a "Special" instrument approach procedure typically without additional demonstration. For GLS, Category I operations may be conducted at facilities with a published part 97 SIAP, or with a "Special" instrument approach procedure or equivalent for the particular operator(s) authorized to use the "special" procedure typically without additional demonstration. For other NAVAID systems or operator combinations (e.g., initial GLS Category II, other Operators desiring to use a special instrument procedure developed by a different operator, TLS) demonstration of capability at new airport/runway is typically appropriate as determined by the CHDO. However, standard or special procedures for Category II other than those based on ILS or MLS may be added to an experienced Category II operator's OpSpecs for a similar procedure without further demonstration if the same or equivalent aircraft/aircraft system and procedure for the approach is already used by that operator or is shown on the FAA's Category II status checklist as being conducted at that facility by another operator with similar aircraft or airborne system (e.g., acceptable HUD, GNSS operations). Otherwise, the operator may be requested by the CHDO to accomplish one or more line service landings at Category I or better minima to ensure satisfactory performance before authorizing Category II minima. Special runways on the FAA Category II status checklist (e.g., Irregular Terrain runways) typically require special evaluation for each aircraft or system type (See Paragraph 10.7).

**10.10.2. Category II With New Aircraft Systems.** Unless otherwise specified by AFS-400, experienced Category II Operators may initially use new or upgraded aircraft system capabilities/components to the lowest authorized minima established for those systems or components, or use reduced length demonstration periods, consistent with the new aircraft systems to be used, FAA FSB requirements, and NAVAIDs, runways, and procedures to be used (e.g., New Category II HUD installations on B737-300s previously authorized for Category II for that operator based on autoland)

**10.10.3. Adding a New Category II Aircraft Type.** Experienced Category II Operators may operate new or upgraded aircraft types/systems, or derivative types, using reduced length demonstration periods (e.g., less than 6 months/100 landings) when authorized by AFS-400. Demonstration requirements are established considering any applicable FAA FSB criteria, applicability of previous operator service experience, experience with that aircraft type by other operators, experience of crews of that operator for Category II and the type of system, and other such factors, on an individual basis. Appropriate minima reduction steps may also be established for an abbreviated demonstration period, consistent with prior operator experience, NAVAIDs, and runways used, and procedures to be used, etc. (e.g., Newly acquired B757s being added to Category II OpSpecs, in addition to an operator's currently approved Category II A300 and MD-80 fleets).

**10.11. Category II Program Status Following Operator Acquisitions/Mergers.** Category II Operators involved in acquisitions of other Operators, or mergers, and their respective CHDOs, must ensure compatibility of programs, procedures, aircraft systems, runways served, and any other relevant issues before amending OpSpecs, or advising the surviving or controlling operator of the status of Category II OpSpecs of the acquired or merged operator. If CHDO doubt exists regarding applicability or status of Category II OpSpec provisions for a resulting new, surviving, acquired, or merged carrier, AFS-400 should be consulted.

**10.12. Initiating Combined Category I and II, or Category I, II, and III Programs for New Equipment Types.** When appropriate provisions of this AC are used for Category I and II programs for a new equipment type (e.g., HUD), those programs may be initiated simultaneously for either a new Category II or Category II/III operator, or for an existing operator currently approved for Category II or III using other systems (e.g., ILS/FD).

**10.13. U.S. Carrier Category I and II Operations at Foreign Airports.** An applicant having U.S. Category I approval may be authorized to use that minima at foreign airports IAW its OpSpecs and Order 8260.31.

**a.** Once approved, the operator must comply with both FAA and local requirements. The operator must also ensure current status information for NOTAMs are available and advise its CHDO of incompatible requirements (use of OCA (H) etc.) for resolution by CHDO or AFS-400.

**b.** Although it is recognized that the systems at foreign airports may not be exactly IAW U.S. standards, it is important that any foreign facilities used for Category II provide the necessary information or functions consistent with the intent of the U.S. standards. Carriers desiring Category II approvals at foreign airports or runways not on the FAA-approved list should submit such requests through its FAA principal operations inspector to AFS-400.

**c.** Figure 10.13-1 provides a checklist for carrier use to facilitate approval of Category II/III operations at facilities listed in the controlling states Aeronautical Information Publication (AIP). It should be used to ensure suitability of the intended facility and to verify conformance or equivalence with U.S. standards at non-U.S. airports. Completion of this checklist must reflect achieved or completed status - not planned actions. For ICAO states that do not maintain an AIP, a copy of the NOTAM, obstruction data, and/or a reliable and regular method of correspondence with the charting services used by U.S. certificate holders must be attached.

## Figure 10.13 - 1

# FACILITY CHECKLIST FOR CATEGORY II/III
**(FOR NON-US FACILITIES)**

AIRPORT (ICAO ID): ________ COUNTRY: ____________ DATE: ____________

Runway: ________ Length: _________ Width: _________ G/S Angle (deg.): ___________

Lowest Minima ________________________ (ft/m) Runway TCH _____________ (ft/m)

Special Limitations (if any):
_________________________________________________________________.

LIGHTING:
Approach _____ TDZ _____ Centerline ____ HIRL ____ Stopbars _____

Other (e.g., PAPI):
_________________________________________________________________.

MARKINGS:
Runway_______ Taxiway_______ Other (e.g., Taxiway Position) ___________________

Critical Area Protection Policy (ceiling/visibility or conditions):
LOC ____________________________ G/S __________________________________________

METEROLOGICAL DATA: METARs ________ TAFs ___________
TRANSMISSOMETERS:

(Locations/Lowest RVR reported /readout step increment)

Touchdown _______________ Mid _________________ Rollout __________________________

OBSTRUCTION CLEARANCE ASSESSMENT COMPLETION DATE: __________________
Verified by: certificate holder ________, “state of the aerodrome” __________, other ___________
Irregular terrain a factor (Y/N): _______ Similar type aircraft currently operate (Y/N) __________

NOTAM SOURCE/CONTACT: ________________________________________________________
FIELD CONDITIONS SOURCE/CONTACT ___________________________________________

Attached procedure has been developed IAW:
FAA Handbook 8260.3B (TERPS) ____ ICAO PANS-OPS Doc. 8168-OPS/611, Vol-11 ____
Other Criteria Accepted by FAA ____ (indicate criteria) ______________________________

Facility reviewed IAW ICAO Manual of All Weather Operations, as revised
(DOC 9365/AN910) Chapters 3, 5, and 6 DATE REVIEW COMPLETED: _________________

Name: ______________________________
Title: _______________________________
Signature: ___________________________________
Date: _______________________________

Attachments List:

**10.14. Category I and II Operations on Off-Route Charters.**

**a.** Unless otherwise specified by AFS-400, experienced Category I operations using non-traditional systems (HUD, GNSS etc.) and Category II operators may receive authorization to use Category I and II minima at U.S. off-route charter airports and runways as follows:

**(1)** The runway has a published part 97 SIAP, or equivalent, or

**(2)** The runway must be on the FAA Category II status checklist, and not require special evaluation, or

**(3)** The aircraft used must be the same as or equivalent to an aircraft already using the facility by other U.S. operators (e.g., an off route charter with a B737/GNSS) could operate to runways having Category I and II operations by an other operator's B737-300 using same or equivalent system).

**b.** The OpSpec must authorize off-route charter Category I or II procedures, and

**c.** If applicable, the CHDO must be advised of the specific airports, aircraft, crew qualifications and any special provisions to be used, prior to the intended operation.

**10.15. Approval of Category I and II Minima.**

**a.** Applicants should submit documentation requesting approval to the FAA CHDO or FSDO responsible for that operator's certificate. The application should demonstrate compliance with the appropriate provisions of applicable paragraphs of this AC, particularly Paragraphs 7 through 12. Proposed OpSpecs provisions should be included with the application.

**b.** Following FAA concurrence, as described in paragraph 10 above, OpSpecs authorizing Category I or II minima may be issued (see Appendix 7 for sample OpSpecs).

**c.** During the period following the issuance of new or revised OpSpecs for Category II (typically 6 months), the operator must successfully complete a suitable operations demonstration and data collection program in "line service" for each type aircraft, as the final part of the approval process.

**d.** The approval process is considered to be completed following a successful demonstration period. This is to ensure appropriate performance and reliability of the operator's aircraft, procedures, maintenance, airports, and NAVAIDs. This process must be completed before operations down to lowest requested minima are authorized. Paragraph 10.5 addresses appropriate demonstration process criteria.

**e.** When the data from the operational demonstration has been analyzed and found acceptable, an applicant may be authorized for the lowest requested minima consistent with this AC and applicable standard OpSpecs. Examples of minima step down provisions acceptable to FAA are provided at paragraphs 10.9 and 10.10.

**10.16. Operations Specification Amendments.** The operator is responsible for maintaining current OpSpecs reflecting current approvals authorized by FAA. Once FAA has authorized a change for aircraft systems, new runways, or other authorizations, appropriate and timely amendments to affected OpSpecs should be issued. Issuance of amendments to guidance or procedures in other related material such as the Flight Operations Manual or Training Program may also be required. When updated standard OpSpecs provisions are adopted by FAA, provisions of those updated OpSpecs should normally be applied to each operator's program in a timely manner.

**10.17. Use of Special Obstacle Clearance Criteria (e.g., MASPS, or non-standard RNP Criteria).** This paragraph addresses use of special criteria such as "Required Navigation Performance" (RNP) criteria. Pending implementation of RNP criteria for public use Standard Instrument Approach Procedures (SIAPS), obstacle assessments using RNP criteria will be conducted on a case-by-case basis, only authorized as an element of special procedures for RNP qualified operators, using RNP qualified aircraft. Early application of RNP for special procedures is typically intended to apply to instrument procedure segments classified as a transition to a final approach segment, or to facilitate definition of suitable missed approach segments. Use of special obstacle clearance criteria or non-standard RNP criteria must be approved by AFS-400.

**10.18. Proof-of-Concept Requirements for New Systems/Methods.**

**a.** Proof-of-Concept demonstration [PoC] as used in this AC is defined as a generic demonstration in a full operational environment of facilities, weather, crew complement, aircraft systems and any other relevant parameters necessary to show concept validity in terms of performance, system reliability, repeatability, and typical pilot response to failures as well as to demonstrate that an equivalent level of safety is provided.

**b.** Proof-of-Concept may be established by a combination of analysis, simulation and/or flight demonstrations in an operational environment. PoC is typically a combined effort of FAA airworthiness and operational organizations with the applicant, with input from any associated or interested organizations.

**c.** A typical PoC program consists of the following elements:

**(1)** Applicant submits a request to either FAA Aircraft Certification or Flight Standards.

**(2)** Meetings are arranged to include all disciplines involved: Aircraft certification; Flight Standards; National Resource Specialists; the applicant; and supporting personnel as necessary (e.g., Air Traffic).

**(3)** A test plan is established which includes input from applicable FAA organizations, the applicant, and as applicable, industry user groups.

**(4)** The test plan should include as a minimum: system definition, operations procedures, qualification, training, weather and environment definition, normal, rare-normal, and non-normal conditions to be assessed, flightcrew, test subject, and test crew requirements, test procedures, test safety constraints as applicable, assessment criteria, and analysis, simulator and test aircraft requirements.

**(5)** PoC is conducted using agreed subject pilots, as appropriate.

**(6)** PoC data is collected in a real-time simulator environment and validated in a realistic airplane environment.

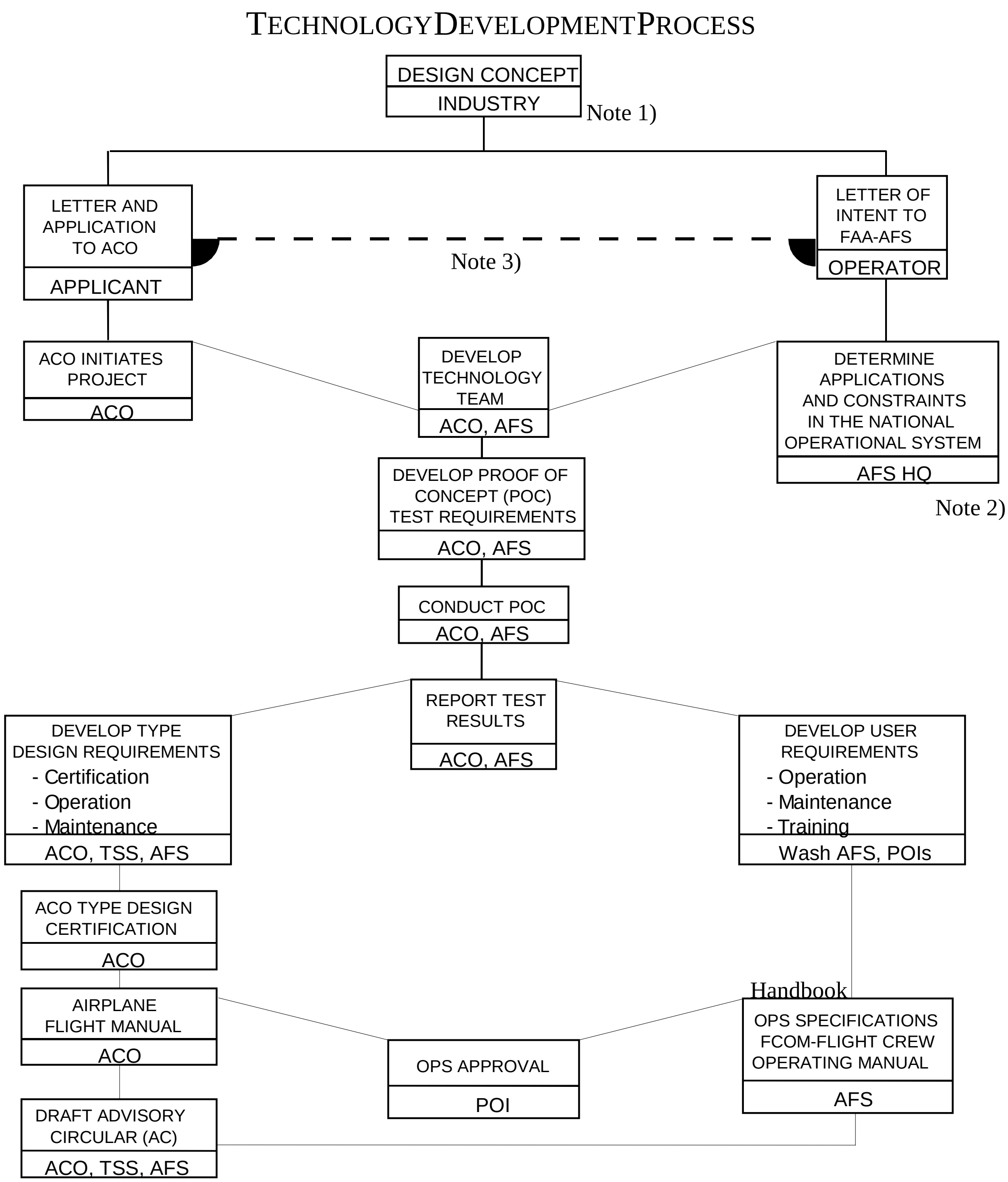
**(7)** FAA is responsible for assessing the PoC data that is typically provided to FAA as agreed by FAA and the applicant. FAA reports relevant findings to the applicant and if applicable, interested industry representatives.

**(8)** FAA operations and airworthiness organizations use the data to develop criteria for approval of type designs, certification processes and procedures, operating concepts, facilities, flightcrew and maintenance qualification, OpSpecs, operations procedures, manuals, AFMs, maintenance procedures, and any criteria necessary.

**(9)** FAA AC criteria for airworthiness and operational approval typically is a product of PoC assessment.

**d.** This process is presented pictorially in the following figure:

# Figure 10.18-1




**Note:** 1) Futher modifications to the applicant's original Type Design may require additional technology revisions and/or follow on Proof of Concept testing.
2) The AFS group has the responsibility to coordinate with all Industry technology groups (ALPA, APA, ATA, Industry, manufactures, vendors, DOD, NASA, etc.)
3) Both the FAA ACO and FAA AFS should be contacted to provide certification and operational data to the respective offices.

**Index:** ACO - Aircraft Certification Office (Including Aircraft Evaluation Group)
AFS - Washington Flight Standards Policy Office
TSS - Transport Standards Staff

RRD7/19/94

**10.19. RNP Qualification and Authorization.**

**a.** Operators may be authorized for RNP operations based on use of aircraft with an approved AFM specifying RNP capability. For such operations, in addition to AFM provisions, any provisions or constraints associated with that capability should be considered or applied (e.g., Aircraft or avionics manufacturer's guidance material, FCOM, or use assumptions made in associated documentation provided by the manufacturer to the operator or authority).

**b.** RNP authorizations for RNP-capable aircraft as specified through an AFM may be generic and related directly to use of the provisions of the AFM (e.g., authorization to use RNP addresses any applicable AFM RNP levels and flightcrew procedures).

**c.** Operators may be authorized for RNP operations based on "fleet qualification" specifying appropriate RNP capability. For such RNP operations, in addition to any necessary operator-specific aircraft type provisions, NAVAID use constraints, area, route, or procedure constraints, should be applied, as necessary.

**d.** RNP authorizations for fleet qualified RNP aircraft typically should address authorized RNP levels, types of procedures, any necessary NAVAID use provisions, or other conditions or constraints as appropriate.

**e.** Authorization for use of RNP is through OpSpecs.

**f.** For associated applicable provisions, also see AC paragraphs 4.4 and 4.5.

**11. FOREIGN AIR CARRIER CATEGORY I WITH SYSTEMS OTHER THAN ILS OR CATEGORY II AT U.S. AIRPORTS (PART 129 OPERATIONS SPECIFICATIONS).**

**11.1. Use of ICAO or FAA Criteria.** International operators requesting or authorized for Category II at U.S. airports should meet criteria of 11.1.1 through 11.1.3 below.

**11.1.1. Acceptable Criteria.**

**a.** Criteria acceptable for use for assessment of international operator's applications for Category II at U.S. airports includes this AC, equivalent JAA criteria, or the ICAO Manual of All Weather Operations DOC 9365/AN910.

**b.** International operators previously approved by FAA IAW earlier criteria may continue to apply that earlier criteria. International operators seeking credit for operations addressed only by this revision of AC 120-29A (e.g., Category II HUD operations) must meet criteria of this AC, or equivalent criteria acceptable to FAA, for those applicable provisions.

**11.1.2. Foreign Operator AFM Provisions.** Unless otherwise authorized by FAA, aircraft used by international operators for Category II within the United States should have AFM provisions reflecting an appropriate level of Category II capability as demonstrated to or authorized by FAA, or demonstrated to or authorized by an authority recognized by FAA as having acceptable equivalent Category II airworthiness criteria (e.g., European JAA, Canada MOT, UK CAA).

**11.1.3. Foreign Operator Category II Demonstrations.**

**a.** International (foreign) air carriers meeting FAA criteria, or criteria acceptable to FAA (e.g., European JAA, ICAO criteria including Doc 9365/AN910), and having more than six months experience in use of Category II operations with the applicable aircraft type may be approved for Category II IAW provisions of their own regulatory authority, or IAW standard provisions of part 129 OpSpecs, which ever is the more restrictive.

**b.** For international (foreign) operators not having the above experience, FAA will confer with the authority of the state of the operator and with the operator to jointly determine suitable provisions for a U.S. Category II authorization for that operator. International (foreign) air carriers not meeting above provisions may be subject to the demonstration requirements of 10.5.2 and 10.9 equivalent to those necessary for U.S. operators, as determined applicable by FAA.

**11.2. Issuance of Part 129 Operations Specifications.** International (foreign) air carriers operating to U.S. airports that meet applicable provisions above are approved for Category II through issuance of part 129 OpSpecs (see Appendix 7). Operators intending Category II operations at U.S.-designated irregular terrain airports, or airports otherwise requiring special assessments, must successfully complete those assessments prior to use of those facilities.

**11.3. Use of Certain Restricted U.S. Facilities.**

**a.** Foreign Operator Category I and II operations may be conducted at facilities not having published Category I and II SIAPS, or may be conducted to minima lower than published on part 97 Category I and II SIAPS if they meet criteria equivalent to that required of a U.S. part 121 carrier, and they are approved by FAA, and the operations are acceptable to the authority of the state of the operator. Similarly, operations may be authorized at other special facilities identified on the FAA Category II/III Status List.

**b.** For such authorizations the following applies:

**(1)** The foreign operator and the pertinent authority of the state of that operator must be advised of facility status,

**(2)** Operator must be approved by the state of the operator's Authority, and

**(3)** FAA must have evidence from that authority that the operator is specifically authorized at that U.S. facility. Foreign operators typically use Category II procedures in the United States which are available as unrestricted public use procedures. However, FAA may also authorize certain restricted public use procedures and special Category II approach procedures for non-U.S. Operators. Typically, these procedures require special airborne equipment capability, special training, or non-standard facility and obstacle assessments. These special procedures are identified on the Category II/III Status List and are not usually published as a part-97 Category II SIAP.

**c.** Foreign Operators may be eligible to use certain of these procedures if they meet the same special criteria as would apply to a U.S. operator and if they are approved by their own authority specifically for the use of the procedure. Some procedures may not be eligible for foreign use because of other applicable restrictions such as a restriction placed on private facility use. Special or restricted procedures require both FAA authorization and specific authorization from the state of the operator's controlling authority for each procedure. This is to ensure that both the operator and foreign authority are aware of the special provisions needed, and to ensure equivalent safety in the use of standard ICAO criteria.

**d.** Each foreign operator seeking Category II procedure authorization at a facility not published as a standard and unrestricted Category II SIAP, or at any other facilities identified as special or restricted on the FAA Category II/III Status List, and that operator's controlling authority must:

**(1)** Be aware of the restrictions applicable to the procedure (e.g., facility status),

**(2)** Provide evidence to FAA of the controlling authority's approval of the operator for each special procedure requested, and

**(3)** Must have the applicable limitations and conditions included in that operator's part 129 OpSpecs for each procedure to be used.

**e.** Foreign Operators shall not normally be authorized for special Category II operations to minima lower than those specified in part 97 Category II SIAPS consistent with ICAO criteria.

## 12. OPERATOR REPORTING, AND TAKING CORRECTIVE ACTIONS.

**12.1. Operator Reporting.** The reporting of satisfactory and unsatisfactory Category II aircraft performance is a useful tool in establishing and maintaining effective maintenance and operating policy and procedures. Additionally, when maintained over longer periods of time, the report data substantiates a successful program and can identify trends or recurring problems that may not be related to aircraft performance. Information obtained from reporting data and its analysis is useful in recommending and issuing appropriate corrective action(s).

**a.** Accordingly, for a period of at least 1 year after an applicant has been advised that its aircraft and program meet Category II requirements, and reduced minima are authorized, the operator is to provide a monthly summary to the FAA of the following information:

**(1)** The total number of approaches where the equipment constituting the airborne portion of the Category II system was used to make satisfactory (actual or simulated) approaches to the applicable Category II minima (by aircraft type).

**(2)** The total number of unsatisfactory approaches by airport and aircraft registration number with explanations in the following categories - airborne equipment faults, ground facility difficulties, aborts of approaches because of ATS instructions, or other reasons.

**b.** The operator should also notify the certificate-holding office as soon as possible of any system failures or abnormalities that require flightcrew intervention after passing 100 ft. during operations in weather conditions below Category I minima.

**c.** Upon request, the CHDO will make this information available to AFS-400 for overall Category II program management, or to assist in assessment of program or facility effectiveness.

**NOTE: The reporting burden contained in this AC does not require office of management and budget approval under the provisions of the Paperwork Reduction Act of 1980, according to Section 3502(4)(a).**

**12.2. Operator Corrective Actions.**

**a. All Programs.**

**(1)** Operators are expected to take appropriate corrective actions when they determine that aircraft, NAVAID, or airport difficulties require program or minima adjustment.

**(2)** At least the following factors should be considered: NAVAID status or performance problems, NOTAMs, airport facility status, air traffic procedure adjustments, lighting or marking system status, airport construction, adverse weather (snow banks, snow removal, icy runways or taxiways, deep snow in glide slope critical areas at non-U.S. airports, etc.), appropriate limitations or restrictions to minima necessary to ensure safe operations.

**b. Category II.**

**(1)** In addition to the corrective actions discussed above, for Category II the operations and maintenance manuals should address any corrections needed. Operators are expected to take appropriate corrective actions when they determine that conditions exist which could adversely affect safe Category II operations. Examples of situations for which an operator may need to take action restricting, limiting, or discontinuing Category II operations include: repeated aircraft system difficulties, repeated maintenance write-ups, chronic pilot reports of unacceptable landing performance, applicable service bulletin issuance, ADs, NAVAID status or performance problems, applicable NOTAMs, airport facility status change, air traffic procedure adjustment, lighting, marking, or standby power system status outages, airport construction, obstacle construction, temporary obstacles, natural disasters, adverse weather, snow banks, snow removal, icy runways or taxiways, deep snow in glide slope critical areas, inability to confirm appropriate critical area protection at non-U.S. airports, and other such conditions.

**(2)** Examples of appropriate corrective action could be an adjustment of Category II programs, procedures, training, modification to aircraft, restriction of minima, limitations on winds, restriction of NAVAID facility use, adjustment of payload, service bulletin incorporation, or other such measures necessary to ensure safe operation

# APPENDIX 1

## DEFINITIONS AND ACRONYMS

This Appendix contains the definition of terms and acronyms used within this Advisory Circular (AC). The appendix also contains certain terms that are not used in this AC but are used in related ACs and are included for convenient reference. Certain definition of terms and acronyms are also provided to facilitate common use of this Appendix for other related ACs.

Some of the definitions and terminology used in this AC are used to describe new operational concepts and technology implementations. Other definitions, including primary and supplemental means of navigation, are evolving terms and are defined in different ways in various documents by the FAA and international aviation community. Although this AC provides a baseline of new definitions and terminology, these updates have not been harmonized throughout the FAA or with the international aviation community.

**Definitions**

| | |
|---|---|
| Actual Navigation Performance | A measure of the current estimated navigation performance, excluding Flight Technical Error (FTE).<br><br>Actual Navigation Performance is measured in terms of accuracy and integrity, and may be affected by the type and availability of navigation signals and equipment.<br><br>Note: Also see Estimated Position Uncertainty (EPU). |
| Aeronautical Chart Critical Data | Data for Aeronautical charts determined IAW RTCA or ICAO Annex 4 criteria considered to have a very low probability of significant error and very high probability of validity (e.g., $P_{error}$ per unit data element <1 X $10^{-8}$ ) |
| Aeronautical Chart Essential Data | Data for Aeronautical charts determined IAW RTCA or ICAO Annex 4 criteria considered to have a low probability of significant error and high probability of validity (e.g., $P_{error}$ per unit data element <1 X $10^{-5}$ ) |
| Aeronautical Chart Routine Data | Data for Aeronautical charts determined IAW RTCA or ICAO Annex 4 criteria considered to have a routine possibility of significant error and routine validity (e.g., $P_{error}$ per unit data element <1 X $10^{-3}$) |
| Approach Intercept Waypoint (APIWP) | A variable waypoint used when necessary to link a barometric LNAV/VNAV flight path with a Final Approach Segment (FAS) that is fixed in space (e.g., an xLS final segment). The APIWP permits LNAV and barometric VNAV segments, which may vary vertically in location on an approach as a function of barometric pressure setting or temperature variation from standard, to join or be connected to a FAS which is otherwise fixed in vertical location with respect to a runway. |

| | |
|---|---|
| Automatic Dependent Surveillance (ADS) | A surveillance technique in which aircraft automatically provide, via data link, data derived from on-board navigation and position fixing systems, including aircraft identification, four dimensional position and additional data as appropriate (ICAO - IS&RP Annex 6). |
| Alert Height | A height above the runway based on the characteristics of the aircraft and its fail-operational landing system, above which a Category III approach would be discontinued and a missed approach initiated if a failure occurred in one of the redundant parts of the fail operational landing system, or in the relevant ground equipment. (ICAO - IS&RP Annex 6). |
| Airborne Navigation System | The airborne equipment that senses and computes the aircraft position relative to the defined path and provides information to the displays and to the flight guidance system. It may include a number of receivers and/or system computers such as a Flight Management Computer and typically provides inputs to the Flight Guidance System. |
| Automatic Go-Around | A Go-Around which is accomplished by an autopilot following pilot selection and initiation of the “Go-Around” autopilot mode. |
| Availability | An expectation that systems or elements required for an operations will be available to perform their intended functions so that the operation will be accomplished as planned to an acceptable level of probability. |
| Balked Landing | A discontinued landing attempt. Term is often used in conjunction with aircraft configuration or performance assessment, as in “Balked landing climb gradient;” Also see “Rejected Landing.” |
| Catastrophic Failure Condition | Failure condition which would result in multiple fatalities, usually with the loss of the airplane. |
| Category I (US)<br><br>(ICAO) | An instrument approach or approach and landing with a decision altitude (height) or minimum descent altitude (height) not lower than 60m (200 ft) and with either a visibility not less than 1/2 statute mile (800m), or a runway visual range not less than 550m (1800 ft). (Adapted from ICAO - IS&RP Annex 6).<br><br>A precision instrument approach and landing with a decision height not lower than 60m (200 ft) and with either a visibility not less than 800m (2400 ft), or a runway visual range not less than 550m (1800 ft).<br><br>(Adapted from ICAO - IS&RP Annex 6). |
| Category II | An instrument approach or approach and landing with a decision height lower than 60m (200 ft) but not lower than 30m (100 ft) and a runway visual range not less than 350m (1200 ft). (Adapted from ICAO - IS&RP Annex 6). |
| Category III | An instrument approach or approach and landing with a decision height lower than 30m (100 ft), or no decision height, or a runway visual range less than 350m (1200 ft). (Adapted from ICAO - IS&RP Annex 6). |
| Category IIIa | An instrument approach and landing with a decision height lower than 30m (100 ft), or no decision height and a runway visual range not less than 200m (700 ft). (Adapted from ICAO - IS&RP Annex 6). |
| Category IIIb | An instrument approach and landing with a decision height lower than 15m (50 ft), or no decision height and a runway visual range less than 200m (700 ft) but not less than 50m (150 ft). (Adapted from ICAO - IS&RP Annex 6).<br><br>FAA Note - the United States does not use Decision Heights for Category IIIb. |

| | |
|---|---|
| Category IIIc | An instrument approach and landing with or without a decision height, with a runway visual range less than 50m (150 ft).<br><br>(Adapted from ICAO - IS&RP Annex 6). |
| Certificate Holding District Office (CHDO) | That FAA Flight Standards District Office (FSDO), Certificate Management Office (CMO), or Certificate Management Unit (CMU) assigned by FAA to have operating certificate oversight responsibility for a particular operator. |
| Class I Navigation | Navigation within the service volume of an ICAO Standard NAVAID. |
| Class II Navigation | A flight operation or portion of a flight operation (irrespective of the means of navigation) which takes place outside (beyond) the designated Operational Service Volume of an ICAO standard airway navigation facility or NAVAID (e.g., VOR, VOR/DME, NDB). |
| Combiner | The element of the HUD in which the pilot simultaneously views the external visual scene along with synthetic information provided in symbolic form. |
| Command Information | Information that directs the pilot to follow a course of action in a specific situation (e.g., Flight Director). |
| Conformal Information | Information which correctly overlays the image of the real world, irrespective of the pilot's viewing position. |
| Datum Crossing Height (DCH) | The height of the Flight Path Control Point (FPCP) above the Runway Datum Point (RDP).<br><br>Note: The FPCP may be specified in units of feet or meters, but is typically specified in units of feet. |
| Decision Altitude (DA) | A specified altitude in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established. (Adapted from ICAO - IS&RP Annex 6). |
| Decision Altitude (Height) (DA(H)) | For Category I, a specified minimum altitude in an approach by which a missed approach must be initiated if the required visual reference to continue the approach has not been established. The “Altitude” value is typically measured by a barometric altimeter or equivalent (e.g., Inner Marker) and is the determining factor for minima for Category I Instrument Approach Procedures. The “Height” value specified in parenthesis is typically a radio altitude equivalent height above the touchdown zone (HAT) used only for advisory reference and does not necessarily reflect actual height above underlying terrain.<br><br>For Category II and certain Category III procedures (e.g., when using a Fail-Passive autoflight system) the Decision Height (or an equivalent IM position fix) is the controlling minima, and the altitude value specified is advisory. The altitude value is available for cross reference. Use of a barometrically referenced DA for Category II is not currently authorized for 14 CFR part 121, 129, or 135 operations at U.S. facilities (Adapted from ICAO - IS&RP Annex 6). |
| Decision Height (DH) | A specified height in the precision approach at which a missed approach must be initiated if the required visual reference to continue the approach has not been established (Adapted from ICAO - IS&RP Annex 6). |
| Defined Flight Path | The flight path as determined by the path definition function of an aircraft’s navigation system. |

| | |
|---|---|
| Design Eye Box | The three dimensional volume in space surrounding the Design Eye Position from which the Head Up Display (HUD) information can be viewed. |
| Design Eye Position | The position at each pilot's station from which a seated pilot achieves the optimum combination of outside visibility and instrument scan. |
| Desired Flight Path | The path that the pilot, or pilot and air traffic service, expect the aircraft to fly. |
| Earth Centered, Earth Fixed (ECEF) | A cartesian coordinate reference system by which GNSS receivers determine a 3-dimensional coordinate frame, and that later is transformed into latitude and longitude measurements (e.g., fixed relative to earth reference and does not vary with barometric pressure). |
| Enhanced Vision System (EVS) | An electronic means to provide the flightcrew with a sensor derived or enhanced image of the external scene (e.g., Millimeter wave radar, FLIR). |
| Estimate of Position Uncertainty (EPU), or<br>Estimated Position Error (EPE) | A measure based on a scale which conveys the current position estimation performance - Also called Estimated Position Error (EPE) |
| Extended Final Approach Segment (EFAS) | That segment of an approach, co-linear with the Final Approach Segment, but which extends beyond the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP). |
| External Visual Reference | Information the pilot derives from visual observation of real world cues outside the cockpit. |
| Extremely Improbable | A probability of occurrence on the order of $1 \times 10^{-9}$ or less per hour of flight, or per event (e.g., takeoff, landing). |
| Extremely Remote | A probability of occurrence between the orders of $1 \times 10^{-9}$ and $1 \times 10^{-7}$ per hour of flight, or per event (e.g., takeoff, landing). |
| Fail Operational System | A system capable of completing the specified phases of an operation following the failure of any single system component after passing a point designated by the applicable safety analysis (e.g., Alert Height). |
| Fail Passive System | A system which, in the event of a failure, causes no significant deviation of aircraft flight path or attitude. |
| Field of View | As applied to a Head Up Display (HUD) - the angular extent of the display that can be seen from within the design eye box. |
| Final Approach Course (FAC) | The final bearing/radial/track of an instrument approach leading to a runway, without regard to distance. For certain previously designed approach procedures that are not aligned with a runway, the FAC bearing/radial/track of an instrument approach may lead to the extended runway centerline, rather than to alignment with the runway. |
| Final Approach Fix (FAF) | The fix from which the final approach to an airport is executed. For standard procedures that do not involve multiple approach segments intercepting the runway centerline near the runway, the FAF typically identifies the beginning of the straight-in final approach segment. |
| Final Approach Point (FAP) | The point applicable to instrument approaches other than ILS, MLS, or GLS, with no depicted FAF (e.g., only applies to approaches such as an on-airport VOR or NDB), where the aircraft is established inbound on the final approach course from a procedure turn, and where descent to the next procedurally specified altitude, or to minimum altitude, may be commenced. |

| | |
|---|---|
| Final Approach Segment (FAS) | The segment of an approach extending from the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP), whichever occurs later, to the Glidepath Intercept Reference Point (GIRP). For the purpose of procedure construction, The Final Approach segment is defined as beginning at the FAF and ending at the Flight Path Control Point (FPCP) or point at which the missed approach segment starts (e.g., point of lowest nominal DA(H)). |
| Flight Guidance System | 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, and relevant display and annunciation elements, and it typically accepts inputs from the airborne navigation system. |
| Flight Path Alignment Point (FPAP) | The FPAP is a point, usually at or near the stop end of a runway, used in conjunction with the RDP and a vector normal to the WGS-84 ellipsoid at the RDP, to define the geodesic plane of a final approach and landing flight path (e.g., FAS and RWS). The FPAP typically may be the RDP for the reciprocal runway. |
| Flight Path Control Point (FPCP) | The Flight Path Control Point (FPCP) is a calculated point located above the RDP in a direction normal to the WGS-84 ellipsoid. The FPCP is used to establish the vertical descent path and descent angle of the final approach flight path<br><br>(e.g., FAS) to the landing runway. |
| Flight Technical Error (FTE) | The accuracy with which the aircraft is controlled as measured by the indicated aircraft position with respect to the indicated command or defined flight path position.<br><br>Note: FTE does not include human performance conceptual errors, typically which may be of large magnitude (e.g., entry of an incorrect waypoint or waypoint position, selection of an incorrect procedure, selection of an incorrect NAVAID frequency, failure to select a proper flight guidance mode. FTE can be influenced by factors such as flightcrew response to guidance (e.g., response to Flight Director information), or external environment conditions such as a wind gradient or turbulence). |
| "Fly By" Vertical Waypoint | A "Fly By" vertical waypoint (WP) is a WP for which an aircraft may initiate a vertical rate or flight path angle change to depart the current segment of a specified vertical path (VNAV path) shortly prior to an active WP, in order to expeditiously capture the next vertical path segment without overshoot. |
| "Fly Over" Vertical Waypoint | A "Fly Over" vertical waypoint (WP) is a WP for which an aircraft must stay on the defined vertical path (VNAV path) until passing an active WP and may not initiate capture of the next vertical path segment until after passing the active WP. |
| Frequent | Occurring more often than 1 in 1000 events or 1000 flight hours. |
| Glide Path Angle (GPA) | The glide path angle is an angle, defined at the FPCP, that establishes the descent gradient for the final approach flight path (e.g., FAS) of an instrument approach procedure. It is measured in the geodesic plane of the approach (defined by the RDP, FPAP, and a vector normal to the WGS-84 ellipsoid at the RDP). The vertical and horizontal references for the GPA are a vector normal to the WGS-84 ellipsoid at the RDP and a plane perpendicular to that vector at the FPCP, respectively. |
| Glide Path Intercept Waypoint (GPIWP) | The point at which the established glide slope intercept altitude (MSL) meets the Final Approach Segment (FAS), on a standard day, using a standard altimeter setting (1013.2 HPa or 29.92 in). |

| | |
|---|---|
| Glidepath Intercept Reference Point (GIRP) | The GIRP is the point at which the extension of the final approach path (e.g., FAS) intercepts the runway. |
| GNSS Landing System (GLS) | A differential GNSS (e.g., GPS) based landing system providing both vertical and lateral position fixing capability. Note: Term may be applied to any GNSS based differentially corrected landing system providing lateral and vertical service for approach and landing equivalent to or better than that provided by a U.S. Type I ILS, or equivalent ILS specified by ICAO Annex 10. |
| Global Positioning System (GPS) | The NAVSTAR Global Positioning System operated by the United States Department of Defense. It is a satellite -based radio navigation system composed of space, control, and user segments. The space segment is composed of satellites. The control segment is composed of monitor stations, ground antennas, and a master control station. The user segment consists of antennas and receiver-processors that derive time and compute a position and velocity from the data transmitted from the satellites. |
| Global Navigation Satellite System [GNSS] | A world wide position, velocity and time determination system that uses one or more satellite constellations. |
| Go-around | A transition from an approach to a stabilized climb. |
| Guidance | Information used during manual control, automatic control, or monitoring of automatic control of an aircraft that is of sufficient quality to be used by itself for the intended purpose of achieving a particular flight path . |
| Hazardous Failure Condition | Failure Conditions which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions to the extent that there would be:<br>(i) A large reduction in safety margins or functional capabilities;<br>(ii) Physical distress or higher workload such that the flightcrew cannot be relied upon to perform their tasks accurately or completely; or<br>(iii) Serious or fatal injury to a relatively small number of the occupants. |
| Head Up Display System | An aircraft system which provides head up guidance to the pilot during flight. It includes the display element, sensors, computers and power supplies, indications, and controls. It may receive inputs from an airborne navigation system or flight guidance system. |
| Hybrid System | A combination of two or more systems of dissimilar design used to perform a particular operation. |
| Improbable | A probability of occurrence greater than $1 \times 10^{-9}$ but less than or equal to $1 \times 10^{-5}$ per hour of flight, or per event (e.g., takeoff, landing). |
| Independent Landing Monitor (ILM) | A millimeter wave radar-based sensor (e.g., typically transmitting at 35 GHz, or 94 GHz) used to present a perspective display of a runway to a pilot on an electronic flight deck display during approach, to serve as an independent integrity monitor for another type of landing NAVAID sensor (e.g., ILS, MLS or GLS). |
| Independent Systems | A system that is not adversely influenced by the operation, computation, or failure of some other identical, related, or separate system (e.g., two separate ILS receivers). |
| Infrequent | Occurring less often than 1 in 1000 events or 1000 flight hours. |

| | |
|---|---|
| Initial Missed Approach Waypoint (IMAWP) | A Waypoint generally aligned with the runway centerline, beyond the touchdown zone, used to establish a suitable initial climb segment beyond the touchdown zone. The IMAWP intends to provide a safe path and altitude, if applicable, in the vicinity of the runway, to be used to establish a safe initial go-around path following a low altitude go-around or rejected landing. |
| Initial Missed Approach Segment (IMAS) | That segment of an approach from the Glide Path Intercept Waypoint (GIRP) to the Initial Missed Approach Waypoint (IMAWP). |
| Instantaneous Field of View | The angular extent of a HUD display which can be seen from either eye from a fixed position of the head. |
| Integrity | A measure of the acceptability of a system or system element, to contribute to the required safety of an operation. |
| Landing | For the purpose of this AC, landing will begin at 100 ft., the DH or the AH to the first contact of the wheels with the runway. |
| Landing Rollout | For the purpose of this AC, rollout starts from the first contact of the wheels with the runway and finishes when the airplane has slowed to a safe taxi speed (in the order of 30 knots). |
| Major Failure Condition | Failure Condition which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions to the extent that there would be, for example, a significant reduction in safety margins or functional capabilities, a significant increase in crew workload or in conditions impairing crew efficiency, or discomfort to occupants, possibly including injuries. |
| Minimum Descent Altitude (Height) (MDA(H)) | See individual definitions below for MDA and MDH. |
| Minimum Descent Altitude (MDA) | A specified altitude in a non-precision approach or circling approach below which descent must not be made without the required visual reference. Minimum Descent Altitude (MDA) is referenced to mean sea level.<br>(ICAO - IS&RP Annex 6). |
| Minimum Descent Height (MDH) | A specified height in an instrument approach other than ILS, MLS, or GLS, or a circling approach, below which descent must not be made without the required visual reference. Minimum Descent Height (MDH) is referenced to aerodrome elevation or to the threshold if that is more than 7 ft. (2m) below the aerodrome elevation. An MDH for a circling approach is referenced to the aerodrome elevation. (ICAO - IS&RP Annex 6).<br><br>FAA Note - The U.S. does not use Minimum Descent Heights. |
| Minimum Use Height (MUH) | A height specified during airworthiness demonstration or review above which, under standard or specified conditions, a probable failure of a system is not likely to cause a significant path displacement unacceptably reducing flight path clearance from specified reference surfaces (e.g., airport elevation) or specified obstacle clearance surfaces. |
| Minor Failure Condition | Failure Condition which would not significantly reduce airplane safety and which involve crew actions that are well within their capabilities. Minor Failure Conditions may include, for example, a slight reduction in safety margins or functional capabilities, a slight increase in crew workload, such as routine flight plan changes, or some inconvenience to occupants. |

| | |
|---|---|
| Missed Approach | The flight path followed by an aircraft after discontinuation of an approach procedure and initiation of a go-around. Typically a "missed approach" follows a published missed approach segment of an instrument approach procedure, or follows radar vectors to a missed approach point, return to landing, or diversion to an alternate. |
| Missed Approach Segment (MAS) | That segment of an instrument approach procedure from a point on the FAS corresponding to the position where the lowest DA(H) occurs under nominal conditions, to the designated IMAWP, or missed approach holding WP, as specified for the procedure. |
| Monitored Head Up Display (HUD) | A HUD which has internal or external capability to reliably detect erroneous sensor inputs or guidance outputs, to ensure that a pilot does not receive incorrect or misleading guidance, failure, or status information. |
| Navigation System Error | An error in the estimation of the aircraft's position. Also called "position estimation error". |
| Non-Normal Means of Navigation | A means of navigation which does not satisfy one or more of the necessary levels of accuracy, integrity, and availability for a particular area, route, procedure, or operation, and which may require use of a pilot's "emergency authority" to continue navigation. |
| Non-normal Conditions | Conditions other than those considered normal conditions or rare-normal conditions (e.g., Failure conditions, certain kinds of error conditions ) |
| NOTAM | Notice to Airmen - A notice distributed by means of telecommunication containing information concerning the establishment, condition, or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. (ICAO - IS&RP Annex 6). |
| Path Definition Error | The difference between the desired path and the defined path.<br>Note: This error may be due to survey errors, database resolution limitations, or other such factors. |
| Path Steering Error | Any resulting difference (i.e., non-zero deviation) between the estimated aircraft position from the desired flight path.<br>Note: This error includes any display errors along with flight technical error. |
| Performance | A measure of the accuracy with which an aircraft, a system, or an element of a system operates compared against specified parameters. Performance demonstration(s) typically include the component of Flight Technical Error (FTE). |
| Position Estimation Error | An error in the estimation of the aircraft's position. Also called "Navigation System Error." |
| Primary Means of Navigation | A means of navigation which satisfies the necessary levels of accuracy and integrity for a particular area, route, procedure, or operation. The failure of a "Primary Means" of navigation may result in, or require reversion to, a "non-normal" means of navigation, or an alternate level of RNP. |
| "Rare-Normal" conditions | A condition which must be expected to normally occur, but does so only very infrequently (e.g., unusually strong winds, significant wind gradients, significant turbulence, significant in-flight icing, significant mountain wave activity) |

| | |
|---|---|
| Redundant | The presence of more than one independent means for accomplishing a given function or flight operation. Each means need not necessarily be identical. |
| Rejected Landing | A discontinued landing attempt. A rejected landing typically is initiated at low altitude but prior to touchdown. If from or following an instrument approach it typically is considered to be initiated below DA(H) or MDA(H). A rejected landing may be initiated in either VMC or IMC. A rejected landing typically leads to or results in a "go around," and if following an instrument approach, a "Missed Approach." If related to consideration of aircraft configuration(s) or performance it is sometime referred to as a "Balked Landing." The term "rejected landing" is used to be consistent with regulatory references such as found in 14 CFR part 121 Appendix E, and policy references as in FAA Order 8400.10. |
| Remote | A probability of occurrence on the order of greater than $1 \times 10^{-7}$ but less than or equal to $1 \times 10^{-5}$ per hour of flight, or per event (e.g., takeoff, landing). |
| Required Navigation Performance (RNP) | A statement of the navigation performance necessary for operation within a defined airspace (Adapted from ICAO - IS&RP Annex 6).<br><br>NOTE: Required Navigation Performance is specified in terms of accuracy, integrity, and availability of navigation signals and equipment for a particular airspace, route, procedure, or operation. |
| Required Navigation Performance Containment (RNP Containment) | RNP Containment represents a bound of the rare-normal performance and specified non-normal performance of a system, typically expressed as 2*RNP(X). When RNP represents Gaussian statistical performance at a two sigma (2 x standard deviation) level, then containment represents a nominal performance bound specified at the level of four sigma (4 x standard deviation). Note: RNP containment use may vary with intended operational applications. |
| Required Navigation Performance Level or Type (RNP Level or RNP Type) | A value typically expressed as a distance in nautical miles from the intended position within which an aircraft would be for at least 95 percent of the total flying time (Adapted from ICAO - IS&RP Annex 6).<br><br>NOTE: Applications of RNP to terminal area and other operations may also include a vertical and/or longitudinal component. ICAO may use the term RNP Type, while certain other States, aircraft manuals, procedures, and Operators may use the term RNP Level.<br><br>Example - RNP 4 represents a navigation lateral accuracy of plus or minus 4 nm (7.4 km) on a 95% basis. RNP is typically defined in terms of its lateral accuracy, and has an associated lateral containment boundary. |
| Required Visual Reference | That section of the visual aids or of the approach area which should have been in view for sufficient time for the pilots to have made an assessment of the aircraft's position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height, the required visual reference is that specified for the particular procedure and operations (ICAO - IS&RP Annex 6 - Decision Height definition - Note 2). |
| Runway Datum Point (RDP) | The RDP is used in conjunction with the FPAP and a vector normal to the WGS-84 ellipsoid at the RDP to define the geodesic plane of a final approach flight path to the runway for touchdown and rollout. It is a point at the designated lateral center of the landing runway defined by latitude, longitude, and ellipsoidal height. The RDP is typically a surveyed reference point used to connect the approach flight path with the runway. The RDP may or may not necessarily be |

| | |
|---|---|
| | coincident with the designated runway threshold |
| Runway Segment (RWS) | That segment of an approach from the Ground Point of Intercept (GPI) to Flight Path Alignment Point (FPAP). |
| Situation Information | Information that directly informs the pilot about the status of the aircraft system operation or specific flight parameters including flight path. |
| Standard Landing Aid (SLA) | A Standard Landing Aid (SLA) is considered to be any navigation service or navigation aid provided by a State which meets internationally accepted performance standards (e.g., ICAO Standards and Recommended Practices (SARPs), or equivalent U.S. or other State standards). |
| Supplementary Means of Navigation | A means of navigation which satisfies one or more of the necessary levels of accuracy, integrity, or availability for a particular area, route, procedure or operation. The failure of a “Supplementary Means” of navigation may result in, or require reversion to, another alternate “normal” means of navigation for the intended route, procedure, or operation. |
| Synthetic Reference | Information provided to the flightcrew by instrumentation or electronic displays, that is electronically generated, processed, enhanced, or otherwise augmented. Information may be either command or situation information (e.g., SVS, EVS). |
| Synthetic Vision System (SVS) | A system used to create a synthetic image (e.g., typically a computer generated picture) representing the environment external to the airplane. |
| Take off Guidance System | A system which provides directional command guidance to the pilot during a takeoff, or takeoff and aborted takeoff. It includes sensors, computers and power supplies, indications and controls. |
| Total Field of View | The maximum angular extent of the display that can be seen with either eye, allowing head motion within the design eye box. |
| Total System Error (TSE) | The difference between the desired flight path and the actual flight path. Typically determined by a sum of the path definition error, navigation system error, and the path steering error (i.e., flight technical error plus any display error). |
| Touch Down Zone (TDZ) | The first 3000 ft. of usable runway for landing, unless otherwise specified by the FAA, or other applicable ICAO or State authority (e.g., for STOL aircraft, or IAW an SFAR). |
| Visual Glide Slope Indicator | An electro-optical device that provides a visual indication of vertical position in relation to a defined glidepath. Specific systems in this classification include the Visual Approach Slope Indicator (VASI), the Precision Approach Path Indicator (PAPI), and Precision Landing Aid Slope Indicator (PLASI). This term is defined in FAA Order 8260.3, U.S. Standard for Terminal Instrument Procedures (TERPS). |
| Visual Guidance | Visual information the pilot derives from the observation of real world cues, out the flight deck window, used as a primary reference for aircraft control or flight path assessment. |
| WGS-84 Ellipsoid | A mathematical model of the earth’s shape based on WGS-84 survey information, used as an element of an earth surface-referenced navigation coordinate frame (see appropriate ICAO or RTCA references for its technical definition and specification - e.g., ICAO “World Geodetic System 1984 Manual - DOC 9674-AN/946”). |

## Acronyms

| ACRONYM | EXPANSION |
|---|---|
| ABAS | Aircraft Based Augmentation System |
| AC | Advisory Circular |
| ACI | Adjacent Channel Interface |
| ACO | FAA Aircraft Certification Office |
| ADF | Automatic Direction Finder |
| ADI | Attitude Director Indicator |
| ADS | Automatic Dependent Surveillance |
| AEG | FAA Aircraft Evaluation Group |
| AFCS | Autopilot Flight Control System |
| AFDS | Autopilot Flight Director System |
| AFGS | Automatic Flight Guidance System |
| AFM | Airplane Flight Manual |
| AH | Alert Height |
| AHI | All Weather Harmonization Items |
| AIP | Aeronautical Information Publication |
| ALS | Approach Light System |
| ANP | Actual Navigation Performance |
| APIWP | Approach Intercept Waypoint |
| APM | Aircrew Program Manager |
| APU | Auxiliary Power Unit |
| AQP | Advanced Qualification Program |
| ARA | Airborne Radar Approach |
| ASR | Airport Surveillance Radar |
| ATC | Air Traffic Control |
| ATIS | Automatic Terminal Information Service |
| ATOGW | Allowable Takeoff Gross Weight |
| ATPC | Airline Transport Pilot Certificate |
| ATS | Air Traffic Service |
| AWO | All Weather Operations |
| BARO | [Abbreviation for “Barometric”] |
| BC | Back Course (e.g., ILS Back Course) |

| | |
|---|---|
| BITE | Built-In Test Equipment |
| CAA | Civil Aviation Authority |
| CDL | Configuration Deviation List |
| CFR | Code of Federal Regulations |
| CFR | Crash Fire Rescue |
| CHDO | Certificate Holding District Office |
| CL | Centerline Lights |
| CMO | FAA Certificate Management Office |
| CMU | FAA Certificate Management Unit |
| CNS | Communication, Navigation, and Surveillance |
| CRM | Collision Risk Model |
| CRM | Crew Resource Management |
| CVR | Cockpit Voice Recorder |
| DA | Decision Altitude |
| DA(H) | Decision Altitude(Height) |
| DCH | Datum Crossing Height |
| DD | DME-DME updating |
| DDM | Difference of Depth Modulation |
| DEP | Design Eye Position |
| DGNSS | Differential Global Navigation Satellite System |
| DH | Decision Height |
| DME | Distance Measuring Equipment |
| DOD | (U.S.) Department of Defense |
| DOT | (U.S.) Department of Transportation |
| DP | Departure Procedure |
| EADI | Electronic Attitude Director Indicator |
| ECEF | Earth Centered Earth Fixed (coordinate frame) |
| EFAS | Extended Final Approach Segment |
| EGPWS | Enhanced Ground Proximity Warning System |
| EHSI | Electronic Horizontal Situation Indicator |
| EPE | Estimated Position Error |
| EPU | Estimated Position Uncertainty |
| EROPS | Extended Range Operations (any number of engines) |
| ET | Elapsed Time |

| | |
|---|---|
| ET | Error Term [FMS use] |
| ETOPS | Extended Range Operations with Two-Engine Airplanes |
| EVS | Enhanced Vision System |
| FAF | Final Approach Fix |
| FAP | Final Approach Point |
| FAR | Federal Aviation Regulation |
| FAS | Final Approach Segment |
| FBS | Fixed Base Simulator |
| FBW | Fly-by-wire |
| FCOM | Flightcrew Operating Manual |
| FDR | Flight Data Recorder |
| FGS | Flight Guidance System |
| FHA | Functional Hazard Assessment |
| FLIR | Forward Looking Infrared Sensor |
| FM | Frequency Modulation |
| FM | Fan Marker |
| FMC | Flight Management Computer |
| FMS | Flight Management System |
| FPAP | Flight Path Alignment Point |
| FPA | Flight Path Angle |
| FPCP | Flight Path Control Point |
| FSB | Flight Standardization Board |
| FSDO | (FAA) Flight Standards District Office |
| FSS | (FAA) Flight Service Station |
| FTE | Flight Technical Error |
| GA | Go-Around |
| GBAS | Ground Based Augmentation System |
| GCA | Ground Controlled Approach |
| GIRP | Glidepath Intercept Reference Point |
| GLS | GPS (or GNSS) Landing System |
| GNSS | Global Navigation Satellite System |
| GPA | Glide Path Angle |
| GPIWP | Glide Path Intercept Waypoint |
| GPWS | Ground Proximity Warning System |

| | |
|---|---|
| GPS | Global Positioning System |
| HAA | Height Above Airport |
| HAT | Height above Touchdown |
| HDG | Heading |
| HQRS | Handling Quality Rating System (see AC25-7A, as amended) |
| HUD | Head Up Display |
| IAP | Instrument Approach Procedure |
| IAW | In Accordance With |
| ICAO | International Civil Aviation Organization |
| IFR | Instrument Flight Rules |
| IM | Inner Marker |
| IMAS | Initial Missed Approach Segment |
| IMAWP | Initial Missed Approach Waypoint |
| IMC | Instrument Meteorological Conditions |
| ILS | Instrument Landing System |
| INAS | International Airspace System |
| IOE | Initial Operating Experience |
| IRS | Inertial Reference System |
| IRU | Inertial Reference Unit |
| JAA | Joint Aviation Authority |
| JAR AWO | Joint Aviation Regulations – All Weather Operations |
| KRM | (Type of Landing system used in certain foreign States) |
| LAAS | Local Area Augmentation System |
| LAD | Local Area Differential |
| LAHSO | Land And Hold Short Operation |
| LDA | Localizer-Type Directional Aid (approach type) |
| LLM | Lower Landing Minima |
| LMM | Compass Locator Middle Marker |
| LLTV | Low Light Level TV |
| LNAV | Lateral Navigation |
| LOA | Letter of Authorization |
| LOC | (ILS) Localizer |
| LOE | Line Operational Evaluation |
| LOFT | Line Oriented Flight Training |

| | |
|---|---|
| LOM | Compass Locator Outer Marker |
| LOS | Line Oriented Simulation |
| MAP | Mode Annunciator Panel |
| MAP | Missed Approach Point |
| MAS | Missed Approach Segment |
| MASPS | Minimum Aviation System Performance Standards |
| MB | Marker Beacon |
| MCP | Mode Control Panel |
| MDA | Minimum Descent Altitude |
| MDA(H) | Minimum Descent Altitude (Height) |
| MDH | Minimum Descent Height - NOTE: MDH is not used for U.S. Operations |
| MEH | Minimum Engage Height |
| MEL | Minimum Equipment List |
| METAR | ICAO Routine Aviation Weather Report |
| MLS | Microwave Landing System |
| MM | Middle Marker |
| MMEL | Master Minimum Equipment List |
| MMR | Multi-mode Receiver |
| MOT | Ministry of Transport |
| MRB | Maintenance Review Board |
| MSL | Mean Sea Level (altitude reference datum) |
| MUH | Minimum Use Height |
| MVA | Minimum Vectoring Altitude |
| NA | Not Authorized or Not Applicable |
| NAS | National Airspace System |
| NAVAID | Navigational Aid |
| ND | Navigation Display |
| NDB | Navigation Data Base |
| NDB | Non-directional Beacon |
| NOTAM | Notice to Airman |
| NRS | National Resource Specialist |
| OCA | Obstacle Clearance Altitude |
| OCH | Obstacle Clearance Height |
| OCL | Obstacle Clearance Limit |

| | |
|---|---|
| OIS | Obstacle Identification Surface |
| OM | Outer Marker |
| OSAP | Offshore Standard Approach Procedure |
| PAI | Principal Avionics Inspector |
| PAR | Precision Approach Radar |
| PC/PT | Proficiency Check/Proficiency Training |
| PF | Pilot Flying |
| PFC | Porous Friction Coarse (runway surface) |
| PIC | Pilot in Command |
| PIREP | Pilot Weather Report |
| PNF | Pilot Not Flying |
| PoC | Proof of Concept |
| POI | Principal Operations Inspector |
| PMI | Principal Maintenance Inspector |
| PRD | Progressive Re-Dispatch |
| PRM | Precision Radar Monitor |
| PTS | Practical Test Standard |
| QFE | Altimeter Setting referenced to airport field elevation |
| QNE | Altimeter Setting referenced to standard pressure (1013.2HPa or 29.92”) |
| QNH | Altimeter Setting referenced to airport ambient local pressure |
| QRH | Quick Reference Handbook |
| RA | Radio Altitude or Radar Altimeter |
| RAIL | Runway Alignment Indicator Light System |
| RCLM | Runway Center Line Markings |
| RCP | Required Communication Performance |
| RDMI | Radio Direction Magnetic Indicator |
| RDP | Runway Datum Point |
| REIL | Runway End Identification Lights |
| RII | Required Inspection Item |
| RMI | Radio Magnetic Indicator |
| RMP | Required Monitoring Performance (e.g., surveillance) |
| RMS | Root-mean-square |
| RNAV | Area Navigation |
| RNP | Required Navigation Performance |

| | |
|---|---|
| RNPx2 | RNP Containment Limit (2 times RNP value) |
| RSP | Required System Performance (Considers RNP, RCP, and RMP) |
| RTCA | An industry standard setting organization - formerly known as the “Radio Technical Commission for Aeronautics” |
| RTS | Return to Service |
| RTO | Rejected Takeoff |
| RVR | Runway Visual Range |
| RVV | Runway Visibility Value |
| RWS | Runway Segment |
| RWY | Runway |
| SA | Selective Availability |
| SARPS | ICAO Standards and Recommended Practices |
| SBAS | Space Based Augmentation System |
| SDF | Simplified Directional Facility |
| SFL | Sequence Flasher Lights |
| SIAP | Standard Instrument Approach Procedure |
| SID | Standard Instrument Departure - Note: This term is no longer in use in the U.S., and has been replaced by the term Departure Procedure (DP) |
| SLA | Standard Landing Aid |
| SLF | Supervised Line Flying |
| SMGC | Surface Movement Guidance Control |
| SMGCP | Surface Movement and Guidance Plan |
| SMGCS | Surface Movement Guidance Control System |
| STAR | Standard Terminal Arrival Route |
| STC | Supplemental Type Certificate |
| STOL | Short Takeoff and Landing |
| SRE | (Type of Landing system used in certain foreign States) |
| SV | Space Vehicle |
| TACAN | Tactical Air Navigation system (NAVAID) |
| TAF | Terminal Aviation Forecast |
| TAWS | Terrain Awareness Warning System |
| TC | Type Certificate |
| TCH | Threshold Crossing Height |
| TDZ | Touchdown Zone |
| TERPS | U.S. Standard for Terminal Instrument Procedures |

| | |
|---|---|
| TLS | Target Level of Safety |
| TOGA | Takeoff or Go-Around (FGS Mode) |
| TSE | Total system error |
| ua | micro amps |
| VGSI | Visual Glide Slope Indicator |
| VDP | Visual Descent Point |
| VFR | Visual Flight Rules |
| VHF | Very High Frequency |
| VIS | Visibility |
| VOR | VHF Omni-directional Radio Range |
| VORTAC | Co-located VOR and TACAN |
| VMC | Visual Meteorological Conditions |
| VNAV | Vertical Navigation |
| $V_1$ | Takeoff Decision Speed |
| $V_{ef}$ | Engine Failure Speed |
| $V_{failure}$ | Speed at which a failure occurs |
| $V_{lof}$ | Liftoff Speed |
| $V_{mcg}$ | Ground Minimum Control Speed |
| WAAS | Wide Area Augmentation System |
| WAD | Wide Area Differential |
| WAT | Weight, Altitude, and Temperature |
| WGS | World Geological Survey |
| WGS-84 | World Geological Survey - 1984 |
| WP | Waypoint |
| xLS | (Generic term used to denote any one or more of the following NAVAIDs: ILS, MLS, or GLS) |

# APPENDIX 2. AIRBORNE SYSTEMS FOR CATEGORY I

Mandatory terms used in this AC such as "shall" or "must" are used only in the sense of ensuring applicability of these particular methods of compliance when the acceptable means of compliance described herein is used. This AC does not change, add, or delete regulatory requirements or authorize deviations from regulatory requirements.

**1. PURPOSE.** This appendix contains airworthiness criteria for the approval of aircraft equipment and installations required to conduct an approach in Category I weather minima.

**2. GENERAL.**

The type certification approval for the equipment, system installations, and test methods should be based on a consideration of factors such as the intended function of the installed system, its accuracy, reliability, and fail-safe features, as well as the operational concepts contained in the body of this Advisory Circular (AC). The guidelines and procedures contained herein are considered acceptable methods of determining transport category airplane airworthiness to conduct an approach in Category I weather conditions.

The overall assurance of performance and safety of an operation can only be assessed when all elements of the system are considered. This appendix includes a discussion of the non-aircraft elements of a system so that an overall assessment of the operation can be accomplished.

References to JAA All Weather Operations Regulations are provided to facilitate the All Weather Operations Harmonization process. A reference to a JAR provision does not necessarily mean that the FAA and JAA requirements are <u>equivalent</u> but that they are <u>related with similar intent</u>. The FAA typically may identify which JAR provisions are acceptable to FAA at the time a type certification basis is established.

**3. INTRODUCTION.**

This appendix addresses the approach phase of flight. For the purpose of this appendix, the approach phase of flight is defined as the flight segment from the Final Approach Fix (FAF) to the Category I decision altitude/height. This appendix provides criteria, which represents an acceptable means of compliance with performance, integrity and availability requirements for low visibility approach. An applicant may propose alternative criteria. With new emerging technologies, there is a potential for many ways of conducting low visibility approach operations. This appendix does not attempt to provide criteria for each potential combination of airplane and non-airplane elements.

**a.** Operations using current ILS or MLS ground-based facilities and airplane elements are in use, and the certification criteria for approval of these airplane systems are established. Other operations, using non-ground based facilities or evolving ground facilities (e.g., local or wide area augmented Global Navigation Satellite System (GNSS)), and the use of some new aircraft equipment require Proof of Concept testing to establish appropriate criteria for operational approval and system certification. The need for a Proof of Concept program is identified in this AC with a [PoC] designator. This appendix provides some general guidelines, but not comprehensive criteria, for airplane systems that require a Proof of Concept.

**b.** The intended flight path may be established in a number of ways. For systems addressed by this appendix, the reference path may be established by a navigation aid (e.g., ILS, MLS). Other methods may be acceptable if shown feasible by a Proof of Concept **[PoC]**. Methods requiring **PoC** include, but are not limited to:

- the use of ground surveyed waypoints, either stored in an on-board data base or provided by data link to the airplane, with path definition by the airborne system,
- sensing of the runway environment (e.g., surface, lighting and/or markings) with a vision enhancement system.

On-board navigation systems may have various sensor elements by which to determine airplane position. The sensor elements may include ILS, MLS, GNSS with ground-based augmentation (GLS), or inertial information. Each of these sensor elements should be used within appropriate limitations with regard to accuracy, integrity and availability.

Indications of the airplane position with respect to the intended path can be provided to the pilot in a number of ways.

- deviation displays with reference to navigation source (e.g., Instrument Landing System (ILS) receiver, Microwave Landing System (MLS) receiver), or

- on-board navigation system computations with corresponding displays of position and reference path, or

- by a vision enhancement system. **[PoC]**

**c.** The minimum visibility required for safe operations with such systems and backup means will be specified by FAA Flight Standards in the operational authorization.

**4. TYPES OF APPROACH OPERATIONS.** The airworthiness criteria in this appendix are intended to be consistent with the operational concepts of paragraph 4.3 of the main body of this AC.

**4.1. Operations based on a Standard Landing Aid.**

ILS and MLS have been characterized by appropriate International Civil Aviation Organization (ICAO) standards, and for the purpose of certification in accordance with this Appendix may be considered a Standard Landing Aid.

Landing Systems based on the GLS may use interim U.S. criteria, or other FAA-agreed State criteria, or other international standards developed for acceptable combination of space and ground-based elements. Acceptable overall aircraft performance may be established based upon the assumption that these services are used and maintained to the specified standards identified, or as specified in the applicable airworthiness approval.

**4.2. Operations based on Required Navigation Performance (RNP).** The airworthiness criteria in this appendix support the operational concept for RNP as described in paragraph 4.5 in the main body of this AC.

**4.2.1. Standard RNP Types.** Approach operations may be specified based upon standard RNP type designations. The type designation identifies the performance standard required to conduct the operation. The RNP Type will have a lateral performance component and may additionally have a vertical component. Refer to Paragraph 4.5.1 in the main body of this AC for Standard RNP Types.

**4.2.2. Non-standard RNP Types.** Some operations may be approved for Non-Standard RNP Types - refer to paragraph 4.5.2 in the main body of this AC. It is envisioned that the airplane systems approval process for Non-Standard RNP Types will be equivalent to that used for Standard RNP Types unless otherwise agreed with the FAA.

**4.3. Operations based on Area Navigation System(s).** Paragraphs 4.3.3 through 4.6 of the main body of this AC provide the criteria for operational authorization of the use of area navigation systems for approach.

**a.** Instrument approach operations may be approved using aircraft area navigation with lateral and vertical or lateral only capability. The navigation system will typically use multi-sensor capability for position fixing (VHF Omni-directional Radio Range (VOR), Distance Measuring Equipment (DME), Global Positioning System (GPS), Inertial Reference System (IRS), Instrument Navigation System (INS), etc.,) to achieve the necessary performance for certain levels of Category I operations.

**b.** Required levels of accuracy, integrity, and availability for various combinations of sensor-dependent operations (e.g., ILS, GLS, VOR, NDB) or area navigation operations (e.g., Lateral Navigation/Vertical Navigation (LNAV/VNAV), LNAV only, or RNP), necessary to support either Category I or Category II instrument approach procedures, as applicable, are specified in paragraph 5 of the main body of this AC.

**5. TYPES OF APPROACH NAVIGATION SERVICE.**

**5.1. Instrument Landing System (ILS).**

ILS is supported by established international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The Airplane Flight Manual (AFM) shall indicate that operation is predicated upon the use of an ILS facility with performance and integrity equivalent to, or better than, an ICAO Annex 10 Facility Performance Category I ILS, a U.S. Type I, or equivalent.

**5.1.1. ILS Flight Path Definition.** The required lateral and vertical flight path is inherent in the design of the ILS. Acceptable performance and integrity standards have been established for ILS.

**5.1.2. ILS Airplane Position Determination.** The airplane lateral and vertical position relative to the desired flight path is accomplished by an airplane ILS receiver that provides deviation from the extended runway centerline path when in the coverage area.

**5.2. Microwave Landing System (MLS).**

MLS is supported by established ICAO Annex 10 international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The AFM shall indicate that operation is predicated upon the use of an MLS facility with performance and integrity equivalent to, or better than, an ICAO Annex 10 Facility Performance Category I MLS, or equivalent.

**5.2.1. MLS Flight Path Definition.** The lateral and vertical required flight path is inherent in the design of the MLS. Acceptable performance and integrity standards have been established for MLS.

**5.2.2. MLS Airplane Position Determination.** The airplane lateral and vertical position relative to the desired flight path is accomplished by an airplane MLS receiver that provides deviation from the extended runway centerline path when in the coverage area.

**5.3. GNSS with Ground-based Augmentation (GLS) [PoC].**

This appendix section is not intended to provide a comprehensive means of compliance for airworthiness approval of GNSS based systems. Currently approved systems are ILS or MLS-based. The application of new technologies and systems will require an overall assessment of the integration of the airplane components with other elements (e.g., new ground-based aids, satellite systems, advanced radar mapping systems, enhanced vision sensor systems) to ensure that the overall safety of the use of these systems for Category I. This GNSS section is included to identify important differences between conventional ILS/MLS-based systems and GNSS based systems that affect GLS criteria development.

The performance, integrity, and availability of any ground station elements, any datalinks to the airplane, any satellite elements and any data base considerations, when combined with the performance, integrity, and availability of the airplane system, should be at least equivalent to the overall performance, integrity, and availability provided by ILS to support Category I operations.

**5.3.1. GLS Flight Path Definition.** Appropriate specification of the required flight path for approach, or approach, landing, and rollout (as applicable), is necessary to assure safety of the operation to the relevant operational minima. The required flight path should be established to provide adequate clearance between the airplane and fixed obstacles on the ground, between airplanes on adjacent approaches, and to ensure that the airplane stays within the confines of the runway.

**a.** The effect of the navigation reference point on the airplane flight path and wheel-to-threshold crossing height must be addressed.

**b.** The required flight path is not inherent in the design of a GNSS based approach, landing, and rollout system; therefore, an airplane navigation system must specify a sequence of earth-referenced path points, or the airplane must receive information from a ground-based system to define the approach, landing, and rollout required path points.

**c.** Certain path points, waypoints, leg types, and other criteria are necessary to safely implement the approach, or approach, landing, and rollout operations based on satellite and other integrated multi-sensor navigation systems.

**d.** Figure 4.6-1 in the main body of this AC shows the minimum set of path points, waypoints, and leg types considered necessary to specify the flight path for approach, or approach, landing, and rollout operations.

**e.** The required flight path may be stored in an airplane database for recall and use by the command guidance and/or control system when required to conduct the approach to relevant minima for landing and rollout.

**f.** The definition, resolution, and maintenance of the waypoints which define the required flight path and flight segments is key to the integrity of this type of approach, landing, and rollout operation.

**g.** A mechanism should be established to assure the continued integrity of the flight path designators.

**h.** The integrity of any database used to define required path points for an approach should be addressed as part of the certification process. The flightcrew shall not be able to modify information in the database that relates to the definition of the required flight path for the final approach, and, if necessary, initial missed approach.

**5.3.2. GLS Airplane Position Determination.** The safety of an approach operation is, in part, predicated on knowing where the airplane is positioned relative to the required flight path. Navigation satellite systems exist which can provide position information to specified levels of accuracy, integrity, and availability. The accuracy, integrity, and availability can be enhanced by additional space and ground-based elements. These systems provide certain levels of capability to support present low visibility operations and are planned to have additional future capability.

**a.** Satellite systems have the potential to provide positioning information necessary to guide the airplane during approach. If operational credit is sought for these operations, the performance, integrity, and availability must be established to support that operation. Ground-based aids such as differential position receivers, pseudolites etc., and a data link to the airplane may be required to achieve the accuracy, integrity, or availability for certain types of operation.

**b.** A level of safety equivalent to current ILS-based operations should be established.

**c.** The role of the satellite-based elements in the landing system should be addressed as part of the airplane system certification process until such time as acceptable national or international standards for satellite-based systems are established.

**Basic GNSS (Un-augmented).** This is the basic navigation service provided by a satellite system. No additional navigation service elements are used to enhance accuracy or integrity of the operation.

**Differential Augmentation.** The role of the differential station in the landing system should be addressed as part of the airplane system certification process, unless an acceptable national or international standard for the ground reference system is established.

**Local Area Differential Augmentation.** Local Area Differential (LAD) augmentation consists of a set of ground-based GNSS receivers that are used to derive pseudo-range corrections and integrity data referenced to a point on or near the airport. This augmentation data is then provided to the airplane via a local, ground-based data broadcast signal.

**Wide Area Differential Augmentation.** Wide Area Differential (WAD) augmentation may be used to provide approach capability supporting appropriate levels of Category I procedures.

**5.3.3. Data Link [PoC].** A data link may be used to provide data to the airplane to provide the accuracy necessary to support certain operations (e.g., navigation waypoints, differential corrections for GNSS).

**a.** The integrity of the data link should be commensurate with the integrity required for the operation.

**b.** The role of the data link in the approach, or approach and landing system should be addressed as part of the airplane system certification process unless an identified acceptable U.S. or international standard(s) for the data link ground system is applicable and is used.

**6. BASIC AIRWORTHINESS REQUIREMENTS.** This section identifies airworthiness requirements including those for performance, integrity, and availability that apply to all types of airplane systems, independent of the type of approach and landing or navigation system used. The definitions of performance, integrity, and availability are found in Appendix 1. The basic airworthiness criteria are intended to be independent of the specific implementation in the airplane or the type of approach system being used. Criteria may be expanded further in later sections of this appendix as it applies to a particular airplane system or architecture.

> **NOTE: Continuity of Approach Function may involve aircraft systems, ground systems and, in some cases, space-based systems. This AC addresses the aircraft part of the system and aircraft criteria will be defined in terms of aircraft system availability to provide quantifiable criteria for airworthiness compliance.**

**6.1. General Requirements.** An applicant shall provide a certification plan which describes how any non-aircraft elements of the Approach System relate to the aircraft system from a performance, integrity and availability perspective. Standard Landing Aids (SLA) can be addressed by reference to ICAO Standards and Recommended Practices (SARPS).

**a.** The plan for certification shall describe the system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements other than those contained in this appendix are necessary.

**b.** The Approach system performance should be established considering the environmental and deterministic effects that may reasonably be experienced for the type of operation for which certification and operational approval will be sought.

**c.** Where reliance is placed on the pilot to detect a failure of engagement of a mode when it is selected (e.g., go-around), an appropriate indication or warning must be provided.

**d.** The effect of the failures of the navigation facilities must be considered taking into account ICAO and other pertinent State criteria.

**e.** The effect of the aircraft navigation reference point on the airplane flight path and wheel-to-threshold crossing height shall be assessed.

**6.2. Approach System Accuracy Requirements.** The following items are general criteria that apply to the various types of approach operations.

**a.** Performance shall be demonstrated by flight test, or analysis validated by flight test, using at least 3 different representative facilities for a minimum of 9 total approaches, with a representative range of environmental and system variables which have an effect on overall performance.

**b.** The performance assessment shall take into account at least the following variables with the variables being applied based upon their expected distribution:

(1) Configurations of the airplane (e.g., flap settings);

(2) Center of gravity;

(3) Landing weight;

(4) Conditions of wind, turbulence, and wind shear;

(5) Characteristics of ground and space based systems and aids (e.g., ILS, MLS, GLS, GNSS); and

(6) Any other parameter which may affect system performance (e.g., airport altitude, approach path slope, variations in approach speed).

**c.** The criteria for acceptable approach performance are based upon acquiring and tracking the required flight path to the appropriate minimum altitude for the procedure. The acquisition should be accomplished in a manner compatible with instrument procedure requirements and flightcrew requirements for the type of approach being conducted.

**d.** An approach guidance system shall not generate command information (e.g., flight director, HUD etc.) which results in flight path control that is oscillatory or requires unusual effort by the pilot to satisfy the performance requirements.

**e.** An approach control system shall not generate flight path control (e.g., autopilot) with sustained oscillations.

**f.** The approach system must cause no sustained nuisance oscillations or undue attitude changes or control activity as a result of configuration or power changes or any other disturbance to be expected in normal operation.

**6.2.1. ILS.** The performance standards for signal alignment and quality contained in ICAO Annex 10 or an equivalent State standard are acceptable standards for operations based on ILS. These standards shall be used in establishing the performance of the operation.

**a.** Lateral tracking performance from 1000’ Height Above Touchdown (HAT) to 200’ HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course.

**b.** Vertical tracking performance from 700’ HAT to 200’ HAT should be stable without large deviations (i.e., within ±75 microamps deviation) from the indicated path.

**6.2.2. MLS.** The performance standards for signal alignment and quality contained in ICAO Annex 10 or an equivalent State standard are acceptable standards for operations based on MLS. These standards shall be used in establishing the performance of the operation.

**a.** Lateral tracking performance from 1000’ HAT to 200’ HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course or path.

**b.** Vertical tracking performance from 700' HAT to 200' HAT should be stable without large deviations (i.e., within ±75 microamps deviation) from the indicated path.

**6.2.3. GLS [PoC].** Paragraph 5.3 provides background GLS considerations.

**a.** Lateral tracking performance from 1000' HAT to 200' HAT should be stable without large deviations (i.e., within ±50 microamps deviation) from the indicated course or path, or equivalent.

**b.** Vertical tracking performance from 700' HAT to 200' HAT should be stable without large deviations (i.e., within ±75 microamps deviation) from the indicated path, or equivalent.

**6.2.4. RNP.** The accuracy criteria for RNP are designed to enable a seamless transition from en route RNP to approach RNP. RNP operations are based upon the accuracy of the airplane flight path in absolute terms with respect to the defined flight path over the ground. The Total System Error (TSE) will be characterized by the combined performance of airplane systems and any navigation aids. The certification plan should identify any navigation aid(s) on which the RNP performance will be established and how the airplane performance interacts with the navigation aid(s) to meet the TSE performance requirements. The certification plan should identify the assumed relationship between airplane performance and any navigation aid performance.

**a.** The approach RNP is specified from the FAF to the point along the final approach segment at which the lowest applicable Decision Altitude (Height) (DA(H)) typically is applied. There may be one or more levels of RNP specified on a final segment. Missed approach RNP, or levels of RNP if more than one level of RNP is specified, is typically specified from a point related to the lowest applicable DA(H), and typically continues to a missed approach holding fix or missed approach waypoint. RNP also may be applied to a "go-around safety" assessment. When applied to a "go-around safety assessment," the RNP level and associated obstacle clearance start at the end of the touchdown zone with an expanding lateral area that widens to match the level of RNP used, and then continues at the RNP level(s) specified. The expanding lateral area starts on the centerline for the approach at the end of the touchdown zone and widens at a 7.5 degree splay, or ICAO 1:8 splay, depending on procedure development criteria used. It is applicable from the end of a touchdown zone to reaching the missed approach holding fix or applicable missed approach waypoint (See Appendix 5).

**b.** Assumptions regarding the performance for any radio navigation aid(s) used should be consistent with ICAO Annex 10 or an equivalent State standard. In cases where site-specific geometry must be considered in the evaluation of the NSE, limits on the assumed geometry should be identified

**c.** The guidance or control system shall be demonstrated to maintain a flight path which tracks the defined flight path to the RNP Type as specified in Paragraph 4.5 of the body of this AC, as applicable.

**6.2.5. Flight Path Definition.** Refer to Paragraph 4.6 in the main body of this AC for consideration on Flight Path Definition when navigation aids are used which do not have the required flight path inherent in the structure of the signal in space.

**6.2.6. Area Navigation Systems.** The accuracy requirements for area navigation systems are as specified in AC 25-15, Approval of Flight Management Systems in Transport Category Airplanes, AC 20-129, Airworthiness Approval of Vertical Navigation (VNAV) Systems for Use In the U.S. NAS and Alaska, and AC 20-130, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, as amended. In addition, criteria described in the table below may alternately be met and referenced in the AFM.

The guidance or control system shall be demonstrated to track the lateral and vertical flight path or lateral flight path alone, if applicable, to one of the levels shown below.

See paragraph 4.4.4. in the main body of this AC for vertical performance specification.

The basis for demonstration, or the demonstrated values, should be referenced in the AFM

**6.3. Approach System Integrity Requirements.** The applicant shall provide the certification authority with an overall operational safety assessment plan for the use of systems other than ILS or MLS for “path in space” guidance. This plan shall identify the assumptions and considerations for the non-aircraft elements of the system and how these assumptions and considerations relate to the airplane system certification plan.

**a.** The onboard components of the landing system, considered separately and in relation to other associated onboard systems, should be designed to comply with Title 14 of the Code of Federal Regulations (14 CFR) part 25, section 25.1309, considering any specific safety-related criteria identified in this appendix, or as identified in accordance with the operating rules.

**b.** The following criteria are provided as advisory material for the application of section 25.1309 to Landing Systems:

**6.3.1. ILS.** The aircraft system response to loss of ILS guidance signals (localizer and glideslope) shall be established.

**6.3.2. MLS.** The aircraft system response to loss of MLS guidance signals (elevation and azimuth) shall be established.

**6.3.3. GLS.** The aircraft system response to loss of GLS guidance signals shall be established.

**6.3.4. RNP.** The aircraft system response to loss of the navigation service(s) used to conduct the RNP operation shall be established.

**a.** The aircraft system response during any switch over to alternate navigation services shall be established.

**b.** It shall be demonstrated that the airplane will maintain the required flight path within the containment limits (i.e., 2 times the RNP value) when un-annunciated failures not shown to be extremely remote (probability in the order of $10^{-7}$ per approach, or less) are experienced.

**6.3.5. Area Navigation Systems.** The integrity requirements for area navigation systems are as specified in AC 25-15, as amended, or equivalent.

**6.4. Approach System Availability Requirements.** Below 500 ft. on approach, the demonstrated probability of a successful landing should be at least 95% (i.e., no more than 5% of the approaches result in a go-around, due to the combination of failures in the landing system and the incidence of unsatisfactory performance). In addition, a dual or single area navigation (RNAV) approach system installation should meet the availability requirements consistent with the operational objective of 14 CFR part 121, section 121.349, (as applicable to standard Operations Specifications (OpSpecs)).

**6.5. Go-around Requirements.** A Go-around may be required following a failure in the Approach System, as required by the flightcrew or by Air Traffic Service (ATS) at any time prior to touchdown.

**a.** It should be possible to initiate a missed approach at any point during the approach until touchdown on the runway. It should be safe to initiate a missed approach that results in a momentary touchdown on the runway.

**b.** A go-around should not require unusual pilot skill, alertness, or strength.

**c.** The proportion of approaches terminating in a go-around below 500 ft. (150 m) due to the combination of failures in the landing system and the incidence of unsatisfactory system performance may not be greater than 5%.

**d.** Information should be available to the operator to assure that a safe go-around flight path can be determined.

**6.6. Flightdeck Information, Annunciation, and Alerting Requirements.** This section identifies information, annunciations and alerting requirements for the flight deck.

The controls, indicators and warnings must be designed to minimize crew errors that could create a hazard. Mode and system malfunction indications must be presented in a manner compatible with the procedures and assigned tasks of the flightcrew. The indications must be grouped in a logical and consistent manner and be visible under all expected normal lighting conditions.

**6.6.1. Flightdeck Information Requirements.** This section identifies requirements for basic situational and guidance information.

**a.** For manual control of approach flight path, the appropriate flight display(s), whether head down or head up, must provide sufficient information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

(1) maintain the approach path

(2) to make the alignment with the runway, and if applicable, safely flare and roll out, or

(3) go-around.

**b.** Sufficient information should be provided in the flight deck to allow the pilots to monitor the progress and safety of the approach operation, using the information identified above and any additional information necessary to the design of the system.

**c.** Required flight performance monitoring capability includes at least the following:

(1) unambiguous identification of the intended path for the approach, and, if applicable, safely flare and roll out, (e.g., ILS/MLS approach identifier/frequency, and selected navigation source), and

(2) indication of the position of the aircraft with respect to the intended path (e.g., raw data localizer and glide path, or equivalent).

**6.6.2. Annunciation Requirements.** A positive, continuous, and unambiguous indication should be provided for the modes actually in operation, as well as those that are armed for engagement. In addition, where engagement of a mode is automatic (e.g., localizer and glide path acquisition), clear indication must be given when the mode has been armed by either action of a member of the flightcrew, or automatically by the system (e.g., a pre-land test - LAND 3).

**6.6.3. Alerting.** Alerting requirements are intended to address the need for warning, caution, and advisory information for the flightcrew.

**6.6.3.1. Warnings.** Section 25.1309 requires that information must be provided to alert the crew to unsafe system operating conditions and to enable the crew to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. The design should account for crew alerting cues, corrective action required, and the capability of detecting faults.

**6.6.3.2. Cautions.** A caution is required whenever immediate crew awareness is required and timely subsequent crew action may be required. A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue or discontinue the approach.

For RNP systems, the guidance or control system shall indicate to the flightcrew when the Actual Navigation Performance (ANP) exceeds the RNP

**6.6.3.3. System Status.** Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided for the operator to determine prior to departure and the flightcrew to determine after departure, the capability of the airplane approach system components to accomplish the intended approach.

**a.** While en route, the failure of each airplane component affecting the approach capability should be indicated without flightcrew action. The indication should be an advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), unless the failure requires a warning or caution for other reasons (e.g., autopilot disconnect warning).

**b.** A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue to the destination or divert to an alternate.

**c.** System Status indications should be identified by names that are different than operational authorization categories (e.g., do not use names such as "CAT I," "CAT II," "CAT III").

**6.7. Multiple Landing Systems and Multi-mode Receivers (MMR) for Category I.** International agreements have established a number of landing systems as an acceptable means to provide guidance to support the conduct of an instrument approach. This section identifies unique requirements which relate to airplane systems which provide the capability to conduct approach and landing operations using these multiple landing systems (e.g., ILS, MLS, GLS). Typically these multiple landing systems are implemented through use of one or more multi-mode navigation receivers (MMR), capable of providing navigation information for ILS, MLS, and GLS or any one or more combinations of these landing sensor systems.

**a.** ICAO has specified an ILS protection date of at least 2010 to support international approach and takeoff operations. In addition, MLS or GLS may be used on a regional basis, until GLS based approach, landing, and departure system are in worldwide use. Accordingly, an operator may elect to use ILS, ILS/MLS, ILS/GLS, or ILS/MLS and GLS. If a Multi-mode Receiver (MMR) is used, MMR characteristics should be consistent with applicable related ARINC characteristics for MMR.

**b.** For systems which elect to use MLS, either FAA criteria or JAR-AWO as amended, (e.g., NPA AWO 9), may be used as a consideration in defining the airworthiness requirements for MLS certification.

**6.7.1. General Requirements.** Where practicable, the flight deck approach procedure should be the same irrespective of the navigation source being used.

**a.** A means (for example, the current ILS audio idents) should be provided to confirm that the intended approach aid(s) has been correctly selected.

**b.** During the approach, an indication of a failure in each non-selected airplane system element must be provided to the flightcrew as an indication of system status; it should not produce a caution or warning;

**6.7.2. Indications.** The following criteria apply to indications in the flight deck for the use of a multi-mode landing system:

The loss of acceptable deviation data shall be indicated on the display. It is acceptable to have a single failure indication for each axis common to all navigation sources.

**6.7.3. Annunciations.** The following criteria applies to annunciations in the flight deck when using a multi-mode approach system:

**a.** The navigation source (e.g., ILS, MLS, GLS, FMS) selected for the approach shall be positively indicated in the primary field of view at each pilot station;

**b.** The data designating the approach (e.g., ILS frequency, MLS channel, GLS approach identifier) shall be unambiguously indicated in a position readily accessible and visible to each pilot;

**c.** A common set of mode ARM and ACTIVE indications (e.g., LOC and GS) is preferred for ILS, MLS, and GLS operations;

**d.** A means should be provided for the crew to determine a failure of the non-selected navigation receiver function, in addition to the selected navigation receiver function. When considering equipment failures, the failure indications should not mislead through incorrect association with the navigation source. For example, it would not be acceptable for the annunciation "ILS FAIL" to be displayed when the selected navigation source is MLS and the failure actually affects the MLS receiver.

**6.7.4. Alerting.** Flight operations require alternate airports for takeoff, en route diversion, and landing. These alternate airports may have different landing systems. Flight operations may be planned, released, and conducted on the basis of using one or more landing systems.

**a.** The capability of each element of a multi-mode approach and landing system shall be available to the flightcrew to support dispatch of the airplane.

**b.** A failure of each element of a multi-mode approach and landing system must be indicated to the flightcrew without pilot action, as an advisory (i.e., not a warning or caution, does not demand immediate flightcrew attention), during en route operation.

**c.** A failure of the active element of a multi-mode approach and landing system during an approach shall be accompanied by a warning, caution, or advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), as appropriate.

**d.** An indication of a failure in each non-selected element of a multi-mode approach and landing system during an approach may be made available to the flightcrew as an advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), but should not produce a caution or warning.

**6.7.5. Multi-mode Receivers (MMR).** For MMRs using more than one type of landing system, the means of compliance required for certification can be simplified, provided the applicant provides appropriate justification. This section provides guidance for retrofit certifications, for "ILS Look alike" applications, and for certification of ILS installations with either new or modified receivers.

Typical receiver configurations for retrofit applications include:

**a.** An ILS receiver from a new supplier;

**b.** A modified ILS receiver from the same supplier (e.g., for purposes of providing improved FM Immunity);

**c.** A re-packaged receiver from the same supplier (e.g., the ILS partition in an MMR, or the transition from ARINC 700 to 900 series equipment);

**d.** A stand-alone MLS receiver ("ILS look alike");

**e.** An MLS partition in an MMR ("ILS look alike");

**f.** A stand-alone GLS receiver ("ILS look alike"); or

**g.** A GLS partition in an MMR ("ILS look alike").

**6.7.5.1. "ILS Look alike" Definition Applicable to MMR.** "ILS Look alike" is defined as the ability of a non-ILS based navigation receiver function to provide operational characteristics and interface functionality to the rest of the aircraft equivalent to that provided by an ILS-based receiver function. Specifically in the case of an MLS or GNSS (GLS) based receiver function, the output should be in DDM/microamps, with a sensitivity equivalent to an ILS receiver taking account of the effects of runway length.

**6.7.5.2. General Certification Considerations.**

**6.7.5.2.1. Certification Process.** An "impact assessment" should address any new receiver functionality considering:

**a.** Differences between the current basis of certification and that requested (if applicable).

**b.** The functionality being added.

**c.** Credit that can be taken for the existing approval.

**6.7.5.2.2. Equipment Approval.** TSO/MOPS compliance should be demonstrated where appropriate, including software qualification and receiver environmental qualification to the appropriate levels.

**6.7.5.2.3. Aircraft Installation Approval (14 CFR Part 25).** The following should be considered:

**a.** Impact on airplane system safety assessments.

**b.** Radio approval (e.g., antenna positions, range, polar diagrams, coverage, compatibility between receiver and antenna).

**c.** EMI/EMC testing.

**d.** Functional integration aspects of the receiver with respect to other systems, controls, warnings, displays.

**e.** Electrical loading.

**f.** Flight data recorder requirements.

**g.** Suitable Aircraft Flight Manual (AFM) provisions.

**h.** Certification means of compliance for the receiver installation (e.g., specification of ground and/or flight testing, as necessary).

**6.7.5.2.4. Alternative Means of Compliance using JAR-AWO.** JAR-AWO may be considered as an acceptable means of compliance for ILS or MLS if the applicant establishes that the proposed new or modified navigation receiver configuration can be considered to have "ILS Look alike" characteristics. The following interpretative material to existing ACJ may be considered for that part of the certification affected by the revised installation:

**ACJ AWO 131 Performance Demonstration.** 2.1 Flight Demonstrations - Program of Landings for Certification.

**ACJ AWO 161(b) Failure Conditions.**

**ACJ AWO 231 Flight Demonstration.** 1.1 Continuous Method (Analysis of Maximum Value).

**ACJ AWO 431 Performance (Interpretative Material).**

**6.7.5.2.5. Recertification of an ILS function following the Introduction of a New or Modified ILS Navigation Receiver Installation.** The certification program should consider the differences between the new configuration and the pre-existing ILS receiver system. An "impact assessment" may be used to establish a basis for certification.

**6.7.5.2.5.1. New or Modified ILS Impact Assessment.**

**a.** An impact assessment should consider the following aspects of the new or modified ILS receiver, or receiver function, for equivalence with the existing ILS receiver configuration:

**(1)** hardware design;

**(2)** software design;

**(3)** signal processing and functional performance;

**(4)** failure analysis;

**(5)** receiver function, installation and integration (e.g., with controls, indicators and warnings).

**b.** The impact assessment should also identify any additional considerations such as:

**(1)** Future functionality provisions which have no impact on system operation;

**(2)** Shared resources to support future functionality.

Based upon the assumption that the ILS receiver, or receiver function, can be shown to be equivalent to the current ILS configuration, the applicant may propose that the new installation be treated as a new ILS receiver for installation on a given airplane type.

**6.7.5.2.5.2. New or Modified ILS Failure Analysis.** The failure characteristics of the new or modified installation should be reviewed, equivalent to systems using ILS data, to ensure that the failure characteristics are compatible with and do not invalidate any original or previous safety assessments.

**6.7.5.2.5.3. New or Modified ILS Autoland or HUD Guidance Landing Function Flight Testing (if necessary).** For systems intended to provide Autoland or HUD guidance landing function using a new ILS, MLS, GLS, or combined MMR receiver, a flight test program of typically a minimum of eight approaches terminating in a successful (automatic or HUD) landing and rollout (if applicable) using the flight control/guidance system, including a minimum of two ILS facilities should be completed. Approaches should include captures from both sides of the final approach course, at angles and distances representative of typical instrument approach procedures, and, if applicable, from below and above the glideslope.

The approach and landing performance (flight path deviation, touchdown data, etc.) as appropriate, should be shown to be equivalent to that achieved in the original ILS certification. Recorded flight test data may be required to support equivalency demonstration.

A demonstration of take off guidance performance should be included where applicable.

**6.7.5.2.5.4. New or Modified ILS Documentation.** The following documentation should be provided for certification:

**a.** An Impact Assessment including effects on System Safety Assessments.

**b.** A Flight test report, if applicable.

**c.** Revisions to the Flight Manual, where appropriate.

**6.7.5.2.6. Recertification following the Introduction of an MLS or GLS Navigation Receiver Installation.**

**6.7.5.2.6.1. MLS or GLS Introduction Impact Assessment.** An MLS or GLS receiver or receiver function can be certificated with an "impact assessment" similar to that required for the re-certification of a new or modified ILS receiver, provided that the unit(s) has been shown to have satisfactory "ILS Look alike" characteristics. The "impact assessment" should assess equivalent aspects of the MLS or GLS receiver or receiver function to those for the existing ILS receiver configuration.

Based upon the assumption that the MLS or GLS receiver or receiver function, can be shown to have "ILS look alike" characteristics, the applicant may propose that the new installation be treated as a new ILS receiver for approval on a particular airplane type.

**6.7.5.2.6.2. MLS or GLS Failure Analysis.** The failure characteristics of the new or modified installation should be reviewed, equivalent to systems using ILS data, to ensure that the failure characteristics are compatible with and do not invalidate any original or previous safety assessments.

**6.7.5.2.6.3. MLS or GLS Statistical Performance Assessment.** If the flight control/guidance system control algorithms are unchanged or effects of any changes are fully accounted for (e.g., navigation reference point), the statistical performance assessment of a currently certificated automatic landing system or Head Up Display landing or takeoff system should typically not have to be re-assessed for the addition of MLS or GLS functionality. This equivalence is based on the assumption that the MLS or GLS receiver, or the MLS or GLS partition of an MMR, can be shown to have satisfactory "ILS Look alike" characteristics.

**6.7.5.2.6.4. MLS or GLS Antenna or Navigation Reference Point Location.** The implication of differences in position of the MLS or GLS and ILS aircraft antennas or Navigation Reference Point should be assessed considering:

**a.** Wheel-to-threshold crossing height;

**b.** Lateral and vertical antenna position or navigation reference point position effects on flight guidance system performance (including any alignment, flare, or rollout maneuvers).

**6.7.5.2.6.5. MLS or GLS Introduction Flight Testing (as necessary).** For an installation of MLS or GLS which can be treated as a new ILS receiver, a flight test program of typically a minimum of 10 to15 approaches terminating in a landing and rollout (if applicable) using the flight control/guidance system, including a minimum of two MLS or GLS facilities for each system to be authorized should be completed. The approaches should include captures from both sides of the final approach course using representative angles and distances, should include captures from below and above the glideslope if applicable, and should include representative wind conditions where antenna or navigation reference point positions may impact performance.

The approach and landing performance (flight path deviation, touchdown data etc.) as appropriate, should be shown to be equivalent to that achieved in the original ILS certification. Recorded flight test data may be required to support equivalency.

A demonstration of take off guidance performance should be included where applicable.

**6.7.5.2.6.6. MLS or GLS Introduction Documentation.** The following documentation should be provided for certification of MLS or GLS:

**a.** An Impact Assessment including effects on System Safety Assessments.

**b.** A Flight test report, if applicable.

**c.** Revisions to the Flight Manual where appropriate.

**6.8. Steep Angle Approaches.** The following considerations should be considered before AFM provisions are incorporated for steep angle approaches:

**a.** The descent gradient range to be demonstrated.

**b.** Suitable "touchdown zone" size considerations, if not standard.

**c.** Adequate descent gradient abuse recovery.

**d.** Adequate speed abuse recovery.

**e.** Engine-failure continuation safety.

**f.** Engine-failure balked or rejected landing safety.

**g.** Adverse tailwind gradients on approach.

**h.** Adverse tailwind component limits at touchdown.

**i.** De-ice and Anti-ice protection considerations.

**j.** Suitability of cockpit visibility during approach and flare.

**k.** Suitability of climb gradient achievable while in the steep angle approach configuration, as necessary.

**l.** Suitability of descent, flare, and touchdown sink rates.

**m.** Provision for drag device (e.g., spoiler or auto-feather) failure.

**n.** Suitability of auto-feather response and time delays, as applicable.

**o.** Flight guidance system compatibility with steep angle approach paths to be flown.

**p.** Antenna function for navigation and communication performance are satisfactory.

**q.** Flight guidance display systems are satisfactory.

**r.** Suitable procedures are provided for approach, rejected landing, and missed approach for all-engine and engine-inoperative cases, and engine failure is addressed at any time until touchdown, during rollout, or after a go around.

**s.** Any adverse deck angle effects or landing gear geometry effects.

**7. APPROACH SYSTEM EVALUATION.** An evaluation should be conducted to verify that the pertinent systems as installed in the airplane meet the airworthiness requirements of paragraph 6 of this appendix. The evaluation should include verification of approach system performance requirements and a safety assessment for verification of the integrity and availability requirements. Engine failure cases and other selected failure conditions identified by the safety assessment should be demonstrated by simulator and/or flight tests.

An applicant shall provide a certification plan(s) that describes:

**a.** The means proposed to show compliance with the requirements of paragraph 6 of this appendix, with particular attention to methods that differ significantly from those described in this appendix.

**b.** How any non-airplane elements of the Approach System relate to the airplane system from a performance, integrity, and availability perspective (e.g., appropriate reference to ICAO Annex or U.S. Standard).

**c.** The assumptions on how the performance, integrity, and availability requirements of the non-airplane elements of the Standard Landing Aid will be assured.

**d.** The system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements in excess of that contained in this appendix are necessary.

Early agreement between the applicant and the FAA should be reached on the proposed certification plan. Upon completion of an FAA engineering design review and supporting simulation studies, a type inspection authorization (TIA) should be issued to determine if the complete installation of the equipment associated with Category I operations meets the criteria of this appendix.

**7.1. Performance Evaluation.** The performance assessment can be accomplished "in flight," or credited from similar installations as follows:

**a.** Performance shall be demonstrated by flight test, or analysis validated by flight test, using at least 3 different representative facilities for a minimum of 9 total approaches, with a representative range of environmental and system variables which have an effect on overall performance.

**b.** Acceptable performance may be established as a by-product of, or in conjunction with, a more restrictive performance demonstration(s) (e.g., Basic type certification, or as a consequence of successfully meeting Category II/III criteria);

- As a dedicated qualitative "in flight" demonstration of acceptable performance; or
- By establishing similarity with other mature and acceptably performing system installations.

For this provision, "in-flight" demonstration is not necessary, but a functional ground check, bench test, or other equipment check is typically appropriate (e.g., this provision is typically used in the instance of installation of a new model of ILS, VOR, ADF, or DME receiver).

**7.2. Safety Assessment.** Except as required by any specific safety-related criteria identified in this appendix, or by the operating rules, a safety assessment of the approach system, considered separately and in conjunction with other systems, shall be conducted to show compliance with section 25.1309.

**8. AIRBORNE SYSTEM REQUIREMENTS.** This section identifies criteria applicable to specific aircraft system architecture selected to conduct the operation. This criteria is developed from operational considerations, approach system considerations, airplane system considerations, and the general operational philosophy contained in the body of this AC.

**8.1. General.** Various airplane systems are expected to comply with the basic performance, integrity, and availability requirements as identified in paragraph 6 of this appendix.

**8.2. Autopilot.** Criteria applicable to Autopilot systems is as specified by section 25.1329.

**8.3. Head Down Guidance.** Criteria applicable to Head Down Guidance systems are specified in the pertinent parts of paragraphs 4 and 5 of this appendix.

**8.4. Head Up Guidance.** The following criteria is applicable to Head Up Guidance systems:

**a.** The workload associated with use of the HUD should be considered in showing compliance with section 25.1523.

**b.** The HUD display medium must not significantly obscure the pilot's view through the cockpit window.

**c.** Control of Approach Flight Path - the HUD must provide sufficient guidance information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

- maintain the approach path
- go-around

**d.** The pilot should be able to align with the runway without the HUD adversely affecting the pilot task. If command information is provided for the flare and landing, it must not be misleading and should be consistent with the characteristics of normal manual maneuvers.

**e.** If only one HUD is installed, it should be installed at the pilot-in-command crew station.

**f.** The HUD guidance must not require exceptional piloting skill to achieve the required performance.

**g.** The HUD system performance and alerting should be consistent with the intended operational use for duties and procedures of the pilot flying (PF) and pilot not flying (PNF) (see paragraphs 5.6 and 5.8 of the main body of this AC).

**h.** If the autopilot is used to control the flight path of the airplane to intercept and establish the approach path, the point during the approach at which the transition from automatic to manual flight takes place shall be identified and used for the performance demonstration.

**i.** Any transition from autopilot to HUD guidance must not require exceptional piloting skill, alertness, strength, or excessive workload.

**8.5. Hybrid HUD/Autoland Systems [PoC].** The following criteria is applicable to Hybrid systems:

**a.** If a HUD is used to monitor an autoflight system, it should be shown to be compatible with the autoflight system and permit a pilot to detect unsuitable autopilot performance.

**b.** Other hybrid systems (e.g., including EVS) require a proof of concept **[PoC]** evaluation to establish suitable criteria.

**8.6. Satellite-Based Approach System.** The following criteria is applicable to satellite-based approach systems:

**a.** Satellite-based systems should be shown to provide equivalent or better capability than navigation systems based on VOR, DME, or ILS for comparable operations, or meet provisions applicable to RNP.

**b.** Satellite-based systems should not exhibit undue sensitivity to masking of satellite vehicles, or interference from onboard or external sources.

**c.** Satellite-based systems should not exhibit adverse characteristics during acquisition or loss of satellites.

**8.7. Area Navigation Systems.**

**a.** Area navigation systems should operate consistent with criteria specified in:

**(1)** AC 25-15, Approval of Flight Management Systems in Transport Category Airplanes;

**(2)** AC 20-129, Airworthiness Approval of Vertical Navigation (VNAV) Systems for use in the U.S. NAS and Alaska; and

**(3)** AC 20-130, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, as amended, or equivalent criteria.

**b.** In addition, area navigation systems used for approach should have at least the following characteristics:

**(1)** If the operational software (ops program) is modifiable or loadable (e.g., by maintenance action) a “Version” identification must be provided and available for display to the pilot or maintenance personnel (e.g., PS4052520-161, or U7.4, or B767-300.3);

**(2)** A suitable database must be used which can be assured to be suited for the specific aircraft and navigation system type, and which can be assessed to have current data (e.g., Navigation Database “NW19810001”);

**(3)** Pilot input/output functions, keys, and displays should have standard functions available, and operate consistent with industry standard conventions and practice;

**(4)** Single systems must be accessible and usable by either pilot located at a pilot or copilot crew station (e.g., the PF or PNF) of a multi-crew aircraft. It is not necessary that such systems also be accessible, or easily accessible, to pilots other than the PF and PNF sitting in a jumpseat (e.g., do not need to be readily accessible to International Relief Officers (IROs)), but it is recommended that such a system be at least visible to such other pilots (if they have assigned duties) for enhancement of crew coordination and monitoring;

**(5)** Dual (or more) system installations must have a convenient and expedient way to “crossload” and be kept updated. Each system should have CDUs, displays, and annunciations, or equivalent that are at least visible and accessible to both the PF and PNF. This is to provide both for monitoring and use in failure cases. It is not necessary that such systems also be accessible, or easily accessible, to pilots other than the PF and PNF sitting in a jumpseat (e.g., do not need to be readily accessible to IROs), but it is recommended that such a system be at least visible to such other pilots (if they have assigned duties) for enhancement of crew coordination and monitoring;

**(6)** System performance must be consistent with operational authorizations sought (see paragraphs 4 and 5 of this appendix), or should be consistent with an identifiable performance standard such as for various levels of RNP;

**(7)** If credit is sought for operating on complex and closely spaced multiple Waypoint paths, an interface with a suitable “track up” or “heading up” navigation map display is necessary;

**(8)** A means to monitor lateral and vertical deviations should be provided (e.g., displacement display, progress page lateral and vertical deviation);

**(9)** A means must be provided to assure suitable operation or updating, and if RNP is included, to identify the level of RNP to be used, and ANP (or EPE);

**8.8. Autothrottle.** If autothrottle capability is installed, the applicant should identify any necessary modes, conditions, procedures, or constraints that apply to its use. Use of the autothrottle should not cause unacceptable performance of any autopilot modes intended for use, and any autopilot mode intended for use with autothrottle should not cause unacceptable autothrottle performance. The autothrottle should expeditiously capture any commanded speed adjustments, acceptably maintain speed, and not cause any hazardous conditions with normal use, or for any probable failure modes, considering pilot intervention using normal piloting skills.

**8.9. Data Link [PoC].** A datalink may be used to provide data to the airplane to provide the accuracy necessary to support the approach.

**a.** The integrity of the datalink should be commensurate with the integrity required for the approach.

**b.** The role of the datalink in the approach system must be addressed as part of the aircraft system certification process until such time as an acceptable national or international standard for the ground system is established.

**9. AIRPLANE FLIGHT MANUAL (AFM).** The AFM should contain the following information:

**a.** Any conditions or constraints on approach performance with regard to airport conditions (e.g., elevation, ambient temperature, approach path slope, runway slope and ground profile under the approach path).

**b.** The criteria used for the demonstration of the system, acceptable normal and non-normal procedures, the demonstrated configurations and types of facilities used, and any constraints or limitations necessary for safe operation.

**c.** The type of navigation facilities used as a basis for certification. This should not be taken as a limitation on the use of other facilities. The AFM may contain a statement regarding the type of facilities or condition known to be unacceptable for use.

**d.** Information should be provided to the flightcrew regarding atmospheric conditions under which the system was demonstrated (e.g., headwind, crosswind, tailwind etc.). The AFM should contain a statement that "Credit may not be predicated on the use of <type of system> if conditions exceed … (those for which the system received airworthiness approval)."

**e.** Any necessary performance, procedure, or configuration data to permit an operator to determine climb gradient and transition distances for safe obstacle clearance during a missed approach, balked landing, or rejected landing. Note that this information need not be specifically included in the AFM if it is available to the operator using some other method acceptable to the operator and manufacturer (e.g., FCOM, supplementary performance information, separate AFM appendix).

Data may be based on corresponding takeoff performance and obstacle assessment data if appropriate accommodation of configuration change and transition distance can be accounted for. Otherwise, additional information on data that may be useful to an operator for determination of engine-inoperative missed performance, maximum allowable weight, or obstacle assessments is discussed in the main body of this advisory circular in Paragraph 4.3.1.8.

> **NOTE 1: The AFM limitation section should <u>not</u> specify DA(H) or RVR limitations.**
>
> **NOTE 2: Section 2 of AC 25.1581-1 discusses AFM contents. The approval status referenced in 2 b (9) (vii) for Category I, II, or III of that AC should be noted in the Normal Procedures Section of the AFM, in accordance with the above provisions of 9. Airplane Flight Manual.**

# APPENDIX 3. AIRBORNE SYSTEMS FOR CATEGORY II

Mandatory terms used in this Advisory Circular (AC) such as “shall” or “must” are used only in the sense of ensuring applicability of these particular methods of compliance when the acceptable means of compliance described herein are used. This AC does not change, add, or delete regulatory requirements or authorize deviations from regulatory requirements.

**1. PURPOSE.** This appendix contains airworthiness criteria for the approval of aircraft equipment and installations required to conduct an approach in Category II weather minima.

**2. GENERAL.**

The type certification approval for the equipment, system installations, and test methods should be based on a consideration of factors such as the intended function of the installed system, its accuracy, reliability, and fail-safe features, as well as the operational concepts contained in the body of this AC. The guidelines and procedures contained herein are considered acceptable methods of determining transport category airplane airworthiness to conduct an approach in Category II weather conditions.

The overall assurance of performance and safety of an operation can only be assessed when all elements of the system are considered. This appendix includes a discussion of the non-aircraft elements of a system so that an overall assessment of the operation can be accomplished.

References to Joint Airworthiness Authority (JAA) All Weather Operations Regulations (JAR) are provided to facilitate the All Weather Operations Harmonization process. A reference to a JAR provision does not necessarily mean that the FAA and JAA requirements are equivalent but that they are related with similar intent. The FAA may typically identify which JAR provisions are acceptable to FAA at the time a type certification basis is established.

**3. INTRODUCTION.** This appendix addresses the approach phase of flight. For the purpose of this appendix, the approach phase of flight is defined as the flight segment from the Final Approach Fix (FAF) to the Category II decision height. This appendix provides criteria which represents an acceptable means of compliance with performance, integrity, and availability requirements for low visibility approach. An applicant may propose alternative criteria. With new emerging technologies, there is a potential for many ways of conducting low visibility approach operations. This appendix does not attempt to provide criteria for each potential combination of airplane and non-airplane elements.

**a.** Operations using current ILS or MLS ground-based facilities and airplane elements are in use, and the certification criteria for approval of these airplane systems are established. Other operations, using non-ground based facilities or evolving ground facilities (e.g., local area augmented Global Navigation Satellite System (GNSS)), and the use of some new aircraft equipment require Proof of Concept testing to establish appropriate criteria for operational approval and system certification. The need for a Proof of Concept program is identified in this AC with a [PoC] designator. This appendix provides some general guidelines, but not comprehensive criteria, for airplane systems that require a Proof of Concept.

**b.** The intended flight path may be established in a number of ways. For systems addressed by this appendix, the reference path may be established by a navigation aid (e.g., ILS, MLS). Other methods may be acceptable if shown feasible by a Proof of Concept **[PoC]**. Methods requiring **PoC** include, but are not limited to:

- the use of ground surveyed waypoints, either stored in an on-board data base or provided by data link to the airplane, with path definition by the airborne system
- sensing of the runway environment (e.g., surface, lighting, and/or markings) with a vision enhancement system

On-board navigation systems may have various sensor elements by which to determine airplane position. The sensor elements may include ILS, MLS, GNSS with ground-based augmentation (GLS), or inertial information. Each of these sensor elements should be used within appropriate limitations with regard to accuracy, integrity, and availability.

Indications of the airplane position with respect to the intended path can be provided to the pilot in a number of ways.

- deviation displays with reference to navigation source (e.g., Instrument Landing System (ILS) receiver, Microwave Landing System (MLS) receiver), or
- on-board navigation system computations with corresponding displays of position and reference path, or
- by a vision enhancement system. **[PoC]**

**c.** The minimum visibility required for safe operations with such systems and backup means will be specified by FAA Flight Standards in the operational authorization.

**4. TYPES OF APPROACH OPERATIONS.** The airworthiness criteria in this appendix are intended to be consistent with the operational concepts of Paragraph 4.3 of the main body of this AC.

**4.1. Operations based on a Standard Landing Aid.**

ILS and MLS have been characterized by appropriate International Civil Aviation Organization l (ICAO) standards, and for the purpose of certification in accordance with this Appendix may be considered a Standard Landing Aid.

Landing Systems based on GNSS Landing System (GLS) may use interim United States criteria, or other FAA agreed State criteria, or other international standards developed for acceptable combination of space and ground-based elements. Acceptable overall aircraft performance may be established based upon the assumption that these services are used and maintained to the specified standards identified, or as specified in the applicable airworthiness approval.

**4.2. Operations based on Required Navigation Performance (RNP).** The airworthiness criteria in this appendix support the operational concept for RNP as described in Paragraph 4.5 in the main body of this AC.

**4.2.1. Standard RNP Types.** Approach operations may be specified based upon standard RNP type designations. The type designation identifies the performance standard required to conduct the operation. The RNP Type will have a lateral performance component and may additionally have a vertical component. Refer to Paragraph 4.5.1 in the main body of this AC for Standard RNP Types.

**4.2.2. Non-standard RNP Types.** Some operations may be approved for Non-Standard RNP Types - Refer to Paragraph 4.5.2 in the main body of this AC. It is envisioned that the airplane systems approval process for Non-Standard RNP Types will be equivalent to that used for Standard RNP Types unless otherwise agreed with the FAA.

**5. TYPES OF APPROACH NAVIGATION SERVICE.**

**5.1. ILS.**

The ILS is supported by established international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The airplane system response during a switchover from an active localizer transmitter to a backup transmitter shall be established.

The Airplane Flight Manual shall indicate that operation is predicated upon the use of an ILS facility with performance and integrity equivalent to, or better than, an International Civil Aviation Organization (ICAO) Annex 10 Facility Performance Category II ILS, an U.S. Type II or equivalent.

**5.1.1. ILS Flight Path Definition.** The required lateral and vertical flight path is inherent in the design of the ILS. Acceptable performance and integrity standards have been established for ILS.

**5.1.2. ILS Airplane Position Determination.** The airplane lateral and vertical position relative to the desired flight path is accomplished by an airplane ILS receiver that provides deviation from the extended runway centerline path when in the coverage area.

**5.2. MLS.**

The MLS is supported by established ICAO Annex 10 international standards for ground station operation. These standards should be used in demonstrating airplane system operation.

The airplane system response during a switchover from an active azimuth transmitter to a backup transmitter shall be established.

The Airplane Flight Manual (AFM) shall indicate that operation is predicated upon the use of an MLS facility with performance and integrity equivalent to, or better than, an ICAO Annex 10 Facility Performance Category II MLS, or equivalent.

**5.2.1. MLS Flight Path Definition.** The lateral and vertical required flight path is inherent in the design of the MLS. Acceptable performance and integrity standards have been established for MLS.

**5.2.2. MLS Airplane Position Determination.** The airplane lateral and vertical position relative to the desired flight path is accomplished by an airplane MLS receiver that provides deviation from the extended runway centerline path when in the coverage area.

**5.3. GNSS Landing System (GLS) [PoC].**

This appendix section is not intended to provide a comprehensive means of compliance for airworthiness approval of GNSS-based systems. Currently approved systems are ILS or MLS-based. The application of new technologies and systems will require an overall assessment of the integration of the airplane components with other elements (e.g., new ground-based aids, satellite systems, advanced radar mapping systems, enhanced vision sensor systems) to ensure that the overall safety of the use of these systems for Category II. This GNSS section is included to identify important differences between conventional ILS/MLS-based systems and GNSS based systems that affect GLS criteria development.

The performance, integrity and availability of any ground station elements, any data links to the airplane, any satellite elements and any data base considerations, when combined with the performance, integrity, and availability of the airplane system, should be at least equivalent to the overall performance, integrity, and availability provided by ILS to support Category II operations.

**5.3.1. GLS Flight Path Definition.** Appropriate specification of the required flight path for approach, or approach, landing, and rollout (as applicable), is necessary to assure safety of the operation to the relevant operational minima. The required flight path should be established to provide adequate clearance between the airplane and fixed obstacles on the ground, between airplanes on adjacent approaches, and to ensure that the airplane stays within the confines of the runway.

**a.** The effect of the navigation reference point on the airplane flight path and wheel to threshold crossing height must be addressed.

**b.** The required flight path is not inherent in the design of a GNSS-based approach, landing, and rollout system; therefore, an airplane navigation system must specify a sequence of earth-referenced path points, or the airplane must receive information from a ground-based system, to define the approach, landing, and rollout required path points.

**c.** Certain path points, waypoints, leg types, and other criteria are necessary to safely implement the approach, or approach, landing, and rollout operations based on satellite and other integrated multi-sensor navigation systems.

**d.** Figure 4.6-1 in the main body of this AC shows the minimum set of path points, waypoints, and leg types considered necessary to specify the flight path for approach, or approach, landing, and rollout operations.

**e.** The required flight path may be stored in an airplane database for recall and use by the command guidance and/or control system when required to conduct the approach to relevant minima for landing and rollout.

**f.** The definition, resolution, and maintenance of the waypoints which define the required flight path and flight segments is key to the integrity of this type of approach, landing, and rollout operation.

**g.** A mechanism should be established to assure the continued integrity of the flight path designators.

**h.** The integrity of any database used to define required path points for an approach should be addressed as part of the certification process. The flightcrew shall not be able to modify information in the database that relates to the definition of the required flight path for the final approach, and if necessary, initial missed approach.

**5.3.2. GLS Airplane Position Determination.** The safety of an approach operation is, in part, predicated on knowing where the airplane is positioned relative to the required flight path. Navigation satellite systems exist which can provide position information to specified levels of accuracy, integrity, and availability. The accuracy, integrity, and availability can be enhanced by additional space and ground-based elements. These systems provide certain levels of capability to support present low visibility operations and are planned to have additional future capability.

**a.** Satellite systems have the potential to provide positioning information necessary to guide the airplane during approach. If operational credit is sought for these operations, the performance, integrity, and availability must be established to support that operation. Ground-based aids such as differential position receivers, pseudolites, etc., and a data link to the airplane may be required to achieve the accuracy, integrity, or availability for certain types of operation.

**b.** A level of safety equivalent to current ILS-based operations should be established.

**c.** The role of the satellite-based elements in the landing system should be addressed as part of the airplane system certification process until such time as acceptable national or international standards for satellite-based systems are established.

**Basic GNSS (Un-augmented).** This is the basic navigation service provided by a satellite system. No additional navigation service elements are used to enhance accuracy or integrity of the operation.

**Differential Augmentation.** The role of the differential station in the landing system should be addressed as part of the airplane system certification process, unless an acceptable national or international standard for the ground reference system is established.

**Local Area Differential Augmentation.** Local Area Differential (LAD) augmentation consists of a set of ground-based GNSS receivers that are used to derive pseudo-range corrections and integrity data referenced to a point on or near the airport. This augmentation data is then provided to the airplane via a local, ground-based data broadcast signal.

**Wide Area Differential Augmentation.** Wide Area Differential (WAD) augmentation may be used to provide approach capability supporting appropriate levels of Category II procedures.

Typically only LAD systems provide a basis for establishing the necessary position fixing accuracy, integrity, and availability for the final portion of a final approach segment or rollout. Unaugmented GNSS or WAD are typically only suited for support of initial or intermediate segments of an approach, final approach to restricted DA(H)s, or missed approach. GNSS or WAD may, however, be used in conjunction with Category II procedures for applications such as equivalent DME distance, or marker beacon position determination, when authorized by the operating rules.

**5.3.3. Data Link [PoC].** A data link may be used to provide data to the airplane to provide the accuracy necessary to support certain operations (e.g., navigation waypoints, differential corrections for GNSS).

**a.** The integrity of the data link should be commensurate with the integrity required for the operation.

**b.** The role of the data link in the approach, or approach and landing system should be addressed as part of the airplane system certification process unless an identified acceptable U.S. or international standard(s) for the data link ground system is applicable and is used.

**6. BASIC AIRWORTHINESS REQUIREMENTS.** This section identifies airworthiness requirements, including those for performance, integrity, and availability that apply to all types of airplane systems, independent of the type of approach and landing or navigation system used. The definitions of performance, integrity, and availability are found in Appendix 1. The basic airworthiness criteria are intended to be independent of the specific implementation in the airplane or the type of approach system being used. Criteria may be expanded further in later sections of this appendix as it applies to a particular airplane system or architecture.

> **Note: Continuity of Approach Function may involve aircraft systems, ground systems and, in some cases, space based systems. This AC addresses the aircraft part of the system, and aircraft criteria will be defined in terms of aircraft system availability to provide quantifiable criteria for airworthiness compliance.**

**6.1. General Requirements.** An applicant shall provide a certification plan which describes how any non-aircraft elements of the Approach System relate to the aircraft system from a performance, integrity, and availability perspective. Standard Landing Aids (SLA) can be addressed by reference to ICAO Standards and Recommended Practices (SARPS).

**a.** The plan for certification shall describe the system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements other than those contained in this appendix are necessary.

**b.** The approach system performance should be established considering the environmental and deterministic effects that may reasonably be experienced for the type of operation for which certification and operational approval will be sought.

**c.** Where reliance is placed on the pilot to detect a failure of engagement of a mode when it is selected (e.g., go-around), an appropriate indication or warning must be provided.

**d.** The effect of the failures of the navigation facilities must be considered taking into account ICAO and other pertinent State criteria.

**e.** The effect of the aircraft navigation reference point on the airplane flight path and wheel-to-threshold crossing height shall be assessed.

**6.2. Approach System Accuracy Requirements.** The following items are general criteria that apply to the various types of approach operation.

**a.** Performance shall be demonstrated by flight test, or analysis validated by flight test, using at least 3 different representative facilities for a minimum of 20 total approaches, with a representative range of environmental and system variables which have an effect on overall performance.

**b.** The performance assessment shall take into account at least the following variables with the variables being applied based upon their expected distribution:

(1) Configurations of the airplane (e.g., flap settings);

(2) Center of gravity;

(3) Landing weight;

(4) Conditions of wind, turbulence, and wind shear;

(5) Characteristics of ground and space based systems and aids (i.e., ILS, MLS, GLS); and

(6) Any other parameter which may affect system performance (e.g., airport altitude, approach path slope, variations in approach speed).

**c.** The criteria for acceptable approach performance are based upon acquiring and tracking the required flight path to the appropriate minimum altitude for the procedure. The acquisition should be accomplished in a manner compatible with instrument procedure requirements and flightcrew requirements for the type of approach being conducted.

**d.** An approach guidance system shall not generate command information (e.g., flight director, HUD etc.) which results in flight path control that is oscillatory or requires unusual effort by the pilot to satisfy the performance requirements.

**e.** An approach control system shall not generate flight path control (e.g., autopilot) with sustained oscillations.

**f.** The approach system must cause no sustained nuisance oscillations or undue attitude changes or control activity as a result of configuration or power changes or any other disturbance to be expected in normal operation.

**6.2.1. ILS.** The performance standards for signal alignment and quality contained in ICAO Annex 10, or an equivalent State standard, are acceptable standards for operations based on ILS. These standards shall be used in establishing the performance of the operation.

**a.** Lateral tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±25 microamps deviation) from the indicated course, for 95% of the time per approach.

**b.** Vertical tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±35 microamps deviation) from the indicated path or ±12 ft, whichever is greater, for 95% of the time per approach.

**Note: When this provision is applied to path tracking in conjunction with Category III, momentary excursions up to ±75 microamps during test demonstrations may be acceptable if flight guidance system touchdown and landing performance is otherwise shown to be satisfactory.**

**c.** The Continuous Method and the Pass/Fail methods found in JAR ACJ AWO 231 may be used in lieu of the 95% of the time per approach and the minimum number of 20 approaches stated above.

**6.2.2. MLS.** The performance standards for signal alignment and quality contained in ICAO Annex 10 or an equivalent State standard are acceptable standards for operations based on MLS. These standards shall be used in establishing the performance of the operation.

**a.** Lateral tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±25 microamps deviation) from the indicated course, for 95% of the time per approach.

**b.** Vertical tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±35 microamps deviation) from the indicated path or ±12 ft, whichever is greater, for 95% of the time per approach.

**Note: When this provision is applied to path tracking in conjunction with Category III, momentary excursions up to ±75 microamps during test demonstrations may be acceptable if flight guidance system touchdown and landing performance is otherwise shown to be satisfactory.**

**c.** The Continuous Method and the Pass/Fail methods found in JAR ACJ AWO 231 may be used in lieu of the 95% of the time per approach and the minimum number of 20 approaches stated above.

**6.2.3. GLS [PoC].** Paragraph 5.3 provides background GLS considerations.

**a.** Lateral tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±25 microamps deviation) from the indicated course or path, or equivalent, for 95% of the time per approach.

**b.** Vertical tracking performance from 300 ft. HAT to 100 ft. HAT should be stable without large deviations (i.e., within ±35 microamps deviation) from the indicated path or ±12 ft, whichever is greater, or equivalent, for 95% of the time per approach.

**Note: When this provision is applied to path tracking in conjunction with Category III, momentary excursions up to ±75 microamps during test demonstrations may be acceptable if flight guidance system touchdown and landing performance is otherwise shown to be satisfactory.**

**c.** The Continuous Method and the Pass/Fail methods found in JAR ACJ AWO 231 may be used in lieu of the 95% of the time per approach and the minimum number of 20 approaches stated above.

**6.2.4. RNP.** The accuracy criteria for RNP are designed to enable a seamless transition from en route RNP to approach RNP to be accomplished. RNP operations are based upon the accuracy of the airplane flight path in absolute terms with respect to the defined flight path over the ground. The Total System Error (TSE) will be characterized by the combined performance of airplane systems and any navigation aids. The certification plan should identify any navigation aid(s) on which the RNP performance will be established and how the airplane performance interacts with the navigation aid(s) to meet the TSE performance requirements. The certification plan should identify the assumed relationship between airplane performance and any navigation aid performance.

**a.** The approach RNP is specified from the FAF to the point along the final approach segment at which the lowest applicable Decision Altitude (Height) (DA(H)) typically is applied. There may be one or more levels of RNP specified on a final segment. Missed approach RNP, or levels of RNP if more than one level or RNP is specified, is typically specified from a point related to the lowest applicable DA(H), and typically continues to a missed approach holding fix or missed approach waypoint. RNP also may be applied to a "go-around safety" assessment. When applied to a "go-around safety assessment" the RNP level and associated obstacle clearance start at the end of the touchdown zone with an expanding lateral area that widens to match the level of RNP used, and then continues at the

RNP level(s) specified. The expanding lateral area starts on the centerline for the approach at the end of the touchdown zone and widens at a 7.5 degree splay, or ICAO 1:8 splay, depending on procedure development criteria used. It is applicable from the end of a touchdown zone to reaching the missed approach holding fix or applicable missed approach waypoint (See Appendix 5).

**b.** Assumptions regarding the performance for any radio navigation aid(s) used should be consistent with ICAO Annex 10 or an equivalent State standard. In cases where site specific geometry must be considered in the evaluation of the NSE, limits on the assumed geometry should be identified.

**c.** The guidance or control system shall be demonstrated to maintain a flight path which tracks the defined flight path to the RNP Type as specified in Paragraph 4.5 of the body of this AC, as applicable.

**6.2.5. Flight Path Definition.** Refer to Paragraph 4.6 in the main body of this AC for consideration on Flight Path Definition when navigation aids are used which do not have the required flight path inherent in the structure of the signal in space.

**6.3. Approach System Integrity Requirements.** The applicant shall provide the certification authority with an overall operational safety assessment plan for the use of systems other than ILS or MLS for "path in space" guidance. This plan shall identify the assumptions and considerations for the non-aircraft elements of the system and how these assumptions and considerations relate to the airplane system certification plan.

**a.** The onboard components of the landing system, considered separately and in relation to other associated onboard systems, should be designed to comply with Title 14 of the Code of Federal Regulations (14 CFR) part 25, section 25.1309, considering any specific safety related criteria identified in this appendix, or as identified in accordance with the operating rules.

**b.** The following criteria is provided as advisory material for the application of section 25.1309 to Landing Systems:

**6.3.1. ILS.** The aircraft system response to loss of ILS guidance signals (localizer and glideslope) shall be established.

The aircraft system response during a switchover from an active localizer or glideslope transmitter to a backup transmitter shall be established.

**6.3.2. MLS.** The aircraft system response to loss of MLS guidance signals (elevation and azimuth) shall be established.

The aircraft system response during a switchover from an active elevation or azimuth transmitter to a backup transmitter shall be established.

**6.3.3. GLS.** The aircraft system response to loss of GLS guidance signals shall be established.

The aircraft system response during any switchover to alternate differential augmentation, pseudolites, and data link services, as applicable, shall be established.

**6.3.4. RNP.** The aircraft system response to loss of the navigation service(s) used to conduct the RNP operation shall be established.

**a.** The aircraft system response during any switch over to alternate navigation services shall be established.

**b.** It shall be demonstrated that the airplane will maintain the required flight path within the containment limits (i.e., 2 times the RNP value) when un-annunciated failures not shown to be extremely remote (probability on the order of $10^{-7}$ per approach, or less) are experienced.

**6.4. Approach System Availability Requirements.** Below 500 ft. on approach, the demonstrated probability of a successful landing should be at least 95% (i.e., no more than 5% of the approaches result in a go-around, due to the combination of failures in the landing system and the incidence of unsatisfactory performance). In addition, a dual or single area navigation (RNAV) approach system installation should meet the availability requirements consistent with the operational objective of 14 CFR part 121, section 121.349, (as applicable to standard Operations Specifications (OpSpecs)).

**6.5. Go-around Requirements.** A go-around may be required following a failure in the Approach System, as required by the flightcrew or by Air Traffic Service (ATS) at any time prior to touchdown.

**a.** It should be possible to initiate a missed approach at any point during the approach until touchdown on the runway. It should be safe to initiate a missed approach that results in a momentary touchdown on the runway.

**b.** A go-around should not require unusual pilot skill, alertness, or strength.

**c.** The proportion of approaches terminating in a go-around below 500 ft. (150 m), due to the combination of failures in the landing system and the incidence of unsatisfactory system performance, may not be greater than 5%.

**d.** Information should be available to the operator to assure that a safe go-around flight path can be determined.

**6.6. Flightdeck Information, Annunciation, and Alerting Requirements.** This section identifies information, annunciations, and alerting requirements for the flight deck.

The controls, indicators, and warnings must be designed to minimize crew errors that could create a hazard. Mode and system malfunction indications must be presented in a manner compatible with the procedures and assigned tasks of the flightcrew. The indications must be grouped in a logical and consistent manner and be visible under all expected normal lighting conditions.

**6.6.1. Flightdeck Information Requirements.** This section identifies requirements for basic situational and guidance information.

**a.** For manual control of approach flight path, the appropriate flight display(s), whether head down or head up, must provide sufficient information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

**(1)** maintain the approach path,

**(2)** to make the alignment with the runway, and if applicable, safely flare and roll out, or

**(3)** go-around.

**b.** Sufficient information should be provided in the flight deck to allow the pilots to monitor the progress and safety of the approach operation, using the information identified above and any additional information necessary to the design of the system.

**c.** Required flight performance monitoring capability includes at least the following:

**(1)** unambiguous identification of the intended path for the approach, and, if applicable, safely flare and roll out, (e.g., ILS/MLS approach identifier/frequency, and selected navigation source), and

**(2)** indication of the position of the aircraft with respect to the intended path (e.g., raw data localizer and glide path, or equivalent).

**6.6.2. Annunciation Requirements.** A positive, continuous, and unambiguous indication should be provided for the modes actually in operation, as well as those that are armed for engagement. In addition, where engagement of a mode is automatic (e.g., localizer and glide path acquisition), clear indication must be given when the mode has been armed by either action of a member of the flightcrew, or automatically by the system (e.g., a pre-land test - LAND 3).

**6.6.3. Alerting.** Alerting requirements are intended to address the need for warning, caution, and advisory information for the flightcrew.

**6.6.3.1. Warnings.** Section 25.1309 requires that information be provided to alert the crew to unsafe system operating conditions and to enable the crew to take appropriate corrective action. A warning indication must be provided if immediate corrective action is required. The design should account for crew alerting cues, corrective action required, and the capability of detecting faults.

**6.6.3.2. Cautions.** A caution is required whenever immediate crew awareness is required and timely subsequent crew action may be required. A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue or discontinue the approach.

For RNP systems, the guidance or control system shall indicate to the flightcrew when the Actual Navigation Performance (ANP) exceeds the RNP

**Deviation alerting**. The FAA does not require excessive deviation alerting, but will approve systems that meet appropriate criteria. If a method is provided to detect excessive deviation of the airplane, laterally and vertically during approach to touchdown, and laterally after touchdown, then it should not require excessive workload or undue attention. This provision does not require a specified deviation alerting method or annunciation, but may be addressed by parameters displayed on the Attitude Direction Indicator (ADI), Electronic Attitude Indicator (EADI), Head Up Display (HUD), or PFD. When a dedicated deviation alerting is provided, its use must not cause excessive nuisance alerts.

For systems demonstrated to meet criteria for Category II, compliance with the following criteria, from JAA AWO 236, is an acceptable means of compliance, but is not a required means of compliance:

**a.** For systems meeting the AWO 236 criteria, excess-deviation alerts should operate when the deviation from the ILS or MLS glide path or localizer centerline exceeds a value from which a safe landing can be made from offset positions equivalent to the excess-deviation alert, without exceptional piloting skill and with the visual references available in these conditions.

**b.** For systems meeting the AWO 236 criteria, excess-deviation alerts should be set to operate with a delay of not more than one (1) second from the time that the deviation thresholds are exceeded.

**c.** For systems meeting the AWO 236 criteria, excess-deviation alerts should be active at least from 300 ft. HAT (90 m) to the decision height, but the glide path alert should not be active below 100 ft. HAT (30 m).

**6.6.3.3. System Status.** Appropriate system status and failure annunciations suited to the guidance systems used, navigation sensors used, and any related aircraft systems (e.g., autopilot, flight director, electrical system) should be provided for the operator to determine prior to departure and the flightcrew to determine after departure, the capability of the airplane approach system components to accomplish the intended approach.

**a.** While en route, the failure of each airplane component affecting the approach capability should be indicated without flightcrew action. The indication should be an advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), unless the failure requires a warning or caution for other reasons (e.g., autopilot disconnect warning).

**b.** A means shall be provided to advise the flightcrew of failed airplane system elements that affect the decision to continue to the destination or divert to an alternate.

**c.** System Status indications should be identified by names that are different than operational authorization categories (e.g., do not use names such as “CAT I,” “CAT II,” “CAT III”).

**6.7. Multiple Landing Systems and Multi-mode Receivers (MMR) for Category II.** International agreements have established a number of landing systems as an acceptable means to provide guidance to support the conduct of an instrument approach. This section identifies unique requirements which relate to airplane systems which provide the capability to conduct approach and landing operations using these multiple landing systems (e.g., ILS, MLS, GLS). Typically, these multiple landing systems are implemented through use of one or more multi-mode receivers (MMR), capable of providing navigation information for ILS, MLS, and GLS or any one or more combinations of these landing sensor systems.

**a.** ICAO has specified an ILS protection date of at least 2010 to support international approach and takeoff operations. In addition, MLS or GLS may be used on a regional basis, until GLS-based approach, landing, and departure system are in worldwide use. Accordingly, an operator may elect to use ILS, ILS/MLS, ILS/GLS, or ILS/MLS and GLS. If a Multi-mode Receiver (MMR) is used, MMR characteristics should be consistent with applicable related ARINC characteristics for MMR.

**b.** For systems which elect to use MLS, either FAA criteria or JAR-AWO as amended, (e.g., NPA AWO 9), may be used as a consideration in defining the airworthiness requirements for MLS certification.

**6.7.1. General Requirements.** Where practicable, the flight deck approach procedure should be the same regardless of the navigation source being used.

**a.** A means (for example, the current ILS audio idents) should be provided to confirm that the intended approach aid(s) has been correctly selected.

**b.** During the approach, an indication of a failure in each non-selected airplane system element must be provided to the flightcrew as an indication of system status; it should not produce a caution or warning.

**6.7.2. Indications.** The following criteria apply to indications in the flight deck for the use of a multi-mode landing system:

The loss of acceptable deviation data shall be indicated on the display. It is acceptable to have a single failure indication for each axis common to all navigation sources.

**6.7.3. Annunciations.** The following criteria applies to annunciations in the flight deck when using a multi-mode approach system:

**a.** The navigation source (e.g., ILS, MLS, GLS, FMS) selected for the approach shall be positively indicated in the primary field of view at each pilot station;

**b.** The data designating the approach (e.g., ILS frequency, MLS channel, GLS approach identifier) shall be unambiguously indicated in a position readily accessible and visible to each pilot;

**c.** A common set of mode ARM and ACTIVE indications (e.g., LOC and GS) is preferred for ILS, MLS, and GLS operations;

**d.** A means should be provided for the crew to determine a failure of the non-selected navigation receiver function, in addition to the selected navigation receiver function. When considering equipment failures, the failure indications should not mislead through incorrect association with the navigation source. For example, it would not be acceptable for the annunciation “ILS FAIL” to be displayed when the selected navigation source is MLS and the failure actually affects the MLS receiver.

**6.7.4. Alerting.** Flight operations require alternate airports for takeoff, en route diversion, and landing. These alternate airports may have different landing systems. Flight operations may be planned, released, and conducted on the basis of using one or more landing systems.

**a.** The capability of each element of a multi-mode approach and landing system shall be available to the flightcrew to support dispatch of the airplane.

**b.** A failure of each element of a multi-mode approach and landing system must be indicated to the flightcrew without pilot action, as an advisory (i.e., not a warning or caution, does not demand immediate flightcrew attention), during en route operation.

**c.** A failure of the active element of a multi-mode approach and landing system during an approach shall be accompanied by a warning, caution, or advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), as appropriate.

**d.** An indication of a failure in each non-selected element of a multi-mode approach and landing system during an approach may be made available to the flightcrew as an advisory (i.e., not a warning or caution, annunciates without flightcrew action, but does not demand immediate flightcrew attention), but should not produce a caution or warning.

**6.7.5. Multi-mode Receivers (MMR).** For MMRs used for systems for Category II, using more than one type of landing system, the means of compliance required for certification can be simplified, provided the applicant provides appropriate justification. This section provides guidance for retrofit certifications, for "ILS Look alike" applications, and for certification of ILS installations with either new or modified receivers. Equivalent provisions as to those described in Appendix 2, paragraph 6.7.5, except as applicable to criteria for Category II, may be applied.

Typical receiver configurations for retrofit applications include:

**a.** An ILS receiver from a new supplier;

**b.** A modified ILS receiver from the same supplier (e.g., for purposes of providing improved FM Immunity);

**c.** A re-packaged receiver from the same supplier (e.g., the ILS partition in an MMR, or the transition from ARINC 700 to 900 series equipment);

**d.** A stand-alone MLS receiver ("ILS look alike");

**e.** An MLS partition in an MMR ("ILS look alike");

**f.** A stand-alone GLS receiver ("ILS look alike"); or

**g.** A GLS partition in an MMR ("ILS look alike").

**6.7.5.1 "ILS Look alike" Definition applicable to MMR.** "ILS Look alike" is defined as the ability of a non-ILS based navigation receiver function to provide operational characteristics and interface functionality to the rest of the aircraft equivalent to that provided by an ILS-based receiver function. Specifically in the case of an MLS or GNSS (GLS) based receiver function, the output should be in DDM/microamps, with a sensitivity equivalent to an ILS receiver taking account of the effects of runway length.

**6.7.5.2. General Certification Considerations.**

**6.7.5.2.1. Certification Process.** An "impact assessment" should address any new receiver functionality considering:

**a.** Differences between the current basis of certification and that requested (if applicable).

**b.** The functionality being added.

**c.** Credit that can be taken for the existing approval.

**6.7.5.2.2. Equipment Approval.** TSO/MOPS compliance should be demonstrated where appropriate, including software qualification and receiver environmental qualification to the appropriate levels.

**6.7.5.2.3. Aircraft Installation Approval (14 CFR Part 25).** The following should be considered:

**a.** Impact on airplane system safety assessments.

**b.** Radio approval (e.g., antenna positions, range, polar diagrams, coverage, compatibility between receiver and antenna).

**c.** EMI/EMC testing.

**d.** Functional integration aspects of the receiver with respect to other systems, controls, warnings, displays.

**e.** Electrical loading

**f.** Flight data recorder requirements

**g.** Suitable Aircraft Flight Manual (AFM) provisions.

**h.** Certification means of compliance for the receiver installation (e.g., specification of ground and/or flight testing, as necessary).

**6.7.5.2.4. Alternative Means of Compliance using JAR-AWO.** JAR-AWO may be considered as an acceptable means of compliance for ILS or MLS if the applicant establishes that the proposed new or modified navigation receiver configuration can be considered to have "ILS Look alike" characteristics. The following interpretative material to existing ACJ may be considered for that part of the certification affected by the revised installation:

**ACJ AWO 131 Performance Demonstration.** 2.1 Flight Demonstrations - Program of Landings for Certification.

**ACJ AWO 161(b) Failure Conditions.**

**ACJ AWO 231 Flight Demonstration.** 1.1 Continuous Method (Analysis of Maximum Value).

**ACJ AWO 431 Performance (Interpretative Material).**

**6.7.5.2.5. Recertification of an ILS function following the Introduction of a New or Modified ILS Navigation Receiver Installation.** The certification program should consider the differences between the new configuration and the pre-existing ILS receiver system. An "impact assessment" may be used to establish a basis for certification.

**6.7.5.2.5.1. New or Modified ILS Impact Assessment.**

**a.** An impact assessment should consider the following aspects of the new or modified ILS receiver, or receiver function, for equivalence with the existing ILS receiver configuration:

**(1)** hardware design;

**(2)** software design;

**(3)** signal processing and functional performance;

**(4)** failure analysis;

**(5)** receiver function, installation and integration (e.g., with controls, indicators, and warnings).

**b.** The impact assessment should also identify any additional considerations such as:

**(1)** Future functionality provisions which have no impact on system operation;

**(2)** Shared resources to support future functionality.

Based upon the assumption that the ILS receiver, or receiver function, can be shown to be equivalent to the current ILS configuration, the applicant may propose that the new installation be treated as a new ILS receiver for installation on a given airplane type.

**6.7.5.2.5.2. New or Modified ILS Failure Analysis.** The failure characteristics of the new or modified installation should be reviewed, equivalent to systems using ILS data, to ensure that the failure characteristics are compatible with and do not invalidate any original or previous safety assessments.

**6.7.5.2.5.3. New or Modified ILS Autoland or HUD Guidance Landing Function Flight Testing (if necessary).** For systems intended to provide Autoland or HUD guidance landing function using a new ILS, MLS, GLS, or combined MMR receiver, a flight test program of typically a minimum of eight approaches terminating in a successful (automatic or HUD) landing and rollout (if applicable) using the flight control/guidance system, including a minimum of two ILS facilities should be completed. Approaches should include captures from both sides of the final approach course, at angles and distances representative of typical instrument approach procedures, and, if applicable, from below and above the glideslope.

The approach and landing performance (flight path deviation, touchdown data etc.) as appropriate, should be shown to be equivalent to that achieved in the original ILS certification. Recorded flight test data may be required to support equivalency demonstration.

A demonstration of take off guidance performance should be included where applicable.

**6.7.5.2.5.4. New or Modified ILS Documentation.** The following documentation should be provided for certification:

**a.** An Impact Assessment including effects on System Safety Assessments.

**b.** A Flight test report, if applicable.

**c.** Revisions to the Flight Manual where appropriate.

**6.7.5.2.6. Recertification following the Introduction of an MLS or GLS Navigation Receiver Installation.**

**6.7.5.2.6.1. MLS or GLS Introduction Impact Assessment.** An MLS or GLS receiver or receiver function can be certificated with an “impact assessment” similar to that required for the re-certification of a new or modified ILS receiver, provided that the unit(s) has been shown to have satisfactory “ILS Look alike” characteristics. The “impact assessment” should assess equivalent aspects of the MLS or GLS receiver or receiver function to those for the existing ILS receiver configuration.

Based upon the assumption that the MLS or GLS receiver or receiver function, can be shown to have "ILS look alike" characteristics, the applicant may propose that the new installation be treated as a new ILS receiver for approval on a particular airplane type.

**6.7.5.2.6.2. MLS or GLS Failure Analysis.** The failure characteristics of the new or modified installation should be reviewed, equivalent to systems using ILS data, to ensure that the failure characteristics are compatible with and do not invalidate any original or previous safety assessments.

**6.7.5.2.6.3. MLS or GLS Statistical Performance Assessment.** If the flight control/guidance system control algorithms are unchanged or effects of any changes are fully accounted for (e.g., navigation reference point), the statistical performance assessment of a currently certificated automatic landing system or Head Up Display landing or takeoff system should typically not have to be re-assessed for the addition of MLS or GLS functionality. This equivalence is based on the assumption that the MLS or GLS receiver, or the MLS or GLS partition of an MMR, can be shown to have satisfactory "ILS Look alike" characteristics.

**6.7.5.2.6.4. MLS or GLS Antenna or Navigation Reference Point Location.** The implication of differences in position of the MLS or GLS and ILS aircraft antennas or Navigation Reference Point should be assessed considering:

**a.** Wheel-to-threshold crossing height;

**b.** Lateral and vertical antenna position or navigation reference point position effects on flight guidance system performance (including any alignment, flare, or rollout maneuvers).

**6.7.5.2.6.5. MLS or GLS Introduction Flight Testing (as necessary).** For an installation of MLS or GLS which can be treated as a new ILS receiver, a flight test program of typically a minimum of 10 to15 approaches terminating in a landing and rollout (if applicable) using the flight control/guidance system, including a minimum of two MLS or GLS facilities for each system to be authorized should be completed. The approaches should include captures from both sides of the final approach course using representative angles and distances, should include captures from below and above the glideslope if applicable, and should include representative wind conditions where antenna or navigation reference point positions may impact performance.

The approach and landing performance (flight path deviation, touchdown data, etc.) as appropriate, should be shown to be equivalent to that achieved in the original ILS certification. Recorded flight test data may be required to support equivalency.

A demonstration of take off guidance performance should be included where applicable.

**6.7.5.2.6.6. MLS or GLS Introduction Documentation.** The following documentation should be provided for certification of MLS or GLS:

**a.** An Impact Assessment including effects on System Safety Assessments.

**b.** A Flight test report, if applicable.

**c.** Revisions to the Flight Manual where appropriate.

**7. APPROACH SYSTEM EVALUATION.** An evaluation should be conducted to verify that the pertinent systems as installed in the airplane meet the airworthiness requirements of paragraph 6 of this appendix. The evaluation should include verification of approach system performance requirements and a safety assessment for verification of the integrity and availability requirements. Engine failure cases and simulator and/or flight tests should demonstrate other selected failure conditions identified by the safety assessment.

An applicant shall provide a certification plan(s) that describes:

**a.** The means proposed to show compliance with the requirements of paragraph 6 of this appendix, with particular attention to methods that differ significantly from those described in this appendix.

**b.** How any non-airplane elements of the Approach System relate to the airplane system from a performance, integrity, and availability perspective (e.g., appropriate reference to ICAO Annex or U.S. Standard).

**c.** The assumptions on how the performance, integrity, and availability requirements of the non-airplane elements of non-Standard Landing Aids will be assured.

**d.** The system concepts and operational philosophy to allow the regulatory authority to determine whether criteria and requirements in excess of that contained in this appendix are necessary.

Early agreement between the applicant and the FAA should be reached on the proposed certification plan. Upon completion of an FAA engineering design review and supporting simulation studies, a type inspection authorization (TIA) should be issued to determine if the complete installation of the equipment associated with Category II operations meets the criteria of this appendix.

**7.1. Performance Evaluation.** Performance for an airborne system intended to meet provisions of this Appendix should be demonstrated by flight test.

The airborne system should be demonstrated in at least the following conditions taking into account manual/coupled autopilot, autothrottle configurations for Category II approaches:

**a.** Wind Conditions:

20 kts - Head wind component

10 kts - Crosswind component

10 kts - Tailwind component

ATS reported surface winds, or equivalent, may be used.

**b.** Performance shall be demonstrated by flight test, or analysis validated by flight test, using at least three different representative facilities for a minimum of 20 total approaches, with a representative range of environmental and system variables which have an effect on overall performance. If more than one approach in the series of approaches attempted is unsuccessful, an additional number of successful approaches may be required, as agreed by the applicant and FAA. When applied to path vertical tracking in conjunction with Category III, momentary excursions up to ±75 microamps during test demonstrations may be acceptable if flight guidance system touchdown and landing performance is otherwise shown to be satisfactory.

FAA will accept use of the Continuous Method and the Pass/Fail Method, found in JAR ACJ AWO 231, in lieu of the 95% of the time per approach described in sub-paragraphs of 6.2, and the minimum number of 20 approaches stated above.

**7.2. Safety Assessment.** Except as required by any specific safety related criteria identified in this appendix, or by the operating rules, a safety assessment of the approach system, considered separately and in conjunction with other systems, shall be conducted to show compliance with section 25.1309.

**8. AIRBORNE SYSTEM REQUIREMENTS.** This section identifies criteria applicable to specific aircraft system architecture selected to conduct the operation. This criteria is developed from operational considerations, approach system considerations, airplane system considerations, and the general operational philosophy contained in the body of this AC.

**8.1. General.** Various airplane systems are expected to comply with the basic performance, integrity, and availability requirements as identified in Paragraph 6 of this Appendix.

**8.2. Autopilot.** The following criteria is applicable to Autopilot systems:

The suitability of pertinent autopilot modes or features applicable to conducting or monitoring an approach, landing, rollout, or go around, as applicable, should be considered in showing compliance with section 25.1523.

The autopilot must not have normal features or performance, or performance in typical adverse environmental conditions which would cause undue crew concern and lead to disconnect (e.g., inappropriate response to ILS beam disturbances or turbulence, unnecessarily abrupt flare or go-around attitude changes, unusual or inappropriate pitch or bank attitudes, or sideslip response).

Control of Approach Flight Path. The autopilot must:

**a.** maintain the approach path;

**b.** if applicable, make the alignment with the runway, flare and land the airplane within the prescribed limits; or

**c.** promptly go-around, with minimum practical loss of altitude.

Autopilot performance must be compatible with either manual speed control, or, if applicable, autothrottle speed control.

Mode definition and logic should be consistent with appropriate industry practice for mode identification and use (e.g., naming, mode arming, and engagement). Definition of new modes or features, not otherwise in common use, should be consistent with their intended function, and consider potential for setting appropriate or adverse precedent.

The autopilot system performance and alerting should be consistent with the intended operational use for duties and procedures of the pilot flying (PF) and pilot not flying (PNF). See paragraphs 5.6 and 5.8 of the main body of this AC.

If the autopilot is used to control the flight path of the airplane to intercept and establish the approach path, the pilot should be able to transition from automatic to manual flight at any time without undue effort, attention, or control forces, and with a minimum of disturbance of flight path.

If an HUD is installed, any transition from autopilot to HUD guidance or vice versa, must not require exceptional piloting skill, alertness, strength, or excessive workload.

A flight director system, or alternative form of guidance, if used, must be compatible with the autopilot and vice versa.

A fault must cause an autopilot advisory, caution, or warning, as necessary. If a warning is necessary, the pilot must be able to detect the warning with a normal level of attention and alertness expected during an approach or go-around.

**8.3. Head Down Guidance.** The following criteria is applicable to Head Down Guidance systems:

A flight director system, or alternative form of guidance, must be designed so that the probability of display of incorrect guidance commands is remote.

Wherever practical, a fault must cause guidance information to be immediately removed from view. If a warning is given instead, it must be such that the pilot will observe the warning while using the information.

**8.4. Head Up Guidance.** The following criteria is applicable to Head Up Guidance systems:

**a.** The workload associated with use of the HUD should be considered in showing compliance with section 25.1523.

**b.** The HUD display medium must not significantly obscure the pilot's view through the cockpit window.

**c.** Control of Approach Flight Path - the HUD must provide sufficient guidance information, without excessive reference to other cockpit displays, to enable a suitably trained pilot to:

- maintain the approach path
- go-around

**d.** The pilot should be able to align with the runway without the HUD adversely affecting the pilot task. If command information is provided for the flare and landing, it must not be misleading and should be consistent with the characteristics of normal manual maneuvers.

**e.** If only one HUD is installed, it should be installed at the pilot-in-command crew station.

**f.** The HUD guidance must not require exceptional piloting skill to achieve the required performance.

**g.** The HUD system performance and alerting should be consistent with the intended operational use for duties and procedures of the pilot flying (PF) and pilot not flying (PNF) (see paragraphs 5.6 and 5.8 of the main body of this AC).

**h.** If the autopilot is used to control the flight path of the airplane to intercept and establish the approach path, the point during the approach at which the transition from automatic to manual flight takes place shall be identified and used for the performance demonstration.

**i.** Any transition from autopilot to HUD guidance must not require exceptional piloting skill, alertness, strength, or excessive workload.

**j.** A flight director system, or alternative form of guidance, must be designed so that the probability of display of incorrect guidance commands is remote.

**k.** Wherever practical, a fault must cause guidance information to be immediately removed from view. If a warning is given instead, it must be such that the pilot will observe the warning while using the information.

**8.5. Hybrid HUD/Autoland Systems [PoC].** The following criteria is applicable to Hybrid systems:

**a.** If an HUD is used to monitor an autoflight system, it should be shown to be compatible with the autoflight system and permit a pilot to detect unsuitable autopilot performance.

**b.** Other hybrid systems (e.g., including EVS) require a proof of concept **[PoC]** evaluation to establish suitable criteria.

**8.6. Satellite-based Approach System.** The following criteria is applicable to Satellite-based Approach systems:

**a.** Satellite-based systems should be shown to provide equivalent or better capability than navigation systems based on VHF Omni-directional Radio Range (VOR), Distance Measuring Equipment (DME), or ILS for comparable operations, or meet provisions applicable to RNP.

**b.** Satellite-based systems should not exhibit undue sensitivity to masking of satellite vehicles, or interference from onboard or external sources.

**c.** Satellite-based systems should not exhibit adverse characteristics during acquisition or loss of satellites.

**8.7. Reserved.**

**8.8. Autothrottle.** For Category II, an autothrottle should meet the provisions of paragraph 8.8 of Appendix 2, and in addition:

**a.** Hold speed within ± 5 knots of the intended speed, except for momentary gusts, in typical environmental conditions expected for use;

**b.** Provide appropriate status, advisory, caution, and warning information for failures;

**c.** Provide timely application of "Go-around thrust" if a go-around mode is available; and

**d.** Not require undue crew attention or skill to recognize and respond to an engine failure during approach or go-around.

**8.9. Data Link [PoC].** A data link may be used to provide data to the airplane to provide the accuracy necessary to support the approach.

**a.** The integrity of the data link should be commensurate with the integrity required for the approach.

**b.** The role of the data link in the approach system must be addressed as part of the aircraft system certification process until such time as an acceptable national or international standard for the ground system is established.

**9. AIRPLANE FLIGHT MANUAL (AFM).** The AFM should contain the following information:

**a.** Any conditions or constraints on approach performance with regard to airport conditions (e.g., elevation, ambient temperature, approach path slope, runway slope, and ground profile under the approach path).

**b.** The criteria used for the demonstration of the system, acceptable normal and non-normal procedures, the demonstrated configurations, and types of facilities used, and any constraints or limitations necessary for safe operation.

**c.** The type of navigation facilities used as a basis for certification. This should not be taken as a limitation on the use of other facilities. The AFM may contain a statement regarding the type of facilities or condition known to be unacceptable for use.

**d.** Information should be provided to the flightcrew regarding atmospheric conditions under which the system was demonstrated (e.g., headwind, crosswind, tailwind). The AFM should contain a statement that "Credit may not be predicated on the use of <type of system> if conditions exceed … (those for which the system received airworthiness approval)."

> **Note 1: The AFM limitation section should <u>not</u> specify DA(H) or Runway Visual Range (RVR) limitations.**
>
> **Note 2: AC 25.1581-1, Airplane Flight Manual, Section 2, discusses AFM contents. The approval status referenced in 2 b (9) (vii) for Category I, II, or III of that AC should be noted in the Normal Procedures Section of the AFM, in accordance with the above provisions.**

**e.** For a system meeting provisions of Appendix 3, the Normal Procedures, Normal Operations, or equivalent section, of the AFM should also contain the following statements:

> “The airborne system has been demonstrated to meet the airworthiness requirements of AC 120-29A Appendix 3 for <specify the pertinent approach capability section(s) criteria met> when the following equipment is installed and operative:
>
> <list pertinent equipment>”
>
> “This AFM provision does not constitute operational approval or credit for Category III use of this system.”

# APPENDIX 4.
# WIND MODEL FOR APPROACH SIMULATION

Wind models need not be applied to obtain approval of systems related to Appendix 2 or Appendix 3. However, if the applicant elects to use simulation with a wind model to support approval, it is recommended that the model specified in Advisory Circular 120-28D, Criteria for Approval of Category III Landing Weather Minima for Takeoff, Landing, and Rollout, is used.

# APPENDIX 5

## OBSTACLE ASSESSMENT FOR RNP FOR CATEGORY I OR CATEGORY II

**1. Obstacle Assessment for Standard Required Navigation Performance (RNP) Types (e.g., Linear Values of RNP).**

**1.1. Obstacle Assessment for RNP Approaches and Missed Approaches.**

**1.1.1. General.** This Appendix provides criteria that may be used by procedure designers in the development of RNP approaches for suitably equipped aircraft together with any necessary operational mitigations and procedures. These criteria should be used in conjunction with other considerations in this AC. When authorized by AFS-400, approaches developed in accordance with this appendix may be issued as special non-14 CFR part 97 procedures issued through OpSpecs or a letter of authorization (LOA). These criteria may be used in conjunction with airworthiness demonstrations of airborne equipment, or in the assessment of other States criteria used in international operations for U.S. Operators.

The approach RNP is specified from the Final Approach Fix (FAF) to the point along the final approach segment at which the lowest applicable DA(H) typically is applied. There may be one or more levels of RNP specified on a final segment. Missed approach RNP, or levels of RNP if more than one level or RNP is specified, is typically specified from a point related to the lowest applicable DA(H), and typically continues to a missed approach holding fix or missed approach waypoint. RNP also may be applied to a “go-around safety” assessment.

When applied to a “go-around safety assessment,” the RNP level and associated obstacle clearance start at the end of the touchdown zone with an expanding lateral area that widens to match the level of RNP used, and then continues at the RNP level(s) specified. The expanding lateral area starts on the centerline for the approach at the end of the touchdown zone and widens at a 7.5 degree splay. Splay criteria based on ICAO PANS-Ops may alternately be used at the discretion of the procedure designer or operator (e.g., 1:8 splay/ 7.125 degrees). A go-around safety assessment is applicable from the end of a touchdown zone to reaching the missed approach holding fix or applicable missed approach waypoint (see below for specific criteria). When conducting a “go-around safety assessment,” the potential growth of ANP following pertinent failures should be appropriately considered, relative to the designated level(s) of RNP in approach or missed approach segments.

Procedures for U.S. air carrier operations (operations conducted IAW Title 14 of the Code of Federal Regulations (14 CFR) part 121 or part 135 should address application of RNP to “go-around safety” (see paragraph 4.3.1.8 of the main body of this AC). It is recommended that other operators also address “go-around safety.” A go-around safety assessment is intended to assist operators in assuring safe operations in the rare event of a low altitude go-around with certain failures. It is not intended to preclude or limit operations necessary at any particular location.

Provisions of this appendix may be used for levels of RNP specified in the AFM or for other levels of RNP as authorized by the FAA.

> **NOTE: The United States Standard for Terminal Instrument Procedures (TERPS) is the basis for Standard Instrument Approach Procedures formulation within the United States and its territories.**

**1.1.2. Final Approach (FAS), Missed Approach (MAS) and other Related Segments.** The criteria presented in this Appendix apply to the Final Approach (FAS) and Missed Approach segments (MAS). The FAS is defined as that segment of an approach extending from the GPIWP or APIWP, whichever occurs later, to GIRP. However, for the purpose of defining RNP obstacle clearance in this appendix, the Final Approach segment (FAS) is considered to begin at the FAF and ends at the FPCP (runway Datum Crossing Height (CH)), or missed approach point (e.g., DA(H)). No specific minimum or maximum length is assigned to the FAS, but the FAF must be located such that consideration is given to how the FMC VNAV operation may be constrained in certain ways at the point the FAS commences. In addition, consideration should be given in the placement of the FAF recognizing that a continuous VNAV descent may be intended to the FAF, instead of a level intermediate segment with a minimum VNAV intercept altitude. The Missed Approach segment is defined as beginning at a point coincident with the lowest applicable DA(H) and ending at a specified missed approach waypoint (e.g., Initial Missed Approach WP, Missed Approach Holding WP). No minimum or maximum length is assigned to the MAS, but consideration should be given to having the aircraft established on an en route transition. Definitions for various segments used in procedure construction are as specified in Table A5-1 below (Also see AC main body paragraph 4.6, and Appendix 1):

## Approach and Missed Approach Segments Applicable To RNAV Instrument Procedures Using RNP

## Table A5-1

| | |
|---|---|
| Final Approach Segment (FAS) | The segment of an approach extending from the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP), whichever occurs later, to the Glidepath Intercept Reference Point (GIRP). For the purpose of procedure construction, The Final Approach segment is defined as beginning at the FAF and ending at the Flight Path Control Point (FPCP) or point at which the missed approach segment starts (e.g., point of lowest nominal DA(H)). |
| Extended Final Approach Segment (EFAS) | That segment of an approach, co-linear with the Final Approach Segment, but which extends beyond the Glidepath Intercept Waypoint (GPIWP) or Approach Intercept Waypoint (APIWP). |
| Runway Segment (RWS) | That segment of an approach from the glidepath intercept reference point (GIRP) to Flight Path Alignment Point (FPAP). |
| Initial Missed Approach Segment (IMAS) | That segment of an approach from the Glide Path Intercept Waypoint (GIRP) to the Initial Missed Approach Waypoint (IMAWP). |
| Missed Approach Segment (MAS) | That segment of an instrument approach procedure from a point on the FAS corresponding to the position where the lowest DA(H) occurs under nominal conditions, to the designated IMAWP, or missed approach holding WP, as specified for the procedure. |

**1.1.3. Approach and Missed Approach Conditions To Be Assessed.** Three basic conditions are considered in the development of obstacle clearance criteria for RNP approaches and missed approaches:

**a.** The aircraft arrives at the DA(H), continues with visual reference to a landing on the runway.

**b.** The aircraft arrives at the DA(H), initiates a missed approach, and experiences an engine failure.

**c.** The aircraft arrives at the DA(H), continues with visual reference to the runway, initiates a rejected landing at the end of the touchdown zone, and experiences an engine failure.

Each of these conditions has associated criteria for lateral and vertical obstacle clearance protection. In addition to these normal and non-normal conditions, rare-normal conditions must be assessed. Unless wind limitations are specified, these rare normal conditions should be considered as a wind from the most adverse direction at the certificated limit for landing, increasing to 50 knots at 1000 ft. AGL. This rare-normal wind condition shall increase at a gradient of 10 knots per 1000 ft. up to a maximum of 100 knots from the most adverse direction (i.e., tailwind). However, such conditions need not be considered in combination with non-normal events (e.g., engine failure).

In instances, the normal missed approach path and non-normal missed approach path may be different laterally. In such an event, transition from the normal path to the non-normal path should be considered, including performance or energy state of the aircraft, for engine failures that could occur at various critical points along the normal flight path.

**1.1.4. Touchdown Zone.** A touchdown zone (TDZ) typically is considered to be the first 3000 ft. of a designated landing runway. When appropriate for the purposes of this provision, Operators may propose to use a different designation for a touchdown zone. For example, alternate consideration of a (TDZ) may be appropriate for runways that:

- Are less than 6000 ft. in length and which do not have standard TDZ markings,
- Short runways requiring special aircraft performance information or procedures for landing,
- Runways for STOL aircraft, or
- Runway where markings or lighting dictate that a different TDZ designation would be more appropriate.

**1.2. Obstacle Criteria.**

**1.2.1. Obstacle Identification Surface Between Point Of Lowest DA(H) and the Runway.** For condition 1.1.3a, described above, an obstacle identification surface is defined for the visual segment between the DA(H) and the TDZ on the runway. This surface originates at the runway threshold and is inclined at an angle 1 degree less than the VNAV angle for the FAS. This surface is bounded laterally by two rays which originate from the center of the runway at a point 1000 ft. from the threshold, splay at an angle of 10 degrees relative to the runway centerline, or FAS, to the DA(H), or the point at which the lateral limit of 2XRNP is reached. This area should be free of fixed or movable obstacles (regardless of whether they are or are not present by their aeronautical purpose) at the time an instrument approach is conducted inside the FAF. A procedure should not be authorized with an obstacle in this area unless the presence of the obstacle(s) is specifically reviewed and authorized by FAA, and the flightcrew of the landing aircraft is provided information on the location and nature of the obstacle. Other options to resolve a penetration include increasing a VNAV angle, removing the obstacle, displacing the runway threshold, not implementing the approach, adjusting a lateral path, or implementing various combinations of the above options (Figure A5-1).

Figure A5-3 shows a method for determination of RNP obstacle clearance for a final segment controlling obstacle between DA(H) and the runway.

**1.2.2. Obstacle Identification Surface Between the Point of Lowest DA(H) and a Missed Approach Waypoint.** For the condition described in paragraph 1.1.3b, above, the lateral containment surface is centered on the FAS and bounded on either side by two parallel lines located at a distance of 2XRNP (Figure A5-2). Within the limits of this containment surface, a variable Required Obstacle Clearance (ROC) must be provided which is a function of altitude and temperature. This ROC is established by a Vertical Navigation Error Budget (VEB) evaluation that characterizes the vertical navigation accuracy of the system and provides a parametric methodology to evaluate procedures and assess the impact of obstacles. For example, the Root-Sum-Square (RSS) of the VNAV performance variables that contribute to errors in the vertical axis include, but are not limited to, horizontal along-track navigation system errors, temperature induced barometric altimetry errors, flight technical errors, static source errors, minimum waypoint resolution, minimum vertical path angle resolution, etc. ROC increases along the FAS from a lower reference point up to the upper elevation reference point typically at the FAF. By subtracting the ROC from the VNAV elevation at defined locations, a sloping Obstacle Identification Surface (OIS) beneath the VNAV path is established. The OIS is anchored by the lower reference point at the path's 250 ft. height above touchdown point and by the upper elevation reference point typically 2000 ft. above field elevation. The DA(H) is defined as the Required Obstacle Clearance plus 50 ft. above the point on the OIS where the aircraft must be established in a climb to clear all obstacles. The climb gradient used for this analysis is established for a particular aircraft by evaluating the worst case condition. This may include one-engine inoperative, maximum permissible tailwind, maximum permissible landing weight, icing/temp/altitude degradations, etc. A variable DA(H) may be employed if certain conditions are specifically excluded (e.g., no icing). For Instrument Approaches other than ILS, GLS, or MLS (see 4.3.3), developed by a VEB evaluation, the minimum ROC is 250 ft.

The methodology for determining the DA(H) is the same regardless of whether the controlling obstacle is in the FAS or MAS.

Figure A5-4 shows a method for determination of RNP obstacle clearance for a missed approach segment controlling obstacle.

Figure A5-5 shows the normal instrument approach case that has neither an approach or missed approach controlling obstacle.

**1.2.3. Obstacle Identification Surface Between the End of the TDZ and a Missed Approach Waypoint.** For the condition 1.1.3c, described above, a lateral containment surface is centered on the MAS and bounded on either side by two rays which originate from a point 200 ft. either side of the runway centerline at the end of the TDZ (typically 3000 ft. from the approach end of the runway - see 1.1.4 above). These rays splay at an angle of 7.5 degrees out to a maximum distance from the MAS centerline of 2XRNP. Within the lateral limits of this containment surface, a minimum of 35 ft. ROC must be provided below the one engine inoperative net flight path of the aircraft (Figure A5-6). Splay criteria based on ICAO PANS-Ops may alternately be used at the discretion of the procedure designer or operator (e.g., 1:8 splay/ 7.125 degrees). For curved initial missed approach segments (e.g., segments based on an ARINC 424 “RF” leg type), an equivalent lateral splay providing equivalent lateral clearance along the path arc length may be used.

Extreme cold temperature considerations should be assessed for VNAV angles, and safe obstacle clearance assured for any initial or intermediate segments (see paragraph 6.2.13).

**1.2.4. FAS Turn Construction.** Final Approach Segment (FAS) turns are constructed using appropriate lateral path guidance algorithms of the navigation system for which the procedure is designed, or by using generic algorithms which take numerous navigation system characteristics representative of the range of systems to be used into consideration.

Navigation database-defined turns defined through short leg WP sequences or ARINC 424 “RF” Leg types may also be used. If used, appropriate consideration should be made for anticipated ground speeds to be used, leg sequencing, and for “roll in' and “roll out” of an RF leg. Normally, an RF leg should not be based on an assumed nominal bank angle greater than 25 degrees, to allow for path recovery in the event of path displacement disturbances.

**1.2.4.1. FAS Turn Construction for Fly-by Waypoints.** For turns on the FAS (other than for an RF leg), the outside (of the turn) lateral containment surface is constructed via an arc of radius 2XRNP, which is centered on the turn waypoint. For the inside lateral containment surface, the ground speed condition which results in the greatest amount of turn anticipation (earliest departure from and latest return to the FAS centerline) is used for construction. For this condition, the containment surface can be constructed in two ways. The first method uses a straight line which extends between the intersections of the two perpendiculars, located at the start and end points of the turn anticipation arc, and the 2XRNP containment surface which is parallel to the segments before and after the turn waypoint. The second method uses an arc of radius equal to the turn anticipation arc minus 2XRNP (Figure A5-7). For RF legs, the RNPX2 surface is as defined by the specified RNP level.

**1.2.4.2. FAS Turn Construction for Fly-over Waypoints.** In the event that this type of turn is required (rare use), the ground speed which results in the greatest amount of overshoot and latest return to the FAS centerline should be determined. For this condition, the outside containment surface is constructed as an arc and straight segment combination parallel to and at a distance of 2XRNP from the computed flight path. The inside containment surface is constructed using the conservative assumption of no overshoot. Given this condition, the containment surface is simply defined as the intersection of the 2XRNP surfaces parallel to the Final Approach Segments (Figure A5-8).

**1.2.5. MAS Turn Construction.** MAS turns are constructed in a manner identical to turns in the FAS, unless the turn occurs prior to the point at which the containment surfaces are fully expanded to the 2XRNP value (e.g., balked or rejected landing). In this event, only fly-by waypoints should be used because of the complexity which results from constructing the outside containment surface for the fly-over waypoints.

**1.2.5.1. MAS Turn Construction for Fly-by Waypoints.** For turns on the MAS, prior to the point at which the containment surfaces are fully expanded to the 2XRNP value, the containment surface should be constructed in the following manner:

- The outside lateral containment surface is constructed by transferring the width of the splay abeam the turn waypoint via an arc to the following segment.
- The arc is of radius equal to the attained half-width of the preceding segment and is centered at the turn waypoint.
- The arc is extended to a line perpendicular to the centerline of the following segment and passes through the turn waypoint.
- The splay is continued from that point by an angle of 7.5 degrees to a distance of 2XRNP from the centerline. To simplify the containment surface construction for the inside of the turn, a straight line is drawn between the earliest point of departure and the latest point of return back to the following segment for the fly-by of the turn waypoint.
- For other than RF legs, the containment surface expands by a 7.5 degree splay angle using the simplified inside turn approximation as the reference centerline. This splay is continued until reaching the 2XRNP displacement from the reference centerline (Figure A5-9). Splay criteria based on ICAO PANS-Ops may alternately be used at the discretion of the procedure designer or operator (e.g., 1:8 splay/ 7.125 degrees).
- For RF legs, the RNPX2 surface is as defined by the specified RNP level.

**1.2.5.2. MAS Turn Construction For Fly-over Waypoints.** Fly-over waypoints are not used for a MAS.

**1.2.6. RNP Reductions.** RNP reductions would normally be expected to occur at waypoints marking the transition from the enroute airway to a transition feeder route to an approach (typically at the IAF). Upon reaching the IAF, there are typically no further RNP reductions throughout the approach and missed approach. RNP reductions should be considered based on the anticipation of the first longitudinal point where the lower level of RNP is required and assurance that appropriate alerting can be provided prior to the time that the lower level of RNP is needed.

If required, RNP reductions on the FAS should be considered based on anticipation of the first longitudinal point where the lower level of RNP is required, and assurance that appropriate alerting can be provided prior to the time the lower level RNP is needed. No transition area is required. However, the RNP reduction should be located such that consideration is given to the maximum latency of RNP alerting messages, maximum ground speed, crew response time, height of any obstacles immediately beyond the change in RNP, and the one-engine inoperative climb gradient. This distance, “d,” is shown in Figure A5-10. RNP increases, particularly on a MAS or at the beginning of a MAS, do not require this special consideration, thus distance “b” in Figure A5-10 could be zero.

RNP reductions are not typically used on a MAS.

**1.2.7. Coordinate Systems.** Waypoint coordinates shall be defined in the WGS-84 or NAD-83 coordinate system (or equivalent international system for locations outside the US). Waypoint resolution shall be provided to at least 0.01 arc minutes.

**1.2.8. Obstruction and Terrain Charts.** The best source(s) of topographical or obstruction charts that are available should be used.

**1.2.8.1. Recommended Use of USGS Charts.** Use of USGS 1:25,000 or 1:24,000 charts (or equivalent) is recommended wherever possible.

**1.2.8.2. Vertical Clearance Adjustments for Certain Topographical Charts.** FAA Order 8260.19C assigns an accuracy code of "2C" to the 1:24,000 topographical charts. This does not meet the minimum accuracy standard for a precision final segment of an approach. For this reason, a 40 ft. horizontal and 20 ft. vertical adjustment is required to the obstacle values taken directly from the topographical chart. These adjustments are applied in the horizontal and vertical direction that most adversely affects the procedure (i.e., the range is reduced by 40 ft. and the height increased by 20 ft.).

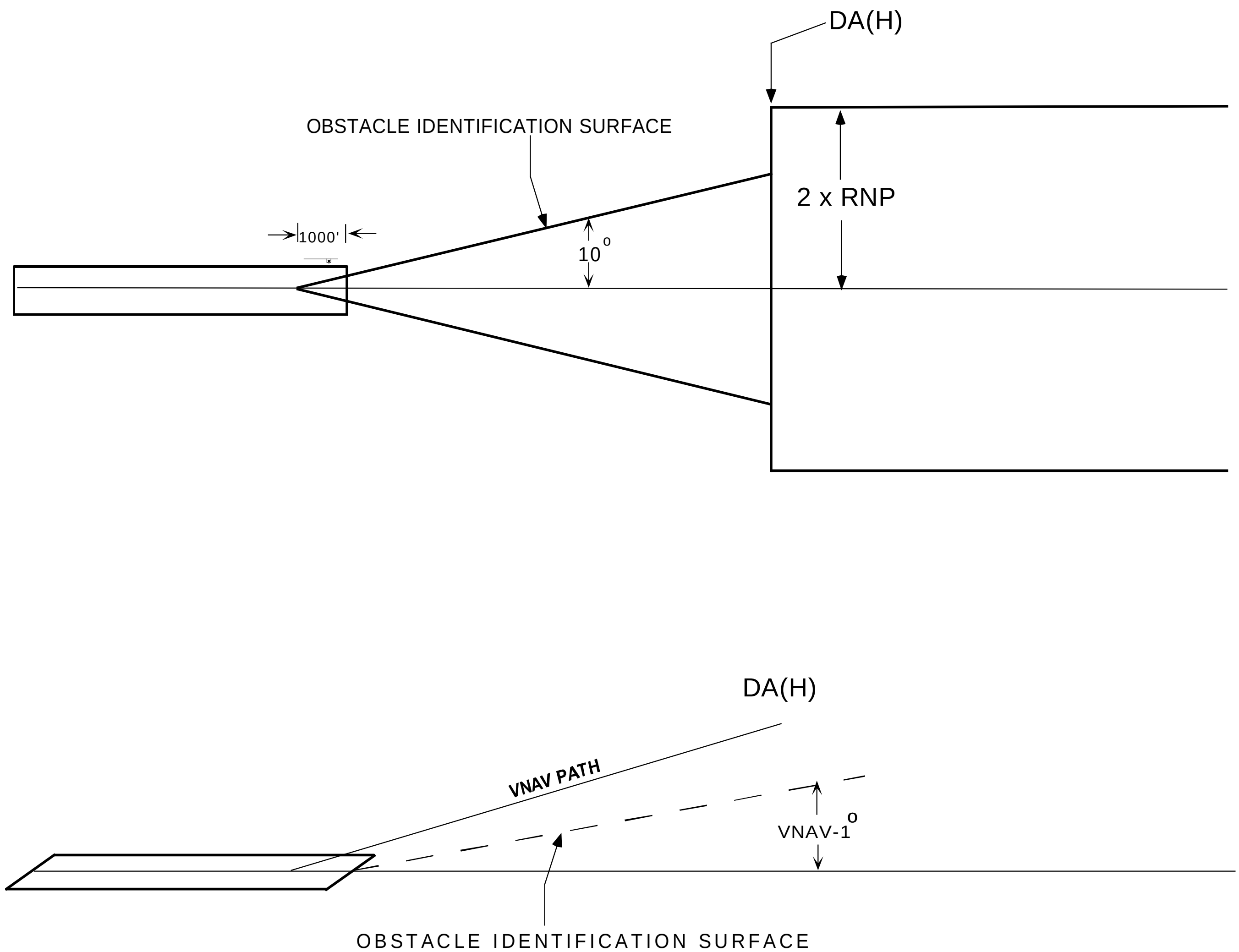
**1.2.8.3. Tree Heights.** Tree heights consistent with the maximum found in the area must be added to all contour elevations, unless specific survey heights are used in areas of interest.

**1.2.8.4. Assumptions for Terrain Elevations.** Assumptions for terrain elevations should be conservative. If an obstacle of interest falls between two gradient lines, the obstacle should be assigned a height equal to the next higher gradient line minus one unit of elevation. For terrain elevations which are critical (or controlling), the terrain should be assumed to rise to a height equal to the next higher gradient line minus one unit of elevation, at an incremental distance beyond the gradient line in question.

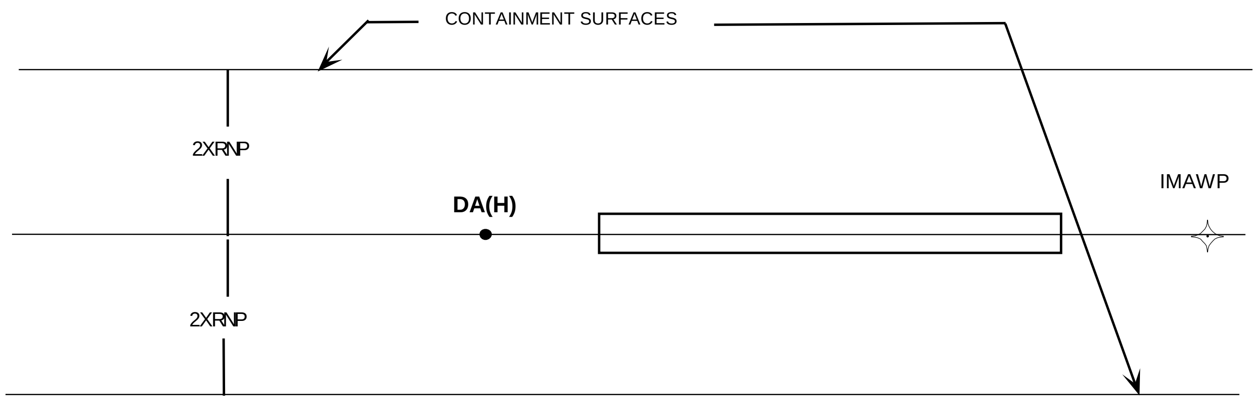
**1.2.9. Man-Made Obstacle Data.** Man-made obstacle data may be obtained from the U.S. Department of Commerce Quarterly Obstacle Memo Digital Obstacle File, Airport Obstruction Chart, FAA IAPA database, or ICAO equivalent. Horizontal and vertical adjustments are applied as a function of the accuracy code assigned to each obstacle. For areas of interest beyond 14 CFR part 77 (or ICAO equivalent) surfaces (e.g., initial and intermediate segments), proper consideration should be made for obstacles which would not be part of the official obstacle records. This consideration may be an appropriate additive to all terrain contours or some other equivalent means (e.g., flight inspection or survey).

**1.2.10. Wheel To Navigation Reference Point or Longitudinal Navigation Reference Points.** Aircraft which have a wheel to navigation reference point (e.g., altimeter reference) vertical height less than 19 ft., or a longitudinal navigation reference point (e.g., altimeter reference point) to lowest and most aft wheel distance of 125 ft. or less at the normal approach pitch attitude and speed need not account for altimeter vertical and longitudinal displacement from wheel height. Aircraft, which have vertical or longitudinal distances that exceed these values, should include suitable correction factors along with any RSS analysis of potential vertical path displacement errors.

**1.3. Examples of completed RNP Forms.** Examples of completed FAA Forms 8260 for RNP Procedures are shown in Figures A5-11 and A5-12 for an "RNAV" Procedure with RNP-based minima and for an "xLS and RNAV" procedure with RNP-based minima.

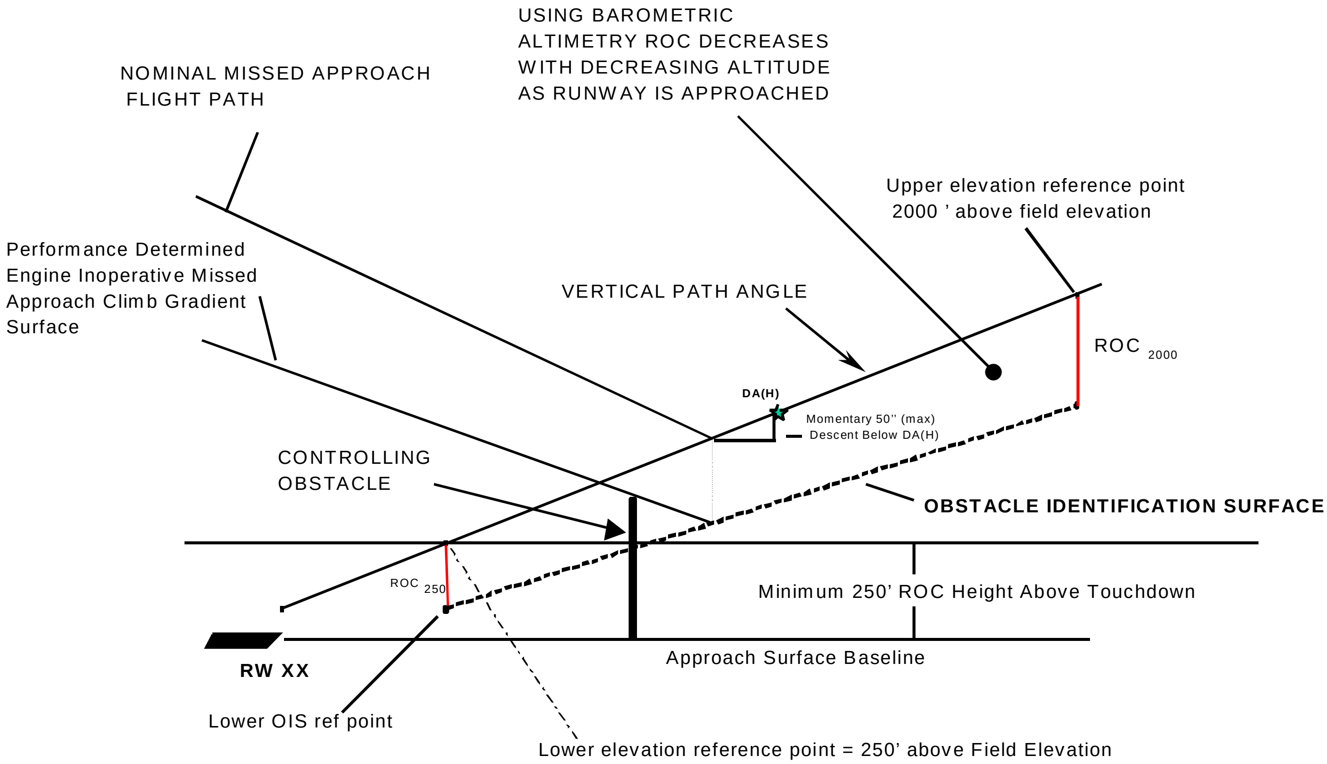



**OBSTACLE IDENTIFICATION - VISUAL SEGMENT**
**Figure A5-1**




**RNP LATERAL AREA TO CONSIDER - MISSED APPROACH FROM DA(H)**
**Figure A5-2**

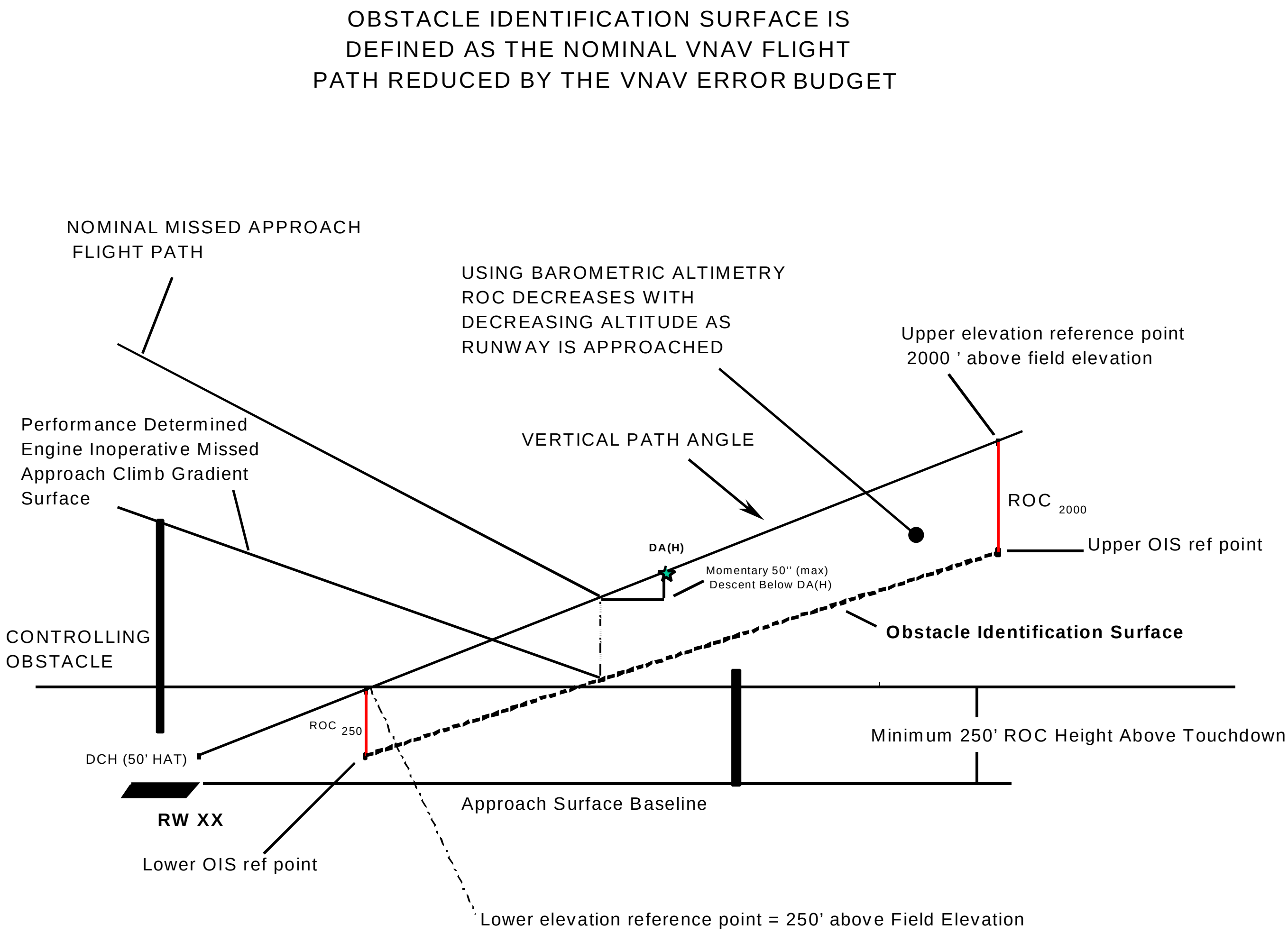
OBSTACLE IDENTIFICATION SURFACE IS
DEFINED AS THE NOMINAL VNAV FLIGHT
PATH REDUCED BY THE VNAV ERROR BUDGET




- DA(H) DETERMINED BY AIRCRAFT PERFORMANCE.
- ASSUMING WORST-CASE CUMULATIVE VNAV ERRORS AIRCRAFT WOULD BE STARTING MISSED APPROACH FROM THE OIS AND CLIMBING ON THE ENGINE INOPERATIVE MISSED APPROACH CLIMB GRADIENTSURFACE
- THE 'ENGINE INOPERATIVE MISSED APPROACH' CLIMB GRADIENT SURFACE MUST CLEAR ALL OBSTACLES

**RNP OBSTACLE CLEARANCE - FINAL SEGMENT**
**CONTROLLING OBSTACLE (BETWEEN THE DA(H) AND THE RUNWAY)**

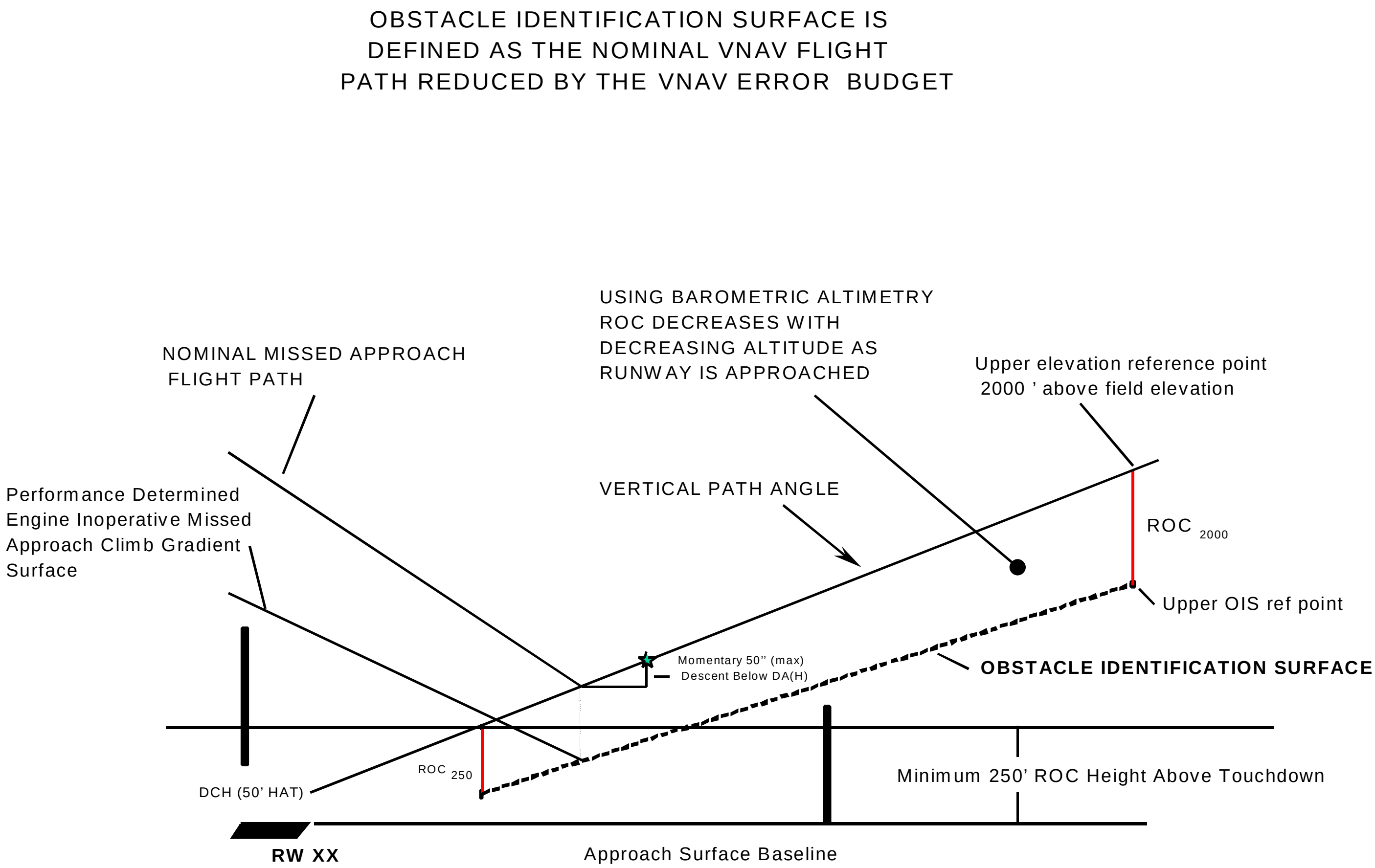
**Figure A5-3**




- DA(H) DETERMINED BY AIRCRAFT PERFORMANCE.
- ASSUMING WORST-CASE CUMULATIVE VNAV ERRORS AIRCRAFT WOULD BE STARTING MISSED APPROACH FROM THE OIS AND CLIMBING ON THE ENGINE INOPERATIVE MISSED APPROACH CLIMB GRADIENTSURFACE
- THE 'ENGINE INOPERATIVE MISSED APPROACH' CLIMB GRADIENT SURFACE MUST CLEAR ALL OBSTACLES

**RNP OBSTACLE CLEARANCE - MISSED APPROACH SEGMENT CONTROLLING OBSTACLE**

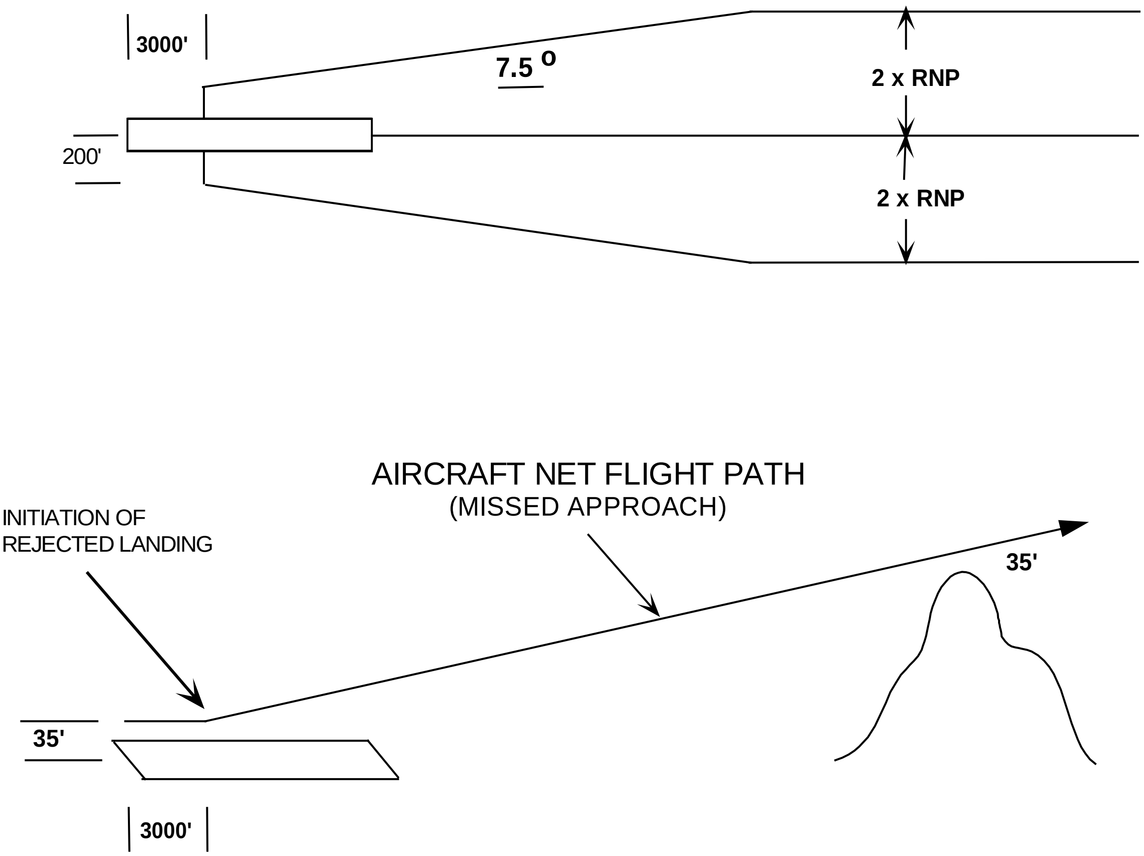
**Figure A5-4**



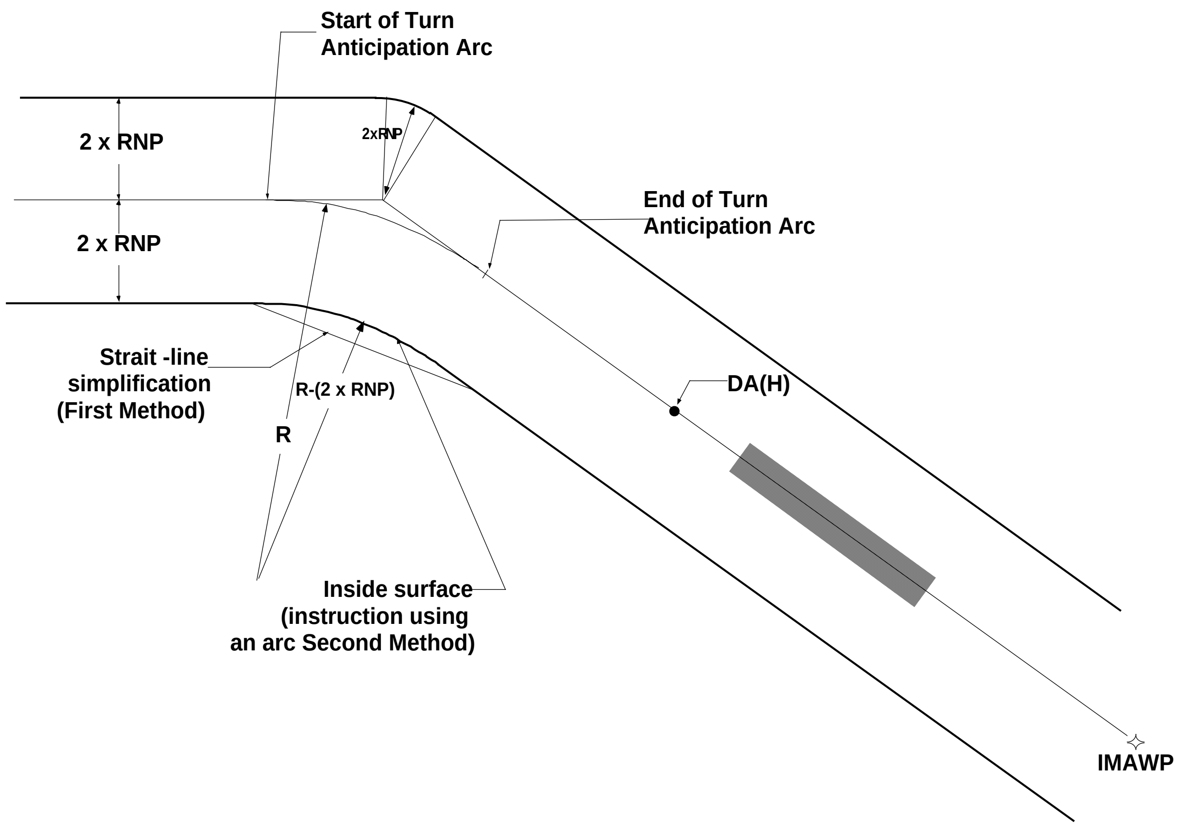

- DA(H) DETERMINED BY AIRCRAFT PERFORMANCE.
- ASSUMING WORST-CASE CUMULATIVE VNAV ERRORS AIRCRAFT WOULD BE STARTING MISSED APPROACH FROM THE OIS AND CLIMBING ON THE ENGINE INOPERATIVE MISSED APPROACH CLIMB GRADIENTSURFACE
- THE 'ENGINE INOPERATIVE MISSED APPROACH' CLIMB GRADIENT SURFACE MUST CLEAR ALL OBSTACLES

**RNP OBSTACLE CLEARANCE - NO CONTROLLING OBSTACLE**

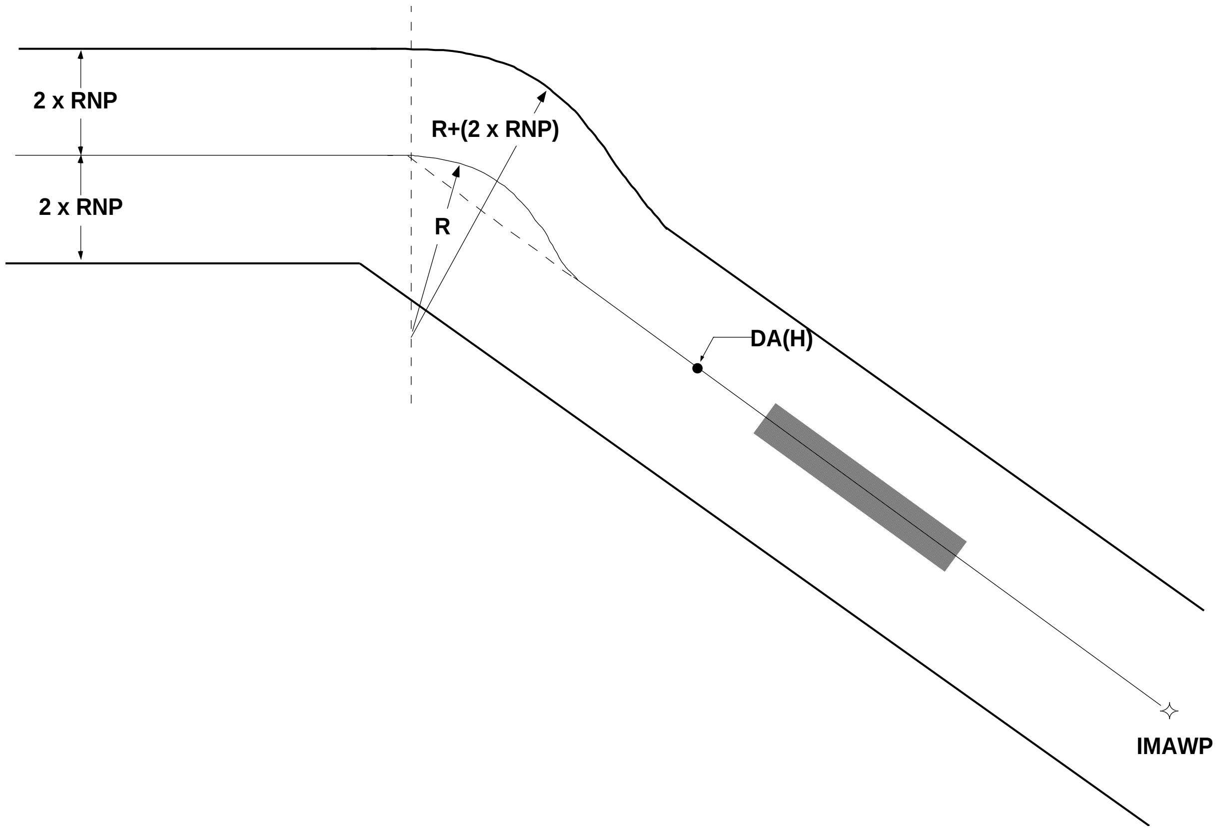
**Figure A5-5**



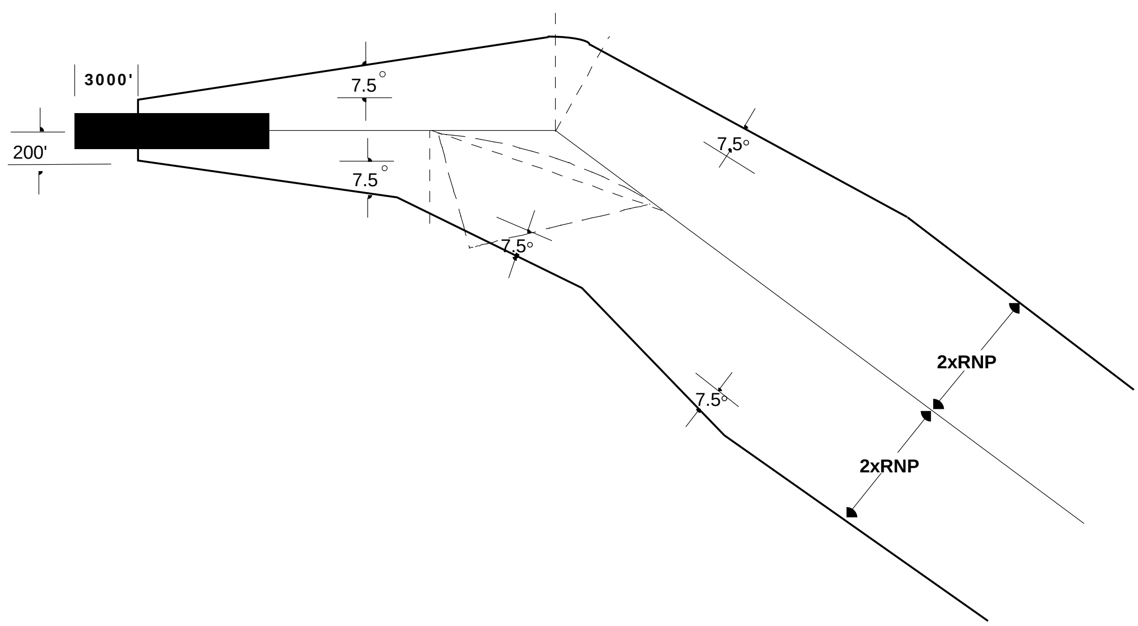

**RNP LATERAL AREA TO CONSIDER - REJECTED LANDING**
**Figure A5-6**




**RNP LATERAL AREA TO CONSIDER - TURNS**
**Figure A5-7**

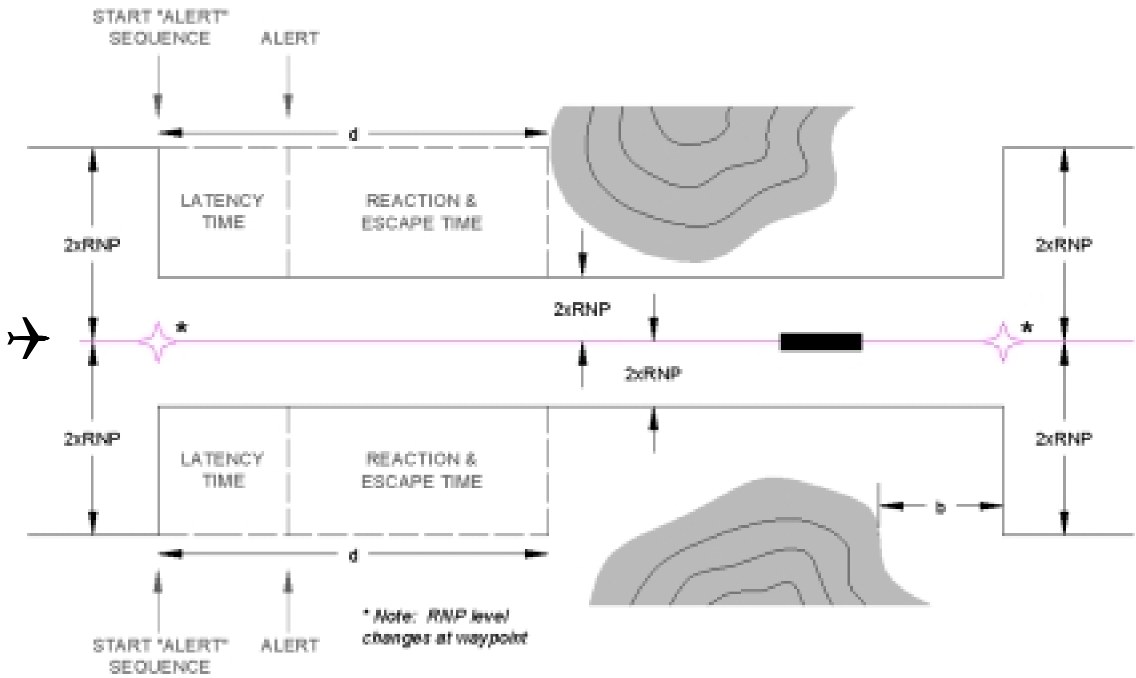



**RNP LATERAL AREA TO CONSIDER - "FLY OVER WAYPOINTS"**
**Figure A5-8**




**RNP LATERAL AREA TO CONSIDER - REJECTED LANDING (WITH TURNS)**
**Figure A5-9**

**RNP LATERAL AREA TO CONSIDER - CHANGE OF RNP TYPE**
**Figure A5-10**



## SAMPLE OF A COMPLETED FAA FORM 8260-7
## Instrument Approach Procedure - RVAV with RNP Based Minima
## (Side 1)

RNP RNAV

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION -- FLIGHT STANDARDS SERVICE
SPECIAL INSTRUMENT APPROACH PROCEDURE -- FLIGHT STANDARDS SERVICE

Bearings, headings, courses, and radials are magnetic. Elevations and altitudes are in feet, MSL, except HAT, HAA, TCH, and RA. Altitudes are minimum altitudes unless otherwise indicated. Ceilings are in feet above airport elevation. Distances are in nautical miles unless otherwise indicated, except visibilities which are in statute miles or in feet RVR.

If an instrument approach procedure of the above type is conducted at the below named airport, it shall be conducted in accordance with a charted instrument approach procedure predicated on the specifications contained herein, unless an approach is conducted in accordance with a different procedure for such airport authorized by the Administrator. Minimum altitudes shall correspond with those established for en route operation in the particular area or as set forth below.

| TERMINAL ROUTES | | | | MISSED APPROACH |
|---|---|---|---|---|
| FROM | TO | COURSE AND DISTANCE | ALTITUDE | MAP: AT THE DA(H) |
| CASHS WP | RW7B WP | 017.54/14.82 | 6600 | |
| RW7B WP (IAF) | MA30B WP | 185.55/4.70 | 4400 | CLIMB TO 4000' VIA THE RNP RNAV MISSED APPROACH TRACK TO CRUMM WP AND HOLD |
| MA30B WP | MA30A WP | 174.02/4.92 | GP3100 | |
| MA30A WP | RW7A WP | 127.16/3.92 | GP1870 | |
| RW7A WP | RW07 WP | 070.99/1.96 | GP1253 | |

1. PT R SIDE OF COURSE 005.52 OUTBOUND 5700' FT WITHIN 10 MILES OF RW7B WP (IAF)
2.
3. FAC: VARIES FAF: MA30A WP DIST FAF TO MAP: 5.20 THLD: 5.88
4. MIN. ALT: MA30B WP 4400', MA30A WP 3100', RW7A WP 1870'
5. DIST TO THLD FROM OM: MM: IM: 150 HAT: 100 HAT: GS ANT:
6. MIN GS INCPT: 3100' GS ALT AT: OM: MM: IM:
7. GS ANGLE: 3.00 TCH: 50'
8. MSA FROM: RW07 WP: 360-090: 5500'; 090-180: 7700'; 180-360: 10600'

ADDITIONAL FLIGHT DATA:
CRUMM WP: SOUTHEAST, RIGHT TURNS, 274 DEGREES INBOUND; 4000'

MAG VAR: 19E EPOCH YEAR: 1995

MINIMUMS

TAKEOFF: STANDARD SEE NOTES ALTERNATE: N A

| CATEGORY | A | | | B | | | C | | | D | | | E | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DH/ MDA | VIS | HAT/HAA | DH/ MDA | VIS | HAT/ HAA | DH/ MDA | VIS | HAT/ HAA | DH/ MDA | VIS | HAT/ HAA | DH/ MDA | VIS | HAT/ HAA |
| S-RNP 0.3/VNAV | | | | 1496 | 3/4 | 268 | | | | | | | | | |

NOTES: SPECIAL AIRCREW TRAINING REQUIRED
FOR USE BY SLANT E (/E). DUAL GPS EQUIPPED, RNP CERTIFIED AIRCRAFT ONLY
CIRCLING NOT AUTHORIZED

CHART THE FOLLOWING NAVAIDS: WENATCHEE VOR 111.0 EAT

BALL TAG 1: MAX HOLDING SPEED 230 KTS

APPROACH FEEDER SEGMENTS ARE ALL RNP 0.5
APPROACH AND MISSED APPROACH SEGMENTS ARE ALL RNP 0.3

FOR INOPERATIVE ODALS, INCREASE CAT B VISIBILITY TO 1 MILE

| CITY AND STATE | ELEVATION: 1245' TDZE: 1203' AIRPORT NAME: | FACILITY IDENTIFIER: | PROCEDURE NO. / AMDT NO. / EFFECTIVE DATE: | SUP: NONE AMDT: DATED: |
|---|---|---|---|---|
| WENATCHEE, WA | PANGBORN MEMORIAL | RNV07 | RNP RNAV RWY 07, ORIGINAL | |

FAA FORM 8260 - 7 / February 1995 (computer generated) PAGE 1 OF 1 PAGES

**Figure A5-11**

## (Cont.) SAMPLE OF A COMPLETED FAA FORM 8260-7
## Instrument Approach Procedure - RVAV with RNP Based Minima

**(Side 2)**

NOTES CONTINUED: MISSED APPROACH

| FROM | TO | COURSE AND DISTANCE |
|---|---|---|
| RW07 WP | RW30B WP | 104.07/4.59 |
| RW30B WP | SHAKER WP | 126.57/2.85 |
| SHAKER WP | CRUMM WP | 93.87/5.72 |

AIR CARRIER NOTES:

The procedure on the other side and the foregoing data are hereby:

| FLIGHT CHECKED BY | | |
|---|---|---|
| NAME: | FIFO | DATE: |

| DEVELOPED BY | | |
|---|---|---|
| NAME: | FIFO | DATE: |

| RECOMMENDED BY | | |
|---|---|---|
| NAME: MANAGER | FIFO | DATE: |

| APPROVED BY | | |
|---|---|---|
| NAME: | REGION, FLT STANDARDS | DATE: |

OPERATIONS SPECIFICATIONS – AIRPORT

__________ holding Air Carrier Operating Certificate No. __________ hereby acknowledges receipt of Operations Specifications to operate into and out of the airport named on the other side ☐ Regular, ☐ Refueling, ☐ Alternate ☐ Provisional for __________ airport with the following type aircraft:

Unless otherwise authorized in the Operations Specifications - Airport, an instrument approach of this type shall be conducted in accordance with the procedure specified on the other side and the air carrier minimums specified above with the following exceptions:

DATE: ________ RECEIVED FOR THE AIR CARRIER BY: __________ (SIGNATURE) TITLE: __________

AMENDMENT NO. ________

BY DIRECTION OF THE ADMINISTRATOR __________ (SIGNATURE) __________ (TITLE)

EFFECTIVE DATE: ________

**Figure A5-12**

## 2. FINAL APPROACH OBSTACLE ASSESSMENT - NON-STANDARD LEVELS OF RNP

**2.1. Obstacle Assessment For Non-Standard Levels of RNP.** Category I or Category II instrument approach procedures may be based on various criteria for obstacle clearance including FAA AC 120-29 as amended, Standards for Terminal Instrument procedures (FAA Order 8260.31, TERPS), ICAO PANS-OPS, or other state criteria for operations within those States. Category I or II operations may also be based on Non-Standard Levels or Types of RNP when approved by FAA.

**2.2. OBSTACLE CRITERIA.**

**2.2.1.** The obstacle assessment criteria described below may be used for Category I or Category II procedures which are based on ILS, MLS, GLS (GNSS/Differential GNSS) or other systems which provide equivalent performance.

**2.2.2.** Airborne Systems previously assessed against earlier criteria of Advisory Circular (AC) 120-29 through Change 3, or Systems for Category III assessed using AC 120-28 through AC 120-28C, Criteria for Approval of Category III Landing Weather Minimal, or equivalent ILS/MLS criteria (BCARs, JAR, etc.) are considered to have met the criteria below, without further demonstration.

**2.2.3.** Airborne systems may be demonstrated to successfully perform to a value of HAT other than the lowest applicable standard HAT (e.g., 100 ft. HAT for Category II; or 200 ft. HAT for Category I). When such demonstrations (e.g., for FMS) are conducted, the operational DA(H) authorized may be limited to corresponding higher minima, based on the lowest HAT successfully demonstrated (e.g., 250 ft. HAT, 300 ft. HAT).

**2.2.4.** While the criteria of this appendix is primarily intended for Category I or Category II, it also may have other applications such as for assuring acceptable performance along the final approach segment of a Category III procedure, down to 100 ft. HAT.

**2.3. USE OF THESE CRITERIA FOR AIRBORNE SYSTEM AIRWORTHINESS DEMONSTRATIONS WITH NON-STANDARD LEVELS OF RNP.** When this criteria is used in conjunction with airworthiness demonstrations of airborne systems using Non-Standard RNP Criteria, the following assumptions should be applied, unless use of other assumptions is determined to be acceptable to FAA.

**2.3.1. LATERAL PERFORMANCE.**

**2.3.1.1.** The lateral dimensions defined by containment should contain the structure of the aircraft, except that compensation for varying pitch attitudes, bank angles, or yaw/drift angles during approach need not be applied. A maximum wing semi-span of 115 ft. may be assumed.

**2.3.1.2.** The lateral window at 100 ft. HAT may be considered to be equivalent to that specified for a value of RNP .01, and its related containment (e.g., A 470 ft. lateral window at 100 ft. HAT equivalent to RNP .01). A 470 foot lateral window may be assumed, and may be related to RNP .01 as follows:

> [(RNP .01nm x 2= 120 ft. containment limit)+(115 ft. wing semi-span) = ±235 ft. half-lateral approach window, or a 470 ft. lateral approach window at 100 ft. HAT]

**2.3.2. VERTICAL PERFORMANCE.**

**2.3.2.1.** A maximum of 19 ft. wheel to G/S antenna/navigation reference point height, and a level terrain DA(H) of 81 ft. RA may be assumed at the 100 ft. HAT point.

**2.3.2.2.** A value of ±12 ft. (2 sigma) vertical tracking performance based on an equivalent performance level to that specified previously in superseded AC 120-29 Change 3 may be used, and may be assumed to be met at 100 ft. HAT (81 ft.

RA). This performance level is considered to provide for 4 sigma navigation reference point containment of $\pm$ 24 ft., or a vertical window of 48 ft. at 100 ft. HAT.

**2.4. OTHER CONSIDERATIONS.** Use of RNP criteria does not affect and should not affect application of other applicable obstacle assessment processes related to obstacle construction (e.g., Obstacle Identification analysis or aeronautical studies assessing obstructions in navigable airspace per part 77). This criteria is not intended to replace criteria established by FAA for airspace planning (e.g., Air Traffic planning for simultaneous instrument approach operations).

# APPENDIX 6.

## GROUND SYSTEM AND OBSTRUCTION CLEARANCE CRITERIA FOR CATEGORY II APPROACH AND LANDING OPERATIONS

**1. PURPOSE.** This Appendix outlines ground system and obstruction clearance criteria for Category II approach and landing operations supported by ILS, MLS, or GLS (e.g., GPS/DGPS LAAS), or for Category II operations based on RNP. To the extent that this criteria relates to or is referenced by criteria in AC 120-28D, Criteria for Approval of Category III Landing Weather Minima for Takeoff, Landing, and Rollout, as amended, for Category III, it may also be used as the basis for Category III criteria.

**2. GENERAL.** Category II procedures are based on both navigation and visual guidance systems. The navigation system must be capable of guiding an aircraft to the runway reference datum (e.g., the ILS, MLS, GLS, or RNP-based glide path reference datum) with appropriate accuracy. The visual guidance system must provide appropriate visual cues to the pilot on approach from at least the decision altitude (height), down to and including touchdown, and along the runway for rollout, under the appropriate visibility conditions.

In order for a runway to qualify for Category II operations, the runway must be capable of supporting the lowest Category I minimums.

Runways which do not meet the criteria established in this appendix, but where an operational or other evaluation identifies that an equivalent level of safety exists, may be authorized appropriate Category II minimums. Such an evaluation shall be conducted by Flight Standards Service on a case-by case basis as required.

This circular, Standard Operations Specifications (OpSpecs), as amended, and the criteria in the Air Transportation Operations Inspectors Handbook, FAA Order 8400.10, establish the lowest approach and landing minimums which can be authorized for Category II operations for air carriers operating under Title 14 of the Code of Federal Regulations (14 CFR) part 121 or 135. These minima may also apply to commercial Operators operating under 14 CFR part 125. The implementation guidelines in Order 8260.36A may be used for new ILS, GLS, or MLS. Criteria in TERPS or ICAO PANS-Ops may be used for established ILS Procedures and facilities.

Foreign airports served by U.S. air carriers or commercial operators under part 121, 125, or 135 may be approved in accordance with the provisions of pertinent ICAO Annexes, Standards, or Recommended Practices (SARPS), on the basis of a comparable level of safety.

**3. SUPPORTING NAVIGATION AIDS OR SENSORS FOR CATEGORY II PROCEDURES.**

**a. NAVAID System(s).** A system which meets appropriate integrity, continuity and reliability performance standards for a U.S. Category II procedure and provides continuous electronic guidance at least to the ILS reference datum (or equivalent for RNP) should be provided, consistent with the elements described below:

**(1)** Localizer or Localizer Equivalent Sensor Capability. The localizer or equivalent (e.g., LAAS/DGPS), or RNP equivalent lateral guidance should be provided from the specified coverage limit down to the specified reference datum, or equivalent, as indicated in the U.S. Standard Flight Inspection Manual, FAA Order 8200.1, United States Standard Flight Inspection Manual, as amended.

**(2)** Glide Slope or Glide slope Equivalent. The glide slope or elevation antenna, or glide slope equivalent (e.g., LAAS/DGPS), or RNP equivalent, should provide guidance in the vertical plane from the specified coverage limit down to the ILS reference datum, or equivalent, as indicated in the U.S. Standard Flight Inspection Manual.

**(3)** VHF Marker Beacons. In addition to the outer and middle marker beacons for ILS, a 75 MHz inner marker beacon should be provided at each runway intended for a Public Use Published 14 CFR part 97 Category II Procedure based on ILS. Special procedures authorized through OpSpecs need not have one or more of the standard installed marker beacons if another suitable means to determine longitudinal position and suitable glideslope is available to the operator. Marker beacons may be provided, or equivalent waypoints, fixes, or methods may be provided for Category II Procedures based on GLS or MLS.

**b. Visual Guidance and Lighting Systems.** The lighting system should provide suitable visual guidance from at least the point where an approaching aircraft is at the lowest applicable DA(H), through the remainder of the approach, flare, landing, and rollout. The system should consist of at least the following components or capabilities:

**(1)** Approach Lighting System. Lighting standards are as outlined in FAA Order 6850.2, Visual Guidance Lighting Systems, as amended, except that a negative approach light plane gradient is not permitted in the inner 1500 ft. zone prior to threshold (unless otherwise approved by AFS-1). Where required, approved flush approach lighting system may be installed (i.e., for a displaced landing threshold). For Special Category II procedures authorized through OpSpecs, approach lighting at least equivalent to a MALSR should be installed, unless a different approach lighting configuration is approved by FAA for use by each applicable operator.

**(2)** Touchdown Zone Lighting System. A lighting system should be provided defining the runway TDZ and conforming to AC 150/5340-4C, Installation Details for Runway Centerline Touchdown Zone Lighting Systems, as amended. For Special Category II procedures authorized through OpSpecs, TDZ lighting need not necessarily be installed if the runway's lighting configuration is reviewed and approved by FAA for use by each applicable operator (e.g., based on use of autoland or HUD guidance systems).

**(3)** Centerline Lighting System. A centerline lighting system defining the runway centerline and conforming to AC 150/5340-4C, as amended, using L-843 and L-850 runway centerline lighting systems (or equivalent) should be provided. For Special Category II procedures authorized through OpSpecs, centerline lighting need not necessarily be installed if the runway's lighting configuration is reviewed and approved by FAA for use by each applicable operator (e.g., based on use of autoland or HUD guidance systems).

**(4)** High Intensity Runway Edge Lighting. A high intensity runway edge lighting system (or equivalent) should be provided defining the lateral and longitudinal limits of the runway and conforming to AC 150/5340-24, Runway and Taxiway Edge Lighting System, as amended.

**(5)** Taxiway Turnoff Lighting Systems. Unless otherwise approved for Special Category II procedures authorized through OpSpecs, taxiway turnoff lighting systems, stop bar, runway guard lighting, and critical area taxiway lighting designations should be provided in accordance with AC 120-57, Surface Movement Guidance and Control System, as amended, and the AC 150/5340 series, as amended.

**(6)** All Weather Runway Markings. Runways should be marked with all-weather runway markings as specified in AC 150/5340-1G, Standards for Airport Markings, as amended.

**c. Meteorological Reporting and Other Requirements.** Unless otherwise authorized for Special Category II procedures, the following additional meteorological reporting systems or other capabilities should be provided in conjunction with Category II procedures.

**(1) Runway Visual Range (RVR).** An RVR system should be provided to support Category II instrument procedures. For U.S. Operators, RVR is considered to be an instrumentally derived measurement system reporting minimum visibility in units of feet or meters, located adjacent to the applicable runway (see Appendix 1).

(a) For Category II procedures on runways greater than 8000 ft. in length, RVR for at least TDZ, Mid, and Rollout should be available. For Category II procedures on runways less than or equal to 8000 ft. in length, RVR for at least TDZ and Rollout should be available.

(b) For runways with more than 3 RVR reporting facilities (e.g., certain European locations) FAA may determine which and how many transmissometers may apply to U.S. Operators operations, unless specifically addressed by the state of the Aerodrome.

(c) If approved by AFS-1, Category II procedures may be approved on a case by case basis using only TDZ RVR, adjacent or nearby runway RVR reports. Where transmissometers from other runways are used, they should typically be located within a radius of 2000 ft. of the applicable portion of the runway being served, and provide a minimum of 1000 ft. coverage volume of the pertinent area along the intended runway.

(d) Timely reports for TDZ, mid, and rollout RVR values should be provided to the air traffic system (e.g., Tower, TACON, ARTCC, as applicable) for transmission to pilots of arriving aircraft, and for transmission to meteorological services, for timely distribution to pilots and Operators for pre-flight and en route flight planning.

(e) Existing RVR systems with minimum RVR value reporting capability of 600 RVR may continue to be used until replaced or upgraded.

(f) New or replacement RVR systems should have the capability to report RVR ranging from a minimum value of 300 ft., to a maximum value of at least 6000 ft. Readout increments should be in at least 100 ft. increments up to at least 1000 RVR, and thereafter increments of 200 ft. to 3000 RVR. Where possible, RVR systems with a useful reporting range of 50 ft. RVR to 6500 ft. RVR are desirable. Preferred reporting increments are 50 ft. to 1000 RVR, 200 ft. to 3000 RVR, and 500 ft. beyond 3000 RVR. New or replacement systems should, if possible, be capable of reporting in units of feet or meters, so that if metric reports are introduced into the National Aviation System (NAS) or International Aviation System (INAS), RVR systems are easily capable of converting to use the alternate metric units.

(g) FAA Standard 008, as amended, prescribes installation criteria for RVR equipment, and AC 97-1, Runway Visual Range (RVR), as amended, describes RVR measuring equipment and its use.

**(2) Radar (Radio) Altimeter Height.** Radar (radio) altimeter heights will be provided on the FAA Form 8260.3, (or equivalent operator reference material for Special Category II Procedures) indicating the vertical distance at the 100/150 ft. DA(H), assuming a 19 ft. wheel to navigation reference point height (e.g., glide slope antenna height) and the terrain on runway extended centerline beneath this aircraft reference point.

**(3) Facility Status Remote Monitoring.** Remote facility status monitoring should be provided for the following NAVAIDs or visual aids (see FAA Order 6750.24, as amended). For Special Category II procedures authorized through OpSpecs, remote monitoring capability is desired, but is not required. If not provided, a method to assure timely reporting of failures reported to ATS or the airport to flightcrews should be established.

(a) NAVAIDs.

(b) Approach lighting system.

(c) Relevant electrical power sources or systems

(d) Runway edge, centerline and TDZ lights.

(e) Critical taxiway lighting, runway guard lights, and stop bars.

**(4) Facility Status Monitoring by Periodic Inspection or After Reported Failures.** The following systems may require inspection by airport management or FAA personnel or pilot reports to determine if they are operating in accordance with specified criteria, reference AC 120-57, as amended. Monitoring procedures should be capable of detecting when more than 10 percent of the lights are inoperative. The lighting system/configuration should be considered inoperative when more than 10 percent of the lights are not functioning. Taxiway lights and individual airport/runway lights do not have to be remotely monitored. However, when visual aid lighting systems which support Category II are monitored by observation, the inspection interval should ensure that undetected failures of more than 10 percent of the lights, or more than two adjacent lights would be unlikely, taking into consideration lamp expected life, environmental conditions, etc. The procedure to visually verify operation of runway edge, centerline, and TDZ lights should specify that a visual inspection take place within one day prior to commencement of anticipated Category II operations, or at least daily for continued Category II operations. The following systems should be considered:

(a) Touchdown zone and centerline lights.

(b) Runway edge lights.

(c) Runway markings.

(d) Runway guard lights.

(e) Taxiway centerline lights.

(f) Taxiway clearance bar lights.

(g) Taxiway signs.

(h) Taxiway markings.

For Special Category II procedures authorized through OpSpecs, NAVAID, lighting, and marking monitoring may be authorized for each operator if a procedure is equivalent to the above provisions, and is approved by FAA considering use by each applicable operator.

**d. Critical Areas.** Obstacle-critical areas will be marked and lighted to ensure that ground traffic does not violate critical areas during specified operations. These areas may differ depending on the type of NAVAIDs used. Procedural methods may be used for Special Category II procedures, if assurance can be provided that critical areas can be suitably protected for each operator using the special procedure.

(1) Glide Path Critical Area. The glide path critical area for ILS installations is specified in FAA Order 6750.16B, as amended. The glide path critical area of the elevation antenna for MLS installations is specified in FAA Order 6830.5, as amended.

(2) Localizer Critical Area. The localizer critical area for ILS installations is specified in FAA Order 6750.16B, as amended. The Azimuth Antenna critical area for MLS installations is specified in FAA Order 6830.5, as amended.

**4. OBSTACLE CLEARANCE CRITERIA.** Unless otherwise specified by AFS-1 the criteria found in FAA Orders 8260.3B and 8260.36 or this AC should be used to establish Category II minimums for each new ILS, MLS, or GLS based procedure. Order 8260.3B TERPS criteria may be used for previously established ILS systems. Appendix 5 of this AC contains guidance for RNP final approach and missed approach segments.

# APPENDIX 7

## Standard Operations Specifications

**1. General.** This appendix provides samples of standard operations specifications (OpSpecs) provisions typically issued for operations described in this AC. Standard OpSpecs are developed by the Federal Aviation Administration (FAA) Flight Standards Service, Washington D.C., and are issued by certificate holding district offices (CHDO) to each specific operator. CHDOs incorporate any necessary specific information applicable to that operator, to that operator's fleet of aircraft, or to that operator's specific operational environment or requirements (e.g., areas of operation).

OpSpecs specify limitations, conditions, and other provisions which Operators must comply with to comply with Title 14 of the Code of Federal Regulations (14 CFR). Standard OpSpecs are normally coordinated with industry prior to issuance to ensure a mutual and clear understanding of content and applicability and to pre-determine the effect they may have on operations. After appropriate coordination, new standard provisions, or amendments to existing provisions, are incorporated into the FAA's computer-based OpSpecs program used by field offices.

Use of standard OpSpecs provisions facilitates application of equivalent safety criteria for various operators, aircraft types, and operating environments. Occasionally, it may be necessary to issue OpSpecs provisions that are non-standard because of unique situations not otherwise addressed by standard provisions. Non-standard OpSpec provisions may be more or less restrictive than standard provisions, depending on the circumstances necessary to show appropriate safety for the intended application. Nonstandard OpSpecs provisions typically should not be contrary to the provisions of standard paragraphs. In cases when a non-standard paragraph is more or less restrictive than a standard paragraph, appropriate justification must be provided.

The following Standard OpSpec paragraphs are provided:

Part A - General

A002 Definitions and Abbreviations

Part C - Airplane Terminal instrument Procedures and Airport Authorizations and Limitations

C051 Terminal Instrument Procedures
C052 Basic Instrument Approach Procedure Authorizations -- All Airports
C053 Straight-in Category I Approach Procedures other than ILS, MLS, or GPS and IFR Landing Minimums - All Airports
C054 Special Limitations and Provisions for Instrument Approach Procedures and IFR Landing Minimums
C055 Alternate Airport IFR Weather Minimums
C056 IFR Standard Takeoff Minimums, Part 121 Operations -- All Airports
C059 Category II Instrument Approach and Landing Operations
C061 Flight Control Guidance Systems for Automatic Landing Operations Other Than Category II and III
C062 Manually Flown Flight Control Guidance Systems Certified for Landing Operations Other Than Category II or III
C074 Straight-in Category I Precision Approach Procedures and IFR Landing Minimums - All Airports All Airports.
C075 CAT I Landing Minimums - Circling Approach Procedures
C076 Category I IFR Landing Minimums -- Contact Approaches
C078 IFS Lower Than Standard Takeoff Minimums, 14 CFR Part 121 Airplane Operations - All Airports
C090 Required Navigation Performance (RNP)

**2. 14 CFR Part 121 Operations Specifications - PART A.** The following pertinent excerpts are provided from Operations Specifications Part A:

Instrument Approach Categories are defined as follows:

| | |
|---|---|
| Category I | An instrument approach or approach and landing with a decision altitude (height) or minimum descent altitude (height) not lower than 60 m (200 ft) and with either a visibility not less than 1/2 statute mile (800m), or a runway visual range not less than 550 m (1800 ft). |
| Category II | An instrument approach or approach and landing with a decision height lower than 60 m (200 ft) but not lower than 30 m (100 ft) and a runway visual range not less than 350 m (1200 ft). |
| Category III | An instrument approach or approach and landing with a decision height lower than 30 m (100 ft), or no decision height, or a runway visual range less than 350 m (1200 ft). |
| Category IIIa | An instrument approach and landing with a decision height lower than 30 m (100 ft), or no decision height and a runway visual range not less than 200 m (700 ft). |
| Category IIIb | An instrument approach and landing with a decision height lower than 15 m (50 ft), or no decision height and a runway visual range less than 200 m (700 ft) but not less than 50 m (150 ft). |
| Category IIIc | An instrument approach and landing with or without a decision height, with a runway visual range less than 50 m (150 ft). |

Other related definitions as follows:

Class I Navigation. Class I navigation is any en route flight operation or portion of an operation that is conducted entirely within the designated Operational Service Volumes (or International Civil Aviation Organization (ICAO) equivalent) of ICAO standard airway navigation facilities (VHF Omni-directional Radio Range (VOR), VOR/Distance Measuring Equipment (DME), NDB). Class I navigation also includes en route flight operations over routes designated with an "MEA GAP" (or ICAO equivalent). En route flight operations conducted within these areas are defined as "Class I navigation" operations irrespective of the navigation means used. Class I navigation includes operations within these areas using pilotage or any other means of navigation which does not rely on the use of VOR, VOR/DME, or NDB.

Class II Navigation. Class II navigation is any en route flight operation which is not defined as Class I navigation. Class II navigation is any en route flight operation or portion of an en route operation irrespective of the means of navigation which takes place outside (beyond) the designated Operational Service Volume (or ICAO equivalents) of ICAO standard airway navigation facilities (VOR, VOR/DME, NDB). However, Class II navigation does not include en route flight operations over routes designated with an "MEA GAP" (or ICAO equivalent).

Operational Service Volume. The Operational Service Volume is that volume of airspace surrounding a NAVAID which is available for operational use and within which a signal of usable strength exists and where that signal is not operationally limited by co-channel interference. Operational Service Volume includes all of the following:

**a.** The officially designated Standard Service Volume excluding any portion of the Standard Service Volume which has been restricted.

**b.** The Expanded Service Volume.

**c.** Within the United States, any published instrument flight procedure (victor or jet airway, Standard Instrument Departure (SID), Standard Terminal Arrival Routes (STAR), Standard Instrument Approach Procedure (SIAP), or instrument departure).

**d.** Outside the U.S., any designated signal coverage or published instrument flight procedure equivalent to U.S. standards.

**3. 14 CFR Part 121 Operations Specifications - PART C.** The following pertinent excerpts are provided from Operations Specifications Part C:

**C051, Terminal Instrument Procedures.**

a. The certificate holder is authorized to conduct terminal instrument operations using the procedures and minimums specified in these operations specifications, provided one of the following conditions is met:

(1) The terminal instrument procedure used is prescribed by these operations specifications.

(2) The terminal instrument procedure used is prescribed by Title 14 of the Code of Federal Regulations (14 CFR) part 97, Standard Instrument Approach Procedures.

(3) At U.S. military airports, the terminal instrument procedure used is prescribed by the U.S. military agency operating the airport.

(4) If authorized foreign airports, the terminal instrument procedure used at the foreign airport is prescribed or approved by the government of an ICAO contracting state. The terminal instrument procedure must meet criteria equivalent to that specified in either the United States Standard for Terminal Instrument Procedures (TERPS); or ICAO Document 8168-OPS; Procedures for Air Navigation Services-Aircraft Operations (PANS-OPS), Volume II; or Joint Aviation Authorities, Joint Aviation Requirements, operational agreements, Part 1 (JAR-OPS-1).

b. If Applicable, Special Limitations and Provisions for Instrument Approaches at Foreign Airports.

(1) Terminal instrument procedures may be developed and used by the certificate holder for any foreign airport, provided the certificate holder makes a determination that each procedure developed is equivalent to U.S. TERPS, ICAO PANS-OPS, or JAR-OPS-1 criteria and submits to the FAA a copy of the terminal instrument procedure with supporting documentation.

(2) At foreign airports, the certificate holder shall not conduct terminal instrument procedures determined by the FAA to be "not authorized for United States air carrier use." In these cases, the certificate holder may develop and use a terminal instrument procedure provided the certificate holder makes a determination that each procedure developed is equivalent to U.S. TERPS, ICAO PANS-OPS, or JAR-OPS-1 criteria and submits to the FAA a copy of the terminal instrument procedure with supporting documentation.

(3) When operating at foreign airports, RVR values or meteorological visibility might be shown in meters. When the minimums are specified only in meters, the certificate holder shall use the metric operational equivalents as specified in the RVR Conversion Table (Table 1) or the Meteorological Visibility Conversion Table (Table 2) for both takeoff and landing. Values not shown may be interpolated.

| TABLE 1 | |
|---|---|
| RVR CONVERSION | |
| **FEET** | **METERS** |
| 300 ft | 75 m |
| 400 ft | 125 m |
| 500 ft | 150 m |
| 600 ft | 175 m |
| 700 ft | 200 m |
| 1000 ft | 300 m |
| 1200 ft | 350 m |
| 1600 ft | 500 m |
| 1800 ft | 550 m |
| 2000 ft | 600 m |
| 2100 ft | 650 m |
| 2400 ft | 750 m |
| 3000 ft | 1000 m |
| 4000 ft | 1200 m |
| 4500 ft | 1400 m |
| 5000 ft | 1500 m |
| 6000 ft | 1800 m |

| TABLE 2 | | |
|---|---|---|
| METEOROLOGICAL VISIBILITY CONVERSION | | |
| **STATUTE MILES** | **METERS** | **NAUTICAL MILES** |
| ¼ sm | 400 m | ¼ nm |
| 3/8 sm | 600 m | 3/8 nm |
| 1/2 sm | 800 m | 1/2 nm |
| 5/8 sm | 1000 m | 5/8 nm |
| 3/4 sm | 1200 m | 7/10 nm |
| 7/8 sm | 1400 m | 7/8 nm |
| 1 sm | 1600 m | 9/10 nm |
| 1 1/8 sm | 1800 m | 1 1/8 nm |
| 1 ¼ sm | 2000 m | 1 1/10 nm |
| 1 ½ sm | 2400 m | 1 3/10 nm |
| 1 ¾ sm | 2800 m | 1 ½ nm |
| 2 sm | 3200 m | 1 ¾ nm |
| 2 ¼ sm | 3600 m | 2 nm |
| 2 ½ sm | 4000 m | 2 2/10 nm |
| 2 ¾ sm | 4400 m | 2 4/10 nm |
| 3 sm | 4800 m | 2 6/10 nm |

(5) When operating at foreign airports where the published landing minimums are specified in RVR, the RVR may not be available, therefore the meteorological visibility is reported. When the minimums are reported in meteorological visibility, the certificate holder shall convert meteorological visibility to RVR by multiplying the reported visibility by the appropriate factor, shown in Table 3. The conversion of reported meteorological visibility to RVR is used only for Category I landing minimums, and shall not be used for takeoff minima, CAT II or III minima, or when a reported RVR is available.

| TABLE 3 [RVR = (reported meteorological visibility) X (factor)] | | |
|---|---|---|
| **AVAILABLE LIGHTING** | **DAY** | **NIGHT** |
| High Intensity approach and runway lighting | 1.5 | 2.0 |
| Any type of lighting installation other than above | 1.0 | 1.5 |
| No lighting | 1.0 | N/A |

**C052, Basic Instrument Approach Procedure Authorizations - All Airports.**

The certificate holder is authorized to conduct the following types of instrument approach procedures and shall not conduct any other types.

a. Instrument Approach Procedures Other Than ILS, MLS, and GLS

[NOTE: In the new OPSS, the POI will select the approaches that apply to the air carrier. If the OPSS is not available, the POI should delete the approach types that do not apply.]

| | | | | |
|---|---|---|---|---|
| VOR | VOR/DME | NDB | NDB/DME | LOC |
| LOC `BC | LOC/DMESDF | TACAN | ASR | LDA |
| LDA/DME | LDA (w/Glide Slope) | RNAV | GPS | AZI |
| AZI/DME | AZI/DME Back Course | | | |

b. ILS, MLS, and GLS Instrument Approach Procedures

ILS
ILS/PRM
GLS
MLS
PAR
ILS/DME

c. Other Conditions and Limitations (as required).

**C053, Straight-In Category I Approach Procedures Other Than ILS, MLS, or GLS and IFR Landing Minimums - All Airports.**

The certificate holder shall not use any IFR Category I landing minimum lower than that prescribed by the applicable published instrument approach procedure. The IFR landing minimums prescribed in this paragraph are the lowest Category I minimums authorized for use at any airport.

a. Category I Approach Procedures Other Than ILS, MLS, or GLS. The certificate holder shall not use an IFR landing minimum for straight-in approach procedures other than ILS, MLS, or GLS, lower than that specified in the following table. Touchdown zone (TDZ) RVR reports, when available for a particular runway, are controlling for all approaches to and landings on that runway (See NOTE 6).

| **Straight-In Category I Approaches (Approaches other than ILS, MLS, or GPS Landing System (GLS)** | | | | | |
|---|---|---|---|---|---|
| | | **Aircraft Category A, B, and C** | | **Aircraft Category D** | |
| **Approach Light Configuration** | **HAT** (See NOTES 1, 2, & 3) | **Visibility in Statute Miles** | **TDZ RVR In Feet** | **Visibility in Statute Miles** | **TDZ RVR In Feet** |
| **No Lights** | 250 | 1 | 5,000 | 1 | 5,000 |
| **ODALS** | 250 | 3/4 | 4,000 | 1 | 5,000 |
| **MALS, or SALS** | 250 | 5/8 | 3,000 | 1 (See NOTE 5) | 5,000 (see NOTE 5 & 6) |

| | | | | | |
|---|---|---|---|---|---|
| **MALSR, or SSALR, or ALSF-1, or ALSF-2** | 250 | ½ (See NOTE 4) | 2,400 (See NOTE 4 & 6) | 1 (See NOTE 5) | 5,000 (See NOTE 5 & 6) |
| **DME ARC, any light configuration** | 500 | 1 | 5,000 | 1 | 5,000 |

NOTE 1: For NDB approaches with a FAF, add 50 ft. to the HAT.
NOTE 2: For NDB approaches without a FAF, add 100 ft. to the HAT.
NOTE 3: For VOR approaches without a FAF, add 50 ft. to the HAT.
NOTE 4: For NDB approaches, the lowest authorized visibility is ¾ and the lowest RVR is RVR 4000.
NOTE 5: For LOC approaches, the lowest authorized visibility is ¾ and the lowest RVR is RVR 4000.
NOTE 6: The mid RVR and rollout RVR reports (if available) provide advisory information to pilots. The mid RVR report may be substituted for the TDZ RVR report if the TDZ RVR report is not available.

b. Special Limitations and Provisions for Instrument Approach Procedures at Foreign Airports. If the certificate holder operates to foreign airports the following applies:

(1) Foreign approach lighting systems equivalent to U.S. standards are authorized for instrument approaches. Sequenced flashing lights are not required when determining the equivalence of a foreign approach lighting system to U.S. standards.

(2) For straight-in landing minimums at foreign airports where an MDA(H) or DA(H) is not specified, the lowest authorized MDA(H) or DA(H) shall be obtained as follows:

(a) When an obstruction clearance limit (OCL) is specified, the authorized MDA(H) or DA(H) is the sum of the OCL and the touchdown zone elevation (TDZE). If the TDZE for a particular runway is not available, threshold elevation shall be used. If threshold elevation is not available, airport elevation shall be used. For approaches other than ILS, MLS, or GLS, the MDA(H) may be rounded to the next higher 10-foot increment.

(b) When an obstacle clearance altitude (OCA)/obstacle clearance height (OCH) is specified, the authorized MDA(H) or DA(H) is equal to the OCA/OCH. For approaches other than ILS, MLS, or GLS, the authorized MDA(H) may be expressed in intervals of 10 ft.

(c) The HAT or HAA used for approaches other than ILS, MLS, or GLS, shall not be below those specified in subparagraph a above of this operations specification.

(3) When only an OCL or an OCA/OCH is specified, visibility and/or RVR minimums appropriate to the authorized HAA/HAT values determined in accordance with subparagraph b(2) above will be established in accordance with criteria prescribed by U.S. TERPS or Joint Aviation Authorities, Joint Aviation Requirements, operational agreements, Part 1 (JAR-OPS-1).

(4) When conducting an instrument approach procedure outside the United States, the certificate holder shall not operate an aircraft below the prescribed MDA(H) or continue an approach below the DA(H), unless the aircraft is in a position from which a normal approach to the runway of intended landing can be made and at least one of the following visual references is clearly visible to the pilot:

(a) Runway, runway markings, or runway lights.

(b) Approach light system (in accordance with 14 CFR, part 91, section 91.175(c)(3)(i)).

(c) Threshold, threshold markings, or threshold lights.

(d) Touchdown zone, touchdown zone markings, or touchdown zone lights.

(e) Visual glidepath indicator (such as, VASI, PAPI).

(f) Runway end identifier lights.

**C054, Limitations and Provisions for Instrument Approach Procedures and IFR Landing Minimums.**

a. High Minimum Pilot-in-Command Provisions. Pilots-in-command who have not met the requirements of Title 14 of the Code of Federal Regulations (14 CFR) section 121.652 or 135.225(d) as appropriate, shall use the high minimum pilot RVR landing minimum equivalents as determined from the following table.

| RVR Landing Minimum as Published | RVR Landing Minimum Equivalent required for High Minimum Pilots |
|---|---|
| RVR 1800 | RVR 4500 |
| RVR 2000 | RVR 4500 |
| RVR 2400 | RVR 5000 |
| RVR 3000 | RVR 5000 |
| RVR 4000 | RVR 6000 |
| RVR 5000 | RVR 6000 |

b. Limitations on the Use of Landing Minimums for Turbojet Airplanes.

(1) A pilot-in-command of a turbojet airplane shall not conduct an instrument approach procedure when visibility conditions are reported to be less than ¾ statute mile or RVR 4000 until that pilot has been specifically qualified to use the lower landing minimums.

(2) A pilot-in-command of a turbojet airplane shall not begin an instrument approach procedure when the visibility conditions are reported to be less than ¾ statute mile or RVR 4000, unless the following conditions exist:

(a) Fifteen percent additional runway length is available over the landing field length specified for the destination airport by the appropriate sections of 14 CFR.

(b) Suitable instrument (all weather) runway markings or runway centerline lights are operational on that runway.

**C055, Alternate Airport IFR Weather Minimums.**

a. The certificate holder is authorized to derive alternate airport weather minimums from the “Alternate Airport IFR Weather Minimums” table listed below.

b. Special limitations and provisions.

(1) In no case shall the certificate holder use an alternate airport weather minimum other than any applicable minimum derived from this table.

(2) In determining alternate airport weather minimums, the certificate holder shall not use any published instrument approach procedure which specifies that alternate airport weather minimums are not authorized.

(3) Credit for alternate minima based on CAT II or CAT III capability is predicated on authorization for engine inoperative CAT III operations for the certificate holder, aircraft type, and qualification of flightcrew for the respective CAT II or CAT III minima applicable to the alternate airport.

| **Alternate Airport IFR Weather Minimums** [sm = statute mile] | | |
|---|---|---|
| **Approach Facility Configuration** | **Ceiling** | **Visibility** |
| For airports with at least one operational navigational facility providing a straight-in instrument approach procedure, or, when applicable, a circling maneuver from an instrument approach procedure. | A ceiling derived by adding 400 ft. to the authorized Category I HAT or, when applicable, the authorized HAA | A visibility derived by adding 1 sm to the authorized Category I landing minimum. |
| For airports with at least two operational navigational facilities, each providing a straight-in Instrument approach procedure to different, suitable runways. (However, when an airport is designated as an ER-OPS En Route Alternate Airport in these operations specifications, the approach procedures used must be to separate, suitable runways). | A ceiling derived by adding 200 ft. to the higher Category I HAT of the two approaches used. | A visibility derived by adding ½ sm to the higher authorized Category I landing minimum of the two approaches used. |
| For airports with a published CAT II or CAT III approach, and at least two operational navigational facilities, each providing a straight-in ILS, MLS, or GLS approach procedure to different, suitable runways. | CAT II procedures, a ceiling of at least 300 ft. HAT, or for CAT III procedures, a ceiling of at least 200 ft. HAT. | CAT II procedures, a visibility of at least RVR 4000, or for CAT III procedures, a visibility of at least RVR 1800. |

**C056, IFR Takeoff Minimums, Part 121 Airplane Operations - All Airports.**

a. Standard takeoff minimums are defined as 1 statute mile visibility or RVR 5000 for airplanes having 2 engines or less and ½ statute mile visibility or RVR 2400 for airplanes having more than 2 engines.

b. RVR reports, when available for a particular runway, shall be used for all takeoff operations on that runway. All takeoff operations, based on RVR, must use RVR reports from the locations along the runway specified in this paragraph.

c. When a takeoff minimum is not published, the certificate holder may use the applicable standard takeoff minimum and any lower than standard takeoff minimums authorized by these operations specifications. When standard takeoff minimums or greater are used, the Touchdown Zone RVR report, if available, is controlling.

d. When a published takeoff minimum is greater than the applicable standard takeoff minimum and an alternate procedure (such as a minimum climb gradient compatible with aircraft capabilities) is not prescribed, the certificate holder shall not use a takeoff minimum lower than the published minimum. The Touchdown Zone RVR report, if available, is controlling.

**C059, Category II Instrument Approach and Landing Operations.**

The certificate holder is authorized to conduct Category II (CAT II) instrument approach and landing operations to the airports and runways listed in subparagraph g using the procedures and minimums specified in this paragraph and shall conduct no other CAT II operations.

a. CAT II Approach and Landing Minimums. The certificate holder shall not use any CAT II IFR landing minimums lower than those prescribed by any applicable published CAT II instrument approach procedure. The CAT II IFR landing minimums prescribed by these operations specifications are the lowest CAT II minimums authorized for use at any airport.

b. The certificate holder is authorized to use the following CAT II straight-in approach and landing minimums at the authorized airports and runways listed in Table 3, for the aircraft listed in Table 1 below, provided the limitations in subparagraph g. are met.

**Table 1**

| **CAT II Approach and Landing Minimums** | | |
|---|---|---|
| **Airplane M/M/S** | **DH Not less Than** | **Lowest Authorized RVR** |
| | | |

c. Lower than standard CAT II. If the certificate holder is authorized lower than standard CAT II minimums with a decision height of 100 ft. and RVR 1000 ft. (300 meters), it shall be entered in Table 1 above. If authorized in Table 1, the following limitations and provisions must be met:

(1) Used only when conducting an autoland approach, or when using a head up guidance system (HGS) to touchdown.
(2) The airplane and its automatic flight control guidance system or manually flown guidance system must be approved for approach and landing operations as specified by operations specifications paragraphs C060, C061, or C062 of these operations specifications.
(3) The autopilot or HGS must be listed in the required CAT II airborne equipment in subparagraph d, Table 2, of this operations specification.

d. Required CAT II Airborne Equipment. The flight instruments, radio navigation equipment, and other airborne systems required by the applicable Section of the Title 14 of the Code of Federal Regulations (14 CFR) and the FAA-approved Airplane Flight Manual for the conduct of CAT II operations must be installed and operational. The additional airborne equipment listed or referenced in Table 2 below is also required and must be operational for CAT II operations.

**Table 2**

| **Kind of CAT II Operation** | | |
|---|---|---|
| **Airplane M/M/S** | **Additional Equipment & Special Provisions** | **Manual/Auto Pilot** |
| | | |

e. Required RVR Reporting Equipment. The certificate holder shall not conduct any CAT II operation, unless the following RVR reporting systems are installed and operational for the runway of intended landing:

(1) For authorized landing minimums not less than RVR 1600, the touchdown zone RVR reporting system is required and must be used. This RVR report is controlling for all operations.
(2) For authorized landing minimums less than RVR 1600, the touchdown zone and the rollout RVR reporting systems are required and must be used. The touchdown zone RVR report is controlling for all operations and the rollout RVR report provides advisory information to pilots. The mid RVR report (if available)

provides advisory information to pilots and may be substituted for the rollout RVR report if the rollout RVR report is not available.

f. Pilot Qualifications. A pilot-in-command shall not conduct CAT II operations in any airplane until that pilot has successfully completed the certificate holder's approved CAT II training program, and has been certified as being qualified for CAT II operations by one of the certificate holder's check airmen properly qualified for CAT II operations or an FAA inspector. Pilots-in-command who have not met the requirements of 14 CFR Section 121.652 shall use high minimum pilot landing minima not less than RVR 1800.

g. Operating Limitations. The certificate holder shall not begin the final approach segment of an instrument approach procedure, unless the latest reported controlling RVR is at or above the minimums authorized for the operation being conducted. If the aircraft is established on the final approach segment and the controlling RVR is reported to decrease below the authorized minimums, the approach may be continued to the DH applicable to the operation being conducted. The certificate holder shall not begin the final approach segment of an instrument approach procedure when the touchdown zone RVR report is less than RVR 1800, unless all of the following conditions are met:

(1) The airborne equipment required by subparagraph d above is installed and operating satisfactorily.
(2) The required components of the CAT II ground system are installed and in normal operation including all of the following:

(a) Each required component of the ground based CAT II navigation system. For ILS operations, a precision or surveillance radar fix, a designated NDB, VOR, DME fix, or a published minimum GSIA fix may be used in lieu of an outer marker. Except for CAT II instrument approach procedures designated as "RA NA" (radar/radio altimeter not authorized) operative radar/radio altimeters may be used in lieu of an inner marker. A middle marker is not required.
(b) ALSF-1 or ALSF-2 approach lighting systems or foreign authorizations acceptable to FAA. Sequenced flashing lights are required only at U.S. airports.
(c) High intensity runway lights.
(d) Approved touchdown zone lights and runway centerline lights.

(3) The RVR reporting systems required by subparagraph e above are operating satisfactorily.
(4) The crosswind component on the landing runway is less than the airplane flight manual's crosswind limitations, or 15 knots or less, whichever is more restrictive.
(5) Fifteen percent additional runway length is available over the landing field length specified for destination airport in 14 CFR section 121.195(b) or section 135.385(b), as appropriate.
(6) CAT II landing minimums to airports listed in Table 3 without touchdown zone and centerline lighting are authorized only when an auto-coupled approach or HGS is used to touch down.
(7) Additionally, MALSR or ALSF-1 or ALSF-2 approach lighting system or equivalent are required for the operations listed in Table 3.

h. Missed Approach Requirements. A missed approach shall be initiated when any of the following conditions exist:

(1) Upon reaching the authorized decision height, the pilot has not identified the required visual references to safely continue the approach by visual reference alone.
(2) After passing the authorized decision height, the pilot loses contact with the required visual references, or a reduction in visual reference occurs which prevents the pilot from safely continuing the approach by visual reference alone.
(3) The pilot determines that a landing cannot be safely accomplished within the touch down zone.
(4) Before arriving at DH, any of the required elements of the CAT II ground system becomes inoperative.
(5) Any of the airborne equipment required for the particular CAT II operation being conducted becomes inoperative. However, if the certificate holder is authorized for both manually flown and automatically flown CAT II operations, an automatic approach may be continued manually using the approved manual systems, provided the automatic system has malfunctioned and is disengaged higher than 1,000 ft. above the elevation of the touchdown zone.

(6) The crosswind component at touch down is expected to be greater than 15 knots, or greater than airplane flight manual crosswind limitations, whichever is more restrictive.

i. Authorized CAT II Airports and Runways. The certificate holder is authorized CAT II operations at airports and runways approved for CAT II operations in 14 CFR part 97. CAT II operations are also authorized for the airports and runways listed in table 3 below.

**Table 3**

| Airport Name/Identifier | Runways | Special Limitations |
|---|---|---|
| | | |

**<u>C061, Flight Control Guidance Systems for Automatic Landing Operations Other Than Categories II and III</u>**

The certificate holder is authorized to conduct automatic approach and landing operations (other than Categories II and III) at suitably equipped airports. The certificate holder shall conduct all automatic approach and landing operations in accordance with the provisions of this paragraph.

a. <u>Authorized Airplanes and Flight Control Guidance Systems.</u> The certificate holder is authorized to conduct automatic approach and landing operations using the following aircraft and automatic flight control guidance systems.

| Airplane Type | Flight Control Guidance Systems | |
|---|---|---|
| M/M/S | Manufacturer | Model |
| | | |

b. Special Limitations.

(1) The certificate holder shall conduct all operations authorized by this paragraph in accordance with the applicable section of Title 14 of the Code of Federal Regulations and the airworthiness certification basis of the automatic flight control guidance system used.
(2) The certificate holder shall not conduct automatic landing operations to any runway using these systems, unless the certificate holder determines that the flight control guidance system being used permits safe, automatically flown approaches and landings to be conducted at that runway.
(3) The certificate holder shall not conduct any operations authorized by this paragraph, unless the certificate holder's approved training program provides training in the equipment and special procedures to be used.
(4) Except when automatic approaches and landings are performed under the supervision of a properly qualified check airman, any pilot used by the certificate holder to conduct automatic approaches and landings must be qualified in accordance with the certificate holder's approved training program.

**C062, Manually Flown Flight Control Guidance System Certified for Landing Operations Other Than Categories II and III.**

The certificate holder is authorized to conduct approach and landing operations (other than Categories II and III) at suitably equipped airports using manually flown flight control guidance systems approved for landing operations. The certificate holder shall conduct all approach and landing operations authorized by this paragraph in accordance with the provisions of this paragraph.

a. Authorized Airplanes and Manual Flight Control Systems. The certificate holder is authorized to conduct approach and landing operations using the following aircraft and manually flown flight control guidance systems which are certified for landing operations.

| **Airplane Type M/M/S** | **Manual Flight Control Guidance Systems Manufacturer** | **Model** |
|---|---|---|
| | | |

b. Special Limitations.

(1) The certificate holder shall conduct all operations authorized by this paragraph in accordance with applicable section of Title 14 of the Code of Federal Regulations and the airworthiness certification basis of the manually flown flight control guidance system being used.
(2) The certificate holder shall not conduct landing operations to any runway using these systems, unless the certificate holder determines that the flight control guidance system being used permits safe manually flown approaches and landings to be conducted at that runway.
(3) The certificate holder shall not conduct any operations authorized by this paragraph, unless the certificate holder's approved training program provides training in the equipment and special procedures to be used.
(4) Except when operations are performed under the supervision of a properly qualified check airman, any pilot used by the certificate holder to conduct manually flown approaches and landings using these systems must be qualified for the operation being conducted in accordance with the certificate holder's approved training program.

**C074, Category I, ILS, MLS, or GLS Approach Procedures and IFR Landing Minimums - All Airports.**

The certificate holder shall not use any IFR Category I landing minimum lower than that prescribed by the applicable published instrument approach procedure. The IFR landing minimums prescribed in this paragraph are the lowest Category I minimums authorized for use at any airport.

a. Category I, ILS, MLS, or GPS Landing System (GLS) Approach Procedures. The certificate holder shall not use an IFR landing minimum for ILS, MLS, or GLS approach procedures lower than specified in the following table. Touchdown zone RVR reports, when available for a particular runway, are controlling for all approaches to and landings on that runway.

| **ILS/MLS/GLS APPROACHES** (Require operative lateral and vertical guidance) | | | |
|---|---|---|---|
| **Approach Light Configuration** | **HAT** | **Aircraft Category A, B, C, and D** | |
| | | **Visibility in Statute Miles** | **TDZ RVR in Feet** (See NOTE 2) |
| No Lights or ODALS | 200 | 3/4 | 4000 |
| MALS or SALS | 200 | 5/8 | 3000 |
| MALSR, or SSALR, or ALSF-1 or ALSF-2 | 200 | 1/2 | 2400 |
| MALSR with TDZ and CL, or SSALR with TDZ and CL, or ALSF-1/ALSF-2 with TDZ and CL | 200 | visibility not authorized (See NOTE 1) | 1800 |
| MALS, or MALSR, or SSALR, or ALSF- 1/ALSF-2, or REILS and HIRL, or RAIL, and HIRL | 200 | visibility not authorized | 1800 (See NOTE 3) |

NOTE 1: Visibility values below ½ statute mile are not authorized and shall not be used.
NOTE 2: The mid RVR and rollout RVR reports (if available) provide advisory information to pilots. The mid RVR report may be substituted for the TDZ RVR report if the TDZ RVR report is not available.
NOTE 3: These minimums apply to autoland or HGS-equipped aircraft when operated by a properly qualified flightcrew and flown in the appropriate CAT III annunciation mode at the authorized airports and runways listed in paragraph b. below.

b. The certificate holder is authorized ILS, MLS, or GLS Category I landing minimums as low as 1800 RVR without touchdown zone and centerline lights with autoland or HGS-equipped aircraft at the following airports and runways:

| **Airport 4- Letter Identifier** | **Runways** | **Special Limitation** |
|---|---|---|
| | | |

c. Special Aircrew, Aircraft Authorized Minimums. The certificate holder shall not use an IFR landing minimum for straight-in Category I approaches labeled as "Special Aircrew, Aircraft Authorization Required" except in accordance with subparagraph a of this operations specification and the following:

(1) The authorized aircraft must be equipped with an approved approach coupler, flight director, or a head up guidance system (HGS) which provides guidance to decision height. Pilots-in-command (PIC) must be required to engage the autopilot coupler, flight director, or HGS as applicable and use it to decision height or initiation of missed approach unless adequate visual references with the runway environment are established which allow safe continuation to a landing.
(2) Should the autopilot, flight director, or HGS malfunction or be disengaged during the approach, the PIC must execute a missed approach not later than arrival at standard minimums unless visual reference to the runway environment has been established.
(3) Pilots must be trained in the use of the autopilot coupler, flight director, or HGS as applicable and demonstrate proficiency in ILS approaches to minimums using this equipment on checks conducted to satisfy 14 CFR section 121.441 or section 135.297.

d. Limitations and Provisions for Instrument Approach Procedures at Foreign Airports. If the certificate holder operates to foreign airports, the following applies:

(1) Foreign approach lighting systems equivalent to U.S. standards are authorized for instrument approaches. Sequenced flashing lights are not required when determining the equivalence of a foreign approach lighting system to U.S. standards.
(2) For straight-in landing minimums at foreign airports where an MDA(H) or DA(H) is not specified, the lowest authorized MDA(H) or DA(H) shall be obtained as follows:

(a) When an obstruction clearance limit (OCL) is specified, the authorized MDA(H) or DA(H) is the sum of the OCL and the touchdown zone elevation (TDZE). If the TDZE for a particular runway is not available, threshold elevation shall be used. If threshold elevation is not available, airport elevation shall be used. For approaches other than ILS, MLS, or GLS, the MDA(H) may be rounded to the next higher 10-foot increment.
(b) When an obstacle clearance altitude (OCA)/obstacle clearance height (OCH) is specified, the authorized MDA(H) or DA(H) is equal to the OCA/OCH. For approaches other than ILS, MLS, or GLS, the authorized MDA(H) may be expressed in intervals of 10 ft.
(c) The HAT or HAA used for ILS, MLS, or GLS approaches shall not be below those specified in subparagraph a of this operations specification.

(3) When only an OCL or an OCA/OCH is specified, visibility and/or RVR minimums appropriate to the authorized HAA/HAT values determined in accordance with subparagraph d(2) above will be established in accordance with criteria prescribed by U.S. TERPS or Joint Aviation Authorities, Joint Aviation Requirements, operational agreements, Part 1 (JAR-OPS-1).
(4) When conducting an instrument approach procedure outside the United States, the certificate holder shall not operate an aircraft below the prescribed MDA(H) or continue an approach below the DA(H), unless the aircraft is in a position from which a normal approach to the runway of intended landing can be made and at least one of the following visual references is clearly visible to the pilot:

(a) Runway, runway markings, or runway lights.
(b) Approach light system (in accordance with 14 CFR section 91.175(c)(3)(i)).
(c) Threshold, threshold markings, or threshold lights.
(d) Touchdown zone, touchdown zone markings, or touchdown zone lights.
(e) Visual glidepath indicator (such as VASI, PAPI).
(f) Runway end identifier lights.

**C075, Category I IFR Landing Minimums - Circling Maneuvers**

The certificate holder shall not use any IFR Category I landing minimum lower than that prescribed by the applicable published instrument approach procedure. The IFR landing minimums prescribed in this paragraph are the lowest Category I minimums authorized for use at any airport.

a. Circling Maneuvers. The certificate holder shall not conduct circling maneuvers when the ceiling is less than 1,000 ft. or the visibility is less than 3 statute miles, unless the flightcrew has satisfactorily completed an approved training program for the circling maneuver or satisfactorily completed a flight check for the circling maneuver. When conducting an instrument approach procedure which requires a circling maneuver to the runway of intended landing, the certificate holder shall not use a landing minimum lower than the minimum prescribed for the applicable circling maneuver or a landing minimum lower than specified in the following table, whichever is higher. The lowest authorized IFR landing minimum for instrument approaches which require a circling maneuver to the runway of intended landing shall be determined for a particular aircraft by using the speed category appropriate to the highest speed used during the circling maneuver.

| **Speed Category** | **HAA** | **Visibility in Statute Miles** |
|---|---|---|
| less than 91 kts | 350 | 1 |
| 91 to 120 kts | 450 | 1 |
| 121 to 140 kts | 450 | 1 ½ |
| 141 to 165 kts | 550 | 2 |
| above 165 kts | 1000 | 3 |

b. Unless flying with a check airman, a pilot may not fly the circling maneuver if there is a restriction on that pilot's certificate that restricts or limits the circling approach to visual flight rules only.

c. If Applicable, Special Limitations and Provisions for Instrument Approach Procedures at Foreign Airports.

(1) Foreign approach lighting systems equivalent to U.S. standards are authorized for instrument approaches. Sequenced flashing lights are not required when determining the equivalence of a foreign approach lighting system to U.S. standards.

(2) For straight-in landing minimums at foreign airports where an MDA(H) or DA(H) is not specified, the lowest authorized MDA(H) or DA(H) shall be obtained as follows:

(a) When an obstruction clearance limit (OCL) is specified, the authorized MDA(H) or DA(H) is the sum of the OCL and the touchdown zone elevation (TDZE). If the TDZE for a particular runway is not available, threshold elevation shall be used. If threshold elevation is not available, airport elevation shall be used. For approaches other than ILS, MLS, or GLS, the MDA(H) may be rounded to the next higher 10-foot increment.

(b) When an obstacle clearance altitude (OCA)/obstacle clearance height (OCH) is specified, the authorized MDA(H) or DA(H) is equal to the OCA/OCH. For approaches other than ILS, MLS, or GLS, the authorized MDA(H) may be expressed in intervals of 10 ft.

(c) The HAT or HAA used for ILS, MLS, or GLS approaches shall not be below those specified in subparagraph a of this operations specification.

(3) When only an OCL or an OCA/OCH is specified, visibility and/or RVR minimums appropriate to the authorized HAA/HAT values determined in accordance with subparagraph b(2) above will be established in accordance with criteria prescribed by U.S. TERPS or Joint Aviation Authorities, Joint Aviation Requirements, operational agreements, Part 1 (JAR-OPS-1).

(4) When conducting an instrument approach procedure outside the United States, the certificate holder shall not operate an aircraft below the prescribed MDA(H) or continue an approach below the DA(H), unless the aircraft is in a position from which a normal approach to the runway of intended landing can be made and at least one of the following visual references is clearly visible to the pilot:

(a) Runway, runway markings, or runway lights.
(b) Approach light system (in accordance with 14 CFR section 91.175(c)(3)(i)).
(c) Threshold, threshold markings, or threshold lights.
(d) Touchdown zone, touchdown zone markings, or touchdown zone lights.
(e) Visual glidepath indicator (such as VASI, PAPI).
(f) Runway end identifier lights.

d. Notwithstanding the requirements of 14 CFR part 121 appendices E and F, the certificate holder is authorized to apply the requirements of SFAR 58 (AQP), if applicable, for flightcrew training to proficiency in circling maneuvers. The certificate holder may not perform circling maneuvers in weather minimums lower than 1,000 ft. and 3 miles with an HAA no lower than 1,000 ft. or the published minimum for the circling approach, whichever is higher.

**<u>C076, Category I IFR Landing Minimums - Contact Approaches.</u>**

The certificate holder shall not use any IFR Category I landing minimum lower than that prescribed by the applicable published instrument approach procedure. The IFR landing minimums prescribed in paragraphs C053 for *instrument approaches* "other than ILS, MLS, or GLS" approaches and C074 for "ILS, MLS, or GLS" approaches of these operations specifications are the lowest Category I minimums authorized for use at any airport.

a. <u>Contact Approaches</u>. The certificate holder shall not conduct contact approaches unless the pilot-in-command has satisfactorily completed an approved training program for contact approaches. In addition, the certificate holder shall not conduct a contact approach unless the approach is conducted to an airport with an approved instrument approach procedure for that airport, and all of the following conditions are met:

(1) The flight remains under instrument flight rules and is authorized by ATC to conduct a contact approach.
(2) The reported visibility/RVR for the runway of intended landing is at or above the authorized IFR minimum for the Category I approach, other than ILS, MLS, or GLS established for that runway or one statute mile (RVR 5000), whichever is higher.
(3) The flight is operating clear of clouds and can remain clear of clouds throughout the contact approach. The flight visibility must be sufficient for the pilot to see and avoid all obstacles and safely maneuver the aircraft to the landing runway using external visual references.
(4) The flight does not descend below the MEA/MSA, MVA, or the FAF altitude, as appropriate, until:

(a) The flight is established on the instrument approach procedure, operating below the reported ceiling, and the pilot has identified sufficient prominent landmarks to safely navigate the aircraft to the airport, or
(b) The flight is operating below any cloud base which constitutes a ceiling, the airport is in sight, and the pilot can maintain visual contact with the airport throughout the maneuver.

(5) The flight does not descend below the highest circling MDA prescribed for the runway of intended landing until the aircraft is in a position from which a descent to touchdown, within the touchdown zone, can be made at a normal rate of descent using normal maneuvers.

b. If Applicable, Special Limitations and Provisions for Instrument Approach Procedures at Foreign Airports.

(1) Foreign approach lighting systems equivalent to U.S. standards are authorized for instrument approaches. Sequenced flashing lights are not required when determining the equivalence of a foreign approach lighting system to U.S. standards.
(2) For straight-in landing minimums at foreign airports where an MDA(H) or DA(H) is not specified, the lowest authorized MDA(H) or DA(H) shall be obtained as follows:

(a) When an obstruction clearance limit (OCL) is specified, the authorized MDA(H) or DA(H) is the sum of the OCL and the touchdown zone elevation (TDZE). If the TDZE for a particular runway is not available, threshold elevation shall be used. If threshold elevation is not available, airport elevation shall be used. For approaches other than ILS, MLS, or GLS, the MDA(H) may be rounded to the next higher 10-foot increment.
(b) When an obstacle clearance altitude (OCA)/obstacle clearance height (OCH) is specified, the authorized MDA(H) or DA(H) is equal to the OCA/OCH. For approaches other than ILS, MLS, or GLS, the authorized MDA(H) may be expressed in intervals of 10 ft.
(c) The HAT or HAA used for ILS, MLS, or GLS approaches shall not be below those specified in subparagraph a. of this operations specification.

(3) When only an OCL or an OCA/OCH is specified, visibility and/or RVR minimums appropriate to the authorized HAA/HAT values determined in accordance with subparagraph b(2) above will be established in accordance with criteria prescribed by U.S. TERPS or Joint Aviation Authorities, Joint Aviation Requirements, operational agreements, Part 1 (JAR-OPS-1).

(4) When conducting an instrument approach procedure outside the United States, the certificate holder shall not operate an aircraft below the prescribed MDA(H) or continue an approach below the DA(H), unless the aircraft is in a position from which a normal approach to the runway of intended landing can be made and at least one of the following visual references is clearly visible to the pilot:

(a) Runway, runway markings, or runway lights.
(b) Approach light system (in accordance with 14 CFR section 91.175(c)(3)(i)).
(c) Threshold, threshold markings, or threshold lights.
(d) Touchdown zone, touchdown zone markings, or touchdown zone lights.
(e) Visual glidepath indicator (such as VASI, PAPI).
(f) Runway end identifier lights.

**C078, IFR Lower Than Standard Takeoff Minimums, 14 CFR Part 121 Airplane Operations - All Airports**.

Standard takeoff minimums are authorized in operations specification paragraph C056. The certificate holder is authorized to use lower than standard takeoff minimums in accordance with the limitations and provisions of this operations specification as follows.

a. Runway visual range (RVR) reports, when available for a particular runway, shall be used for all takeoff operations on that runway. All takeoff operations, based on RVR, must use RVR reports from the locations along the runway specified in this paragraph.

b. When takeoff minimums are equal to or less than the applicable standard takeoff minimum, the certificate holder is authorized to use the lower than standard takeoff minimums described below:

(1) Visibility or runway visual value (RVV) ¼ statute mile or touchdown zone RVR 1600, provided at least one of the following visual aids is available. The touchdown zone RVR report, if available, is controlling. The mid RVR report may be substituted for the touchdown zone RVR report if the touchdown zone RVR report is not available.

(a) Operative high intensity runway lights (HIRL).
(b) Operative runway centerline lights (CL).
(c) Serviceable runway centerline marking (RCLM).
(d) In circumstances when none of the above visual aids are available, visibility or RVV ¼ statute mile may still be used, provided other runway markings or runway lighting provide pilots with adequate visual reference to continuously identify the takeoff surface and maintain directional control throughout the takeoff run.

**[NOTE: If an operator is not authorized RVR 1000 the POI will not select RVR 1000 in the OPSS. If the OPSS is not available the POI should delete subparagraph b(2), b(3), & b(4) from the word boilerplate.]**

(2) Touchdown zone RVR 1000 (beginning of takeoff run) and rollout RVR 1000, provided all of the following visual aids and RVR equipment are available.

(a) Operative runway centerline lights (CL).
(b) Two operative RVR reporting systems serving the runway to be used, both of which are required and controlling. A mid-RVR report may be substituted for either a touchdown zone RVR report if a touchdown zone report is not available or a rollout RVR report if a rollout RVR report is not available.

**[NOTE: If an operator is not authorized RVR 500 the POI will not select RVR 500 in the OPSS. If the OPSS is not available the POI should delete subparagraph b(3), & b(4) from the word boilerplate.]**

(3) Touchdown zone RVR 500 (beginning of takeoff run), mid RVR 500, and rollout RVR 500, provided all of the following visual aids and RVR equipment are available.

(a) Operative runway centerline lights (CL).
(b) Runway centerline markings (RCLM).
(c) Operative touchdown zone and rollout RVR reporting systems serving the runway to be used, both of which are controlling, or three RVR reporting systems serving the runway to be used, all of which are controlling. However, if one of the three RVR reporting systems has failed, a takeoff is authorized, provided the remaining two RVR values are at or above the appropriate takeoff minimum as listed in this subparagraph.

(4) At foreign airports which have runway lighting systems equivalent to U.S. standards, takeoff is authorized with a reported touchdown zone RVR of 150 meters, mid RVR of 150 meters, and rollout RVR of 150 meters. At those airports where it has been determined that the runway lighting system is not equivalent to U.S. standards, the minimums in subparagraphs a(1) or (2), as appropriate, apply.

c. Takeoff Guidance System, If Applicable. If the certificate holder is authorized to use takeoff minimums based upon the use of takeoff guidance systems, the minimums will be specified for the aircraft listed in the Table 1 below. The certificate holder shall conduct no other takeoffs using these takeoff minimums. If subparagraph c is not authorized, N/A will be annotated in each of the columns in the table.

(1) Special provisions and limitations.
(a) Operative high intensity runway lights (HIRL).
(b) Operative runway centerline lights (CL).
(c) Serviceable runway centerline markings (RCLM).
(d) Front course guidance from the localizer must be available and used (if applicable to guidance systems used).
(e) The reported crosswind component shall not exceed 10 knots.
(f) Operative touchdown zone, and rollout RVR reporting systems serving the runway to be used, both of which are controlling, or three RVR reporting systems serving the runway to be used, all of which are controlling. However, if one of the three RVR reporting systems has failed, a takeoff is authorized, provided the remaining two RVR values are at or above the appropriate takeoff minimum as listed in this subparagraph.
(g) The pilot-in-command and the second-in-command have completed the certificate holders approved training program for these operations.
(h) All operations using these minimums shall be conducted to runways which provide direct access to taxi routings which are equipped with operative taxiway centerline lighting which meets U.S. or ICAO criteria for CAT III operations; or other taxiway guidance systems approved for these operations.

(2) The certificate holder is authorized to use the following takeoff minimums for the airplanes listed below.

**Table 1** (N/A = Not Authorized)

| Airplane M/M/S | Lowest Authorized RVR | Required Takeoff Guidance System |
|---|---|---|
| | | |

**[NOTE: If an operator is not authorized pilot assessment the POI will not select this statement in the OPSS. If the OPSS is not available the POI should delete subparagraph d in its entirety from the word boilerplate.]**

d. Pilot Assessment of RVR for Takeoff (if applicable). In circumstances when the touchdown zone RVR reporting system has failed, is inaccurate, or is not available, the certificate holder is authorized to substitute pilot assessment of equivalent RVR for any touchdown zone RVR report required by this operations specification paragraph provided that:

(1) The pilot has completed the FAA-approved training program for visibility assessment in lieu of RVR, and
(2) Runway markings or runway lighting is available to provide adequate visual reference for the assessment.

**<u>C090, Required Navigation Performance (RNP)</u>**.
The certificate holder is authorized to conduct terminal area RNAV operations using area navigation systems approved for RNP operations and shall conduct all such operations in accordance with the provisions of these operations specifications.

a. <u>Standard Terminal Area RNP Levels.</u> The certificate holder shall not conduct any operation authorized by this paragraph, unless the required navigation performance (RNP level) for the specified procedure or operation has been specified to the aircraft navigation system and the actual navigation performance (ANP) or estimated position error (EPE) is less than the specified RNP.

**STANDARD TERMINAL AREA RNP Levels**

| **RNP Levels** | **Applicability/Operation (Approach segment)** |
|---|---|
| RNP 1 | Initial/Intermediate approach |
| RNP 0.5 | Initial/Intermediate/Final approach |
| RNP 0.3 | Initial/Intermediate/Final approach |
| | |
| | |
| | |
| | |

b. <u>Aircraft and Equipment with Airplane Flight Manual Authorization for RNP</u>. The certificate holder is authorized to conduct terminal area instrument operations using the following aircraft and area navigation systems to comply with RNP requirements when operated in accordance with the approved airplane flight manual.

| **Airplane Type M/M/S** | **Area Navigation Systems M/M** | **Lowest Authorized RNP** |
|---|---|---|
| B737-400 | Smiths/U-10.2 | RNP 0.15 (see note 3) |
| A319-112 | Honeywell/Sextant<br>FMGC B546 CAM 0102<br>Software SWPS406625-931 | RNP 0.15<br>See Notes 3 and 7 |
| | | |
| | | |

c. <u>Other Aircraft and Equipment Authorization for RNP</u>. The certificate holder is authorized to conduct terminal area instrument operations using the following aircraft and area navigation systems to comply with RNP requirements when operated in accordance with the approved airplane flight manual.

| **Airplane Type M/M/S** | **Area Navigation Systems M/M** | **Lowest Authorized RNP** |
|---|---|---|
| B737-400 | Smiths/U7.4 | RNP 1.0 (See Notes 1 and 5) |
| | | |
| | | |

d. <u>Special Limitations</u>.

(1)

(2)

NOTES:
1. Departure Only
2. Approach Only
3. Autopilot required for approach operations at RNP levels of 0.3 or less.
4. When the automatic runway position update is utilized by line selecting the departure runway on the CDU.
5. When the automatic runway position update is utilized by selecting the TO/GA switch during takeoff.
6. When a quick alignment of the inertial reference units to the departure runway coordinates contained in the airborne navigation database is conducted within 1,000 ft. of the departure runway threshold and within 15-minutes of departure.
7. When the required navigation performance (RNP level) for the specified procedure or operation has been specified to the aircraft navigation system and the actual navigation performance (ANP) or estimated position error (EPE) is less than the specified RNP. The RNP level may be specified to the navigation system either manually, through the data base, or use the navigation system default value.
8. Unless otherwise specified on the instrument procedure, approaches other than ILS, MLS or GLS require use of RNP of 0.3 or less.
9. Other RNP Levels, not otherwise specified in an approved terminal area or instrument approach procedure, are as specified below:

**Other RNP Levels Approved(Example only)**

| **RNP Type** | **Applicability/Operation (Approach segment)** |
|---|---|
| RNP 0.3/125 | Initial/Intermediate/Final approach with specified barometric vertical guidance (VNAV) |
| RNP 0.03/45 | Final approach with specified vertical guidance |
| RNP 0.01/15 | Final approach with specified vertical guidance |
| RNP .003/15 | Final approach with specified vertical guidance |
| | |
| | |
| | |

# APPENDIX 8

## Use Of Alternative Operating Minima

**1. General.**

This appendix provides a basis for determining optional operating minima which an operator may use if authorized by operations specifications, in lieu of otherwise published minima. Use of these minima are limited to use within the United States, within any Joint Airworthiness Authority (JAA) (European) State that authorizes use of these minima or equivalent, or in other States which accept or apply Federal Aviation Administration (FAA) or JAA criteria.

Alternate minima may be based on the tables and conversions agreed by FAA and JAA as reflected in the harmonized values of this appendix. Minima based on these tables and conversions which have been determined to be acceptable to FAA may be approved for use by U.S. operators, or for international operators flying to U.S. airports when those Operators have implemented applicable provisions and criteria of the main body of this Advisory Circular (AC), or for international operators, equivalent provisions to FAA or JAA criteria.

These minima provide a basis for determination of a single table for Aerodrome Operating Minima regardless of approach type, and are intended for use by aircraft flying a stabilized descent path and instrument procedures and flightcrew procedures which are based on use of a stabilized descent path to the runway (e.g., using an xLS (e.g., ILS, MLS, or GLS) glide slope, Vertical Navigation (VNAV), or other specifically approved method for maintaining a constant vertical descent path or rate during final approach). Use of minima in this table for other procedures not using a glide slope or constant VNAV descent path to minima is considered only on a case by case basis, by FAA.

This table is intended to cover all categories of straight-in approach procedures including xLS and approaches other than xLS (e.g., Area Navigation (RNAV), Localizer (LOC), BCRS, VHF Omni-directional Radio Range (VOR), NDB). Any procedure based on U.S. TERPS or ICAO PANS-OPS, or special procedures otherwise approved by FAA are eligible to use minima of this appendix. Approaches with glide slope angles or VNAV descent paths in excess of 3.77 degrees, or special procedures at certain airports which require specific knowledge or training, are not typically eligible for use of the approach minima listed in this Appendix.

**2. Terminology.**

A Stabilised approach is considered to mean an approach where:

- A constant, predetermined descent path (usually 3 degrees) is flown from the final approach fix or point to the runway using:
  - xLS Glide path, or
  - RNAV(VNAV), or
  - Height cross check as a function of distance (e.g., Distance Measuring Equipment (DME)), or
  - Height cross check as a function of time (e.g., timing from an approach fix), and

- A missed approach is executed upon reaching Decision Altitude/height (DA(H) or Minimum Descent Altitude/height (MDA(H)) as applicable to the approach, if the pilot has not established the necessary visual reference.

### 3. "Go-Around" Transition To A Missed Approach When Using a DA(H) or MDA(H).

When using minima based on this appendix in conjunction with a DA(H), flightcrew procedures for timely initiation of a go-around and anticipated altitude loss below the DA(H) during the momentary transition to a go-around are assumed to be the same as those specified for ILS, MLS, or GLS. The procedures used may be as specified by the operator or by the aircraft manufacturer, as applicable.

When using minima based on this appendix in conjunction with an MDA(H), it is recognised that the missed approach path following a stabilised approach may momentarily descend below MDA(H) while initiating the missed approach. This momentary and slight descent below MDA(H) during the transition to a missed approach is considered acceptable and is assumed to typically result in a displacement below MDA(H) of 50 ft. or less.

### 4. Alternative RVR/Visibility Value Table.

The following minimum RVR/Visibility values are specified in relation to various HAT values for DA(H) or MDA(H). These values, or equivalent values in terms of RVR or miles of visibility, may be used as the basis to specify various landing minima. These tables apply to formulation of minima for instrument procedures other than those for Category II or III, except as specified in the Notes associated with the table(s) below. The values in these tables may be used as a basis for determination of minima in lieu of values specified by U.S. TERPS or ICAO PANS-OPS. These values are considered applicable to any Category of aircraft (e.g., Instrument approach Category A, B, C, or D) and are applicable up to a 3.77 degree final approach segment descent gradient.

**Table A8-1**

**Alternative RVR/Visibility Values**
**for Various Heights Above Touchdown (HAT)**

**(RVR/Visibility when based on units related to *Feet*)**

| HAT Band (ft) | RVR/Visibility (feet) | | | | HAT Band (ft) | RVR/Visibility (feet) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FF | IF | BF | NF | | FF | IF | BF | NF |
| 200 - 209 | 1800 | 2000 | 2700 | 3000 | 500 - 519 | 5350 | 6350 | 7350 | 7750 |
| 210 - 219 | 1800 | 2000 | 2850 | 3250 | 520 - 539 | 5650 | 6650 | 7650 | 8050 |
| 220 - 229 | 1800 | 2000 | 3000 | 3400 | 540 - 559 | 6000 | 6950 | 7950 | 8350 |
| 230 - 239 | 1800 | 2000 | 3150 | 3550 | 560 - 579 | 6300 | 7250 | 8250 | 8650 |
| 240 - 249 | 1800 | 2350 | 3300 | 3700 | 580 - 599 | 6600 | 7550 | 8550 | 8950 |
| 250 - 259 | 1800 | 2500 | 3450 | 3850 | 600 - 619 | 6900 | 7850 | 8850 | 9250 |
| 260 - 279 | 1800 | 2700 | 3700 | 4100 | 620 - 639 | 7200 | 8200 | 9150 | 9550 |
| 280 - 299 | 2050 | 3000 | 4000 | 4400 | 640 - 659 | 7500 | 8500 | 9450 | 9850 |
| 300 - 319 | 2350 | 3300 | 4300 | 4700 | 660 - 679 | 7800 | 8800 | 9750 | 10150 |
| 320 - 339 | 2650 | 3600 | 4600 | 5000 | 680 - 699 | 8100 | 9100 | 10050 | 10450 |
| 340 - 359 | 2950 | 3950 | 4900 | 5300 | 700 - 719 | 8400 | 9400 | 10350 | 10750 |
| 360 - 379 | 3250 | 4250 | 5200 | 5600 | 720 - 739 | 8700 | 9700 | 10700 | 11050 |
| 380 - 399 | 3550 | 4550 | 5500 | 5900 | 740 - 759 | 9000 | 10000 | 11000 | 11350 |
| 400 - 419 | 3850 | 4850 | 5800 | 6200 | 760 - 799 | 9450 | 10450 | 11450 | 11850 |
| 420 - 439 | 4150 | 5150 | 6100 | 6500 | 800 - 849 | 10150 | 11150 | 12100 | 12500 |
| 440 - 459 | 4450 | 5450 | 6450 | 6800 | 850 - 899 | 10900 | 11900 | 12900 | 13250 |
| 460 - 479 | 4750 | 5750 | 6750 | 7150 | 900 - 949 | 11650 | 12650 | 13650 | 14050 |
| 480 499 | 5050 | 6050 | 7050 | 7450 | 950 - 1000 | 12450 | 13400 | 14400 | 14800 |

**Table A8-1 Note 1**- An RVR/Visibility less than 1800 ft may be authorized for certain runways with full facilities (FF - e.g., ALSF I or ALSF II) and TDZ/CL lights; An RVR/Visibility less than 1800 ft may be authorized for certain runways with MALSR or equivalent (with or without TDZ/CL lights), if automatic landing or flight guidance HUD based approaches are conducted. (See paragraph 5.3.2., Special Category II Authorizations).

**Table A8-2**

**Alternative RVR/Visibility Values**
**for Various Heights Above Touchdown (HAT)**

**(RVR/Visibility when based on units related to *Meters*)**

| HAT BAND (ft) | RVR/Visibility (meters) | | | |
|---|---|---|---|---|
| | FF | IF | BF | NF |
| 200 - 209 | 550 | 700 | 850 | 1000 |
| 210 - 219 | 550 | 700 | 850 | 1000 |
| 220 - 229 | 550 | 700 | 900 | 1050 |
| 230 - 239 | 550 | 700 | 950 | 1100 |
| 240 - 249 | 550 | 700 | 1000 | 1150 |
| 250 - 259 | 600 | 750 | 1050 | 1200 |
| 260 - 279 | 600 | 850 | 1150 | 1250 |
| 280 - 299 | 600 | 900 | 1200 | 1350 |
| 300 - 319 | 700 | 1000 | 1300 | 1450 |
| 320 - 339 | 800 | 1100 | 1400 | 1500 |
| 340 - 359 | 900 | 1200 | 1500 | 1600 |
| 360 - 379 | 1000 | 1300 | 1600 | 1700 |
| 380 - 399 | 1100 | 1400 | 1700 | 1800 |
| 400 - 419 | 1150 | 1450 | 1750 | 1900 |
| 420 - 439 | 1250 | 1550 | 1850 | 2000 |
| 440 - 459 | 1350 | 1650 | 1950 | 2100 |
| 460 - 479 | 1450 | 1750 | 2050 | 2150 |
| 480 499 | 1550 | 1850 | 2150 | 2250 |

| HAT BAND (ft) | RVR/Visibitlity (meters) | | | |
|---|---|---|---|---|
| | FF | IF | BF | NF |
| 500 - 519 | 1650 | 1950 | 2250 | 2350 |
| 520 - 539 | 1750 | 2050 | 2350 | 2450 |
| 540 - 559 | 1800 | 2100 | 2400 | 2550 |
| 560 - 579 | 1900 | 2200 | 2500 | 2650 |
| 580 - 599 | 2000 | 2300 | 2600 | 2750 |
| 600 - 619 | 2100 | 2400 | 2700 | 2800 |
| 620 - 639 | 2200 | 2500 | 2800 | 2900 |
| 640 - 659 | 2300 | 2600 | 2900 | 3000 |
| 660 - 679 | 2400 | 2700 | 3000 | 3100 |
| 680 - 699 | 2450 | 2750 | 3050 | 3200 |
| 700 - 719 | 2550 | 2850 | 3150 | 3300 |
| 720 - 739 | 2650 | 2950 | 3250 | 3350 |
| 740 - 759 | 2750 | 3050 | 3350 | 3450 |
| 760 - 799 | 2900 | 3200 | 3500 | 3600 |
| 800 - 849 | 3100 | 3400 | 3700 | 3800 |
| 850 - 899 | 3350 | 3650 | 3950 | 4050 |
| 900 - 949 | 3550 | 3850 | 4150 | 4300 |
| 950 - 1000 | 3800 | 4100 | 4400 | 4500 |

**Table A8-2 Note 1 -** An RVR/Visibility less than 600 m may be authorized for certain runways with full facilities (FF - e.g., ALSF I or ALSF II) and TDZ/CL lights; An RVR/Visibility less than 600 m may be authorized for certain runways with MALSR or equivalent (with or without TDZ/CL lights), if automatic landing or flight guidance HUD based approaches are conducted. (See paragraph 5.3.2., Special Category II Authorizations).

**Table A8-1 and A8-2 Note 2 -** Minima values higher than the values shown in Table A8-3 below need not be applied to determination of minima when a higher value is otherwise shown in Table A8-1 or A8-2.

**Table A8-1 and A8-2 Note 3 -** Unless otherwise specified by FAA, no resulting minima RVR/visibility value need necessarily result in a value greater than the applicable values shown in Table A8-4 below.

**Table A8-1 and A8-2 Note 4 -** Category A or B aircraft using an acceptable stabilised approach method may use the lower of the minima specified in either the table above, or minima as specified in accordance with U.S. TERPS.

**Table A8-3**

**Limitations on RVR/Visibility Minimum Values for Approaches Other than xLS or 3-D RNAV RNP**

| Aircraft category | A | B | C | D | Facility Requirements |
|---|---|---|---|---|---|
| Minimum RVR/visibility | 750m (2400ft) | 750m (2400ft) | 750m (2400ft) | 750m (2400ft) | NDB, VOR, VOR/DME, LOC, LOC/DME, VDF, LDA, SDF, SRE, 2D-RNAV with a procedure meeting at least the following criteria:<br>- FAS offset from Rwy track ≤ 5 degrees,<br>- A FAF is designated,<br>- Distance to Rwy information is available (e.g., via DME or RNAV), and<br>- Distance from NAVAID facility to Rwy Threshold ≤ 8 nm |
| Minimum RVR/visibility | 1000m (3000ft) | 1000m (3000ft) | 1200m (4000ft) | 1200m (4000ft) | Instrument approach types or cases where the above criteria are not met. |

The above table is not applicable to xLS or 3-D RNAV RNP based Minima. Table A8-1 and A8-2 are used directly for determination of 3-D RNAV RNP based minima, without respect to use of the limiting values of Table A8-3.

**Table A8-4**

**Limitations on “Upper cut-off” Values for RVR/Visibility Minima**

| **Aircraft category** | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| Maximum required RVR/Visibility | 1500 m (5000 ft/) | 1500 m (5000 ft) | 2400 m (1 1/2 sm) | 2400 m (1 1/2 sm) |

Unless otherwise specified by FAA, values higher than the values shown in Table A8-4 above need not be applied when determining RVR/Visibility minima from tables A8-1 or A8-2.

**5. Approach and Runway Lighting Systems Definition, Classification, And Equivalence.**

**Table A8-5**

**Visual Aid Classification for Determination of RVR/Visibility for Instrument Approaches**

| **European Lighting Systems (JAA)** | | **U.S. Lighting Systems (FAA)** | |
|---|---|---|---|
| **Class of facility** | **Length and Intensity of approach lights** | **Class of facility** | **Length of approach lights** |
| **Full**<br>(Calvert or Barette centerline configuration) | 720m or more HI/MI | ALSF1/ALSF2/ALSR/SSALR MALSR | >720m |
| **Intermediate**<br>(simplified approach light system) | 420m - 719m HI/MI | MALSF, MALS<br>SSALF, SALS | >420-719m |
| **Basic**<br>(no ICAO standard exists) | 210 - 419 m HI, MI or LI including one crossbar | ODALS | <420m |
| **Nil** | No approach lights | No approach lights | No approach lights |

**6. Applicability to Various Classes of Instrument Approach Procedures.**

U.S. Instrument Approach procedures are classified as Category I, II, or III by U.S. Operation Specifications (OpSpecs), to address any type of instrument approach. The terms Category II and Category III apply to xLS approach types (i.e., ILS, GLS, or MLS). For U.S. Operators, Category I applies to xLS approaches and also applies to approach types other than xLS (e.g., also applies to RNAV, LOC, VOR, or NDB). States other than the U.S. may or may not apply the term Category I in this manner, or may only apply the term Category I to xLS approaches (e.g., ILS, MLS, or GLS).

Nonetheless, the above equivalent minima provisions based on FAA/JAA harmonized Tables A8-1 through A8-5 may be applied to determine minima for any Category I or II approach type for a U.S. operator regardless of classification (e.g., not withstanding former classifications such as precision or non-precision), unless the FAA or other State of an Aerodrome specifically preclude use of minima based on these tables.

**7. Transition Provisions.**
Transitions provisions may be proposed by operators and may be approved by CHDOs to implement provisions of AC120-29A, as applicable to this appendix. This is to facilitate timely transition to use of these alternate minima. Transition provisions may address such issues as the operator's use of interim charting provisions, interim flight procedures, the operators optional use of either traditional or alternative minima during the transition period, or other issues as determined appropriate by the operator or CHDO.

**8. Authorized RVR Minima Conversions between "Feet and Meters."**

The RVR equivalent visibility values shown in Table A8-6 expressed in feet or meters may be used where necessary. When appropriate, the operator may propose and the CHDO may approve use of the necessary equivalent RVR visibility determinations for meters or feet conversion operationally, or for instrument procedure minima development.

**Table A8 - 6**

**Acceptable "Meters to Feet" or**
**"Feet to Meters" Conversions for RVR**

| RVR | |
|---|---|
| **Feet** | **Meters** |
| 100ft | 25 m |
| 150 ft | 50 m |
| 300 ft | 75 m |
| 400 ft | 125 m |
| 500 ft | 150 m |
| 600 ft | 175 m |
| 700 ft | 200 m |
| 800 ft | 250 m |
| 900 ft | 275 m |
| 1000 ft | 300 m |
| 1200 ft | 350 m |
| 1300 ft | 400 m |
| 1400 ft * | 420 m * |
| 1500 ft | 450 m * |
| 1600 ft | 500 m |
| 1800 ft | 550 m |
| 2000 ft | 600 m |
| 2100 ft | 650 m * |
| 2300 ft | 700 m |
| 2400 ft | 720 m ** |
| 2500 ft * | 750 m * |
| 2600 ft | 800 m |
| 2800 ft | 900 m * |
| 3000 ft | 1000 m |
| 4000 ft | 1200 m |
| 4500 ft | 1400 m |
| 5000 ft | 1500 m |
| 6000 ft | 1800 m |

* = Denotes a value not operationally used at present

** = Standard Op-Specs specify 750m

**9. Acceptable Meteorological Visibility or RVR Equivalence or Conversions.**

The following conversion tables may be used in conjunction with the minima tables above to specify RVR/Visibility minima in terms of feet, meters, or meteorological visibility when appropriate. Interpolations are permitted where necessary. The operator may propose and the CHDO may approve use of the necessary equivalent RVR/visibility values for use operationally, or for instrument procedure minima development.

**Table A8 - 7**

**Acceptable Statute Mile/Meter/Nautical Mile Conversions**

| RVR/Visibility | | |
|---|---|---|
| **Statute Miles** | **Meters** | **Nautical Miles** |
| 1/8 sm | 200 m | 1/9 nm |
| 1/4 sm | 400 m | 1/4 nm |
| 3/8 sm | 600 m | 3/8 nm |
| 1/2 sm | 800 m | 1/2 nm |
| 5/8 sm | 1000 m | 5/8 nm |
| 3/4 sm | 1200 m | 7/10 nm |
| 7/8 sm | 1400 m | 7/8 nm |
| 1 sm | 1600 m | 9/10 nm |
| 1 1/8 sm | 1800 m | 1 1/8 nm |
| 1 1/4 sm | 2000 m | 1 1/10 nm |
| 1 1/2 sm | 2400 m | 1 3/10 nm |
| 1 3/4 sm | 2800 m | 1 1/2 nm |
| 2 sm | 3200 m | 1 3/4 nm |
| 2 1/4 sm | 3600 m | 2 nm |
| 2 1/2 sm | 4000 m | 2 1/2 nm |
| 2 3/4 sm | 4400 m | 2 4/10 nm |
| 3 sm | 4800 m | 2 6/10 nm |

Interpolation for above RVR/visibility values is permitted