

AC 90-100A Compliance for Rockwell Collins FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100

<i>Source Para</i>	<i>Requirement</i>	<i>Compliant?</i>	<i>Applicability</i>	<i>Notes and Comments</i>
1. Purpose		N/A	N/A	Title Line
1.a Purpose	a. This advisory circular (AC) provides operational and airworthiness guidance for operation on U.S. Area Navigation (RNAV) routes, Instrument Departure Procedures (DPs), and Standard Terminal Arrivals (STARs). Operators and pilots should use the guidance in this AC to determine their eligibility for these U.S. RNAV routes and procedures. In lieu of following this guidance without deviation, operators may elect to follow an alternative method, provided the alternative method is found to be acceptable by the Federal Aviation Administration (FAA). For the purpose of this AC, "compliance" means meeting operational and functional performance criteria. Mandatory terms in this AC such as "must" are used only to ensure applicability of these particular methods of compliance when the acceptable means of compliance described are used. This AC does not change, add, or delete regulatory requirements or authorize deviations from regulatory requirements.	N/A	N/A	Explanatory text
1.a Purpose	NOTE: New applicants for a type certificate (TC) or supplemental type certificate (STC) should include a statement of compliance to this AC and qualification for U.S. RNAV routes and terminal procedures when the aircraft is found in compliance with this AC.		(S)TC Applicant	To be addressed by new applicants for a type certificate (TC) or supplemental type certificate (STC)
1.b Applicability of AC 90-100A	b. Applicability of AC 90-100A. AC 90-100A applies to operation on U.S. Area Navigation (RNAV) routes (Q-routes and T-routes), Departure Procedures (Obstacle Departure Procedures and Standard Instrument Departures), and Standard Terminal Arrivals (STARs). It does not apply to over water RNAV routes (ref 14 CFR 91.511, including the Q-routes in the Gulf of Mexico and the Atlantic routes) or Alaska VOR/DME RNAV routes ("JxxxR"). It does not apply to off-route RNAV operations, Alaska GPS routes or Caribbean routes, or helicopter operations involving offshore or specific heliport procedures.	N/A	N/A	Explanatory text
1.c Performance-based navigation concept	This AC sets out a series of performance and functional criteria necessary to conduct RNAV procedures. Aircraft compliant with AC 90-45A, Approval of Area Navigation Systems for Use in the U.S. National Airspace System, may not be compliant with criteria contained herein.	N/A	N/A	Explanatory text
1.d Background	d. Background. This criterion is consistent with the ICAO guidance material for the implementation of area navigation (RNAV 1 and RNAV 2) operations. AC 90-100 became effective 7 January 2005. Since then, ICAO has continued to harmonize area navigation (RNAV) performance criteria. AC 90-100A reflects these harmonized ICAO performance-based navigation criteria as well as lessons learned from the initial US RNAV implementation.	N/A	N/A	Explanatory text

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1.e Structure	e. Structure. After the initial paragraphs which include Terminology and References, this AC is structured as follows: <ul style="list-style-type: none"> o General Information (paragraph 6) o RNAV System Eligibility (paragraph 7) o RNAV System Approval Process (paragraph 8) o Operator Approval Process (paragraph 9) o Flight Crew Operating Procedures (paragraph 10) o Pilot Knowledge Requirements and Training (paragraph 11) o Criteria for RNAV Systems Using DME (Appendix 1) o Criteria for RNAV Systems Using DME and Inertial (Appendix 2) o Criteria for RNAV System Functionality (Appendix 3) 	N/A	N/A	Explanatory text
2.0 Cancellation	CANCELLATION. Advisory Circular 90-100, U.S. Terminal and En Route Area Navigation (RNAV) Operations, dated January 7, 2005, is canceled.		(S)TC Applicant	New applicants for a type certificate (TC) or supplemental type certificate (STC) must cancel any previous AFM statements regarding cancelled AC 90-100.
3.0 RELATED CODE OF FEDERAL REGULATIONS SECTIONS.	Title 14 of the Code of Federal Regulations (14 CFR), Part 91, sections 91.123 and 91.205; Part 95; Part 121, section 121.349; Part 125, section 125.203; Part 129, section 129.17; and Part 135, section 135.165.	N/A	N/A	Explanatory text
4.TERMINOLOGY .	For the purpose of operations on RNAV routes and procedures, the following definitions are provided:	N/A	N/A	Title Line
4.a Aircraft-Based Augmentation System (ABAS)	a. Aircraft-Based Augmentation System (ABAS). A system augmenting and/or integrating information obtained from other GNSS elements with information on board the aircraft. The most common form of ABAS is receiver autonomous integrity monitoring (RAIM).	N/A	N/A	Explanatory text
4.b Area Navigation (RNAV).	A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these. For the purposes of this AC, the specified RNAV accuracy must be met 95% of the flight time.	N/A	N/A	Explanatory text
4.b(1) RNAV 1	b(1) RNAV 1 requires a total system error of not more than 1 NM for 95% of the total flight time.	N/A	N/A	Explanatory text
4.b(2) RNAV 2	b(1) RNAV 2 requires a total system error of not more than 2 NM for 95% of the total flight time.	N/A	N/A	Explanatory text
4.c. Area Navigation (RNAV) System.	a. Area Navigation (RNAV) System. This AC only addresses RNAV systems using positioning inputs from GPS/GNSS and DME, and IRU. Criteria for RNAV systems are discussed in appendix 1 and 2. Criteria for RNAV system functionality is discussed in appendix 3.	N/A	N/A	Explanatory text

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4.d Critical DME	a. Critical DME. A DME facility that, when unavailable, results in navigation service which is insufficient for DME/DME/IRU supported operations along a specific route or procedure. The required performance assumes an aircraft's RNAV system meets the minimum standard (baseline) for DME/DME RNAV systems found in appendix 1, or the minimum standard for DME/DME/IRU systems found in appendix 2. For example, terminal RNAV DPs and STARs may be published with only two DMEs, in which case, both are critical.	N/A	N/A	Explanatory text
4.e DME/DME (D/D) RNAV	e. DME/DME (D/D) RNAV refers to navigation using DME ranging from at least two DME facilities to determine position.	N/A	N/A	Explanatory text
4.f DME/DME/Inertial (D/D/I)	f. DME/DME/Inertial (D/D/I) RNAV refers to navigation using DME ranging from at least two DME facilities to determine position along with use of an inertial reference unit (IRU) to provide sufficient position information during limited DME gaps.	N/A	N/A	Explanatory text
4.g Flight Technical Error (FTE)	g. Flight Technical Error (FTE). Accuracy with which an aircraft is controlled, as measured by the indicated aircraft position with respect to the indicated command or desired position. It does not include procedural blunder errors.	N/A	N/A	Explanatory text
4.h Global Navigation Satellite System (GNSS)	h. Global Navigation Satellite System (GNSS). The GNSS is a worldwide position and time determination system, which includes one or more satellite constellations, aircraft receivers, and system integrity monitoring. GNSS is augmented as necessary to support the required navigation performance for the actual phase of operation.	N/A	N/A	Explanatory text
4.i Global Positioning System (GPS)	i. Global Positioning System (GPS). The U.S. GNSS core satellite constellation providing space-based positioning, velocity, and time. GPS is composed of space, control, and user elements.	N/A	N/A	Explanatory text
4.j Position estimation error (PEE)	j. Position estimation error (PEE). Difference between true position and estimated position.	N/A	N/A	Explanatory text
4.k Receiver Autonomous Integrity Monitoring (RAIM)	k. Receiver Autonomous Integrity Monitoring (RAIM). A technique used within a GPS receiver/processor to monitor GPS signal performance. This integrity determination is achieved by a consistency check among redundant measurements.	N/A	N/A	Explanatory text
4.l RNAV Procedure	l. RNAV Procedure. An RNAV Instrument Departure Procedure or RNAV Standard Terminal Arrival.	N/A	N/A	Explanatory text
4.l(1) Instrument Departure Procedure	l (1) Instrument Departure Procedure. A DP is a published IFR procedure providing obstruction clearance from the terminal area to the en route structure. There are two types of DPs: Standard Instrument Departures (SIDs) and Obstacle Departure Procedures (ODPs).	N/A	N/A	Explanatory text

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4.l(1)(i) Instrument Departure Procedure	4.l(1)(i) Standard Instrument Departure (SID). A SID is a published IFR air traffic control (ATC) departure procedure providing obstacle clearance and a transition from the terminal area to the en route structure. SIDs are primarily designed for air traffic system enhancement to expedite traffic flow and to reduce pilot/controller workload.	N/A	N/A	Explanatory text
4.l(1)(ii) Obstacle Departure Procedure (ODP).	4.l(1)(ii) Obstacle Departure Procedure (ODP). A preplanned instrument flight rule (IFR) departure procedure printed for pilot use in textual or graphic form to provide obstruction clearance via the least onerous route from the terminal area to the appropriate en route structure. ODPs are recommended for obstruction clearance and may be flown without ATC clearance unless an alternate departure procedure (SID or radar vector) has been specifically assigned by ATC.	N/A	N/A	Explanatory text
4.l(2) Standard Terminal Arrival (STAR)	4.l(2) Standard Terminal Arrival (STAR). A STAR is a published IFR air traffic control arrival procedure that provides a transition from the en route structure to the terminal area. STARs may include one or more runway transitions providing guidance to either a standard instrument approach procedure or a point in space from which radar vectors are provided by ATC.	N/A	N/A	Explanatory text
4.m RNAV Route	m. RNAV Route. An RNAV route ("Q" or "T"), within the high or low altitude structure of the Contiguous United States, requiring system performance by GPS/GNSS or DME/DME/IRU RNAV systems, as required.	N/A	N/A	Explanatory text
4.n. Total System Error	n. Total System Error. The difference between the true position and the desired position. This error is equal to the vector sum of the path steering error, path definition error, and position estimation error.	N/A	N/A	Explanatory text
5. References	(NOTE: All references to the edition are current as of the publication date of this AC).	N/A	N/A	Explanatory text
6. General Information on RNAV 1 and RNAV 2 Operations	General Information on RNAV 1 and RNAV 2 Operations	N/A	N/A	Title line
6.a Operation on U.S. RNAV routes, DPs, and STARs:	6.a Operation on U.S. RNAV routes, DPs, and STARs:		Operator	
6.a(1)	a(1) Relies on normal descent profiles and identifies minimum segment altitude requirements;	N/A	N/A	
6.a(1) Note	NOTE: Pilots operating aircraft with an approved Baro-VNAV system may continue to use their Baro-VNAV system while executing U.S. RNAV routes, DPs, and STARs. Operators must ensure compliance with all altitude constraints as published in the procedure by reference to the barometric altimeter.		Operator	

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6.a(2)	a(2) Does not require the pilot to monitor ground-based NAVAIDs used in position updating unless required by the Airplane Flight Manual (AFM), Pilot Operating Handbook (POH), or the operating manual for their avionics;		Operator	According to the AFM, POH, or operating manual, as applicable
6.a(3)	a(3) Bases obstacle clearance assessments on the associated required system performance; and	N/A	N/A	
6.a(4)	a(4) Guidance in this AC does not supersede appropriate operating requirements for equipage. For example, Part 91 can have a single RNAV system, and Part 121 can have a single RNAV system and another independent navigation system allowing safe flight to a suitable alternate airport.		New (S)TC applicant and Operator	
6.b	b. The DME navigation infrastructure supporting the design of an RNAV route or procedure has been assessed and validated by the FAA. This includes analysis by FAA flight inspection assets. DME coverage may use Expanded Service Volume (ESV) for select DME facilities so there is no requirement to use VOR, LOC, NDB, or AHSR during normal operation of the DME/DME RNAV system. ESV facilities require a satisfactory flight inspection prior to use.	N/A	N/A	
6.b(1)	b(1) DME signals are considered to meet signal-in-space accuracy tolerances everywhere the signals are received.	N/A	N/A	Assumption
6.b(2)	b(2) For RNAV operations where reliance is placed upon the IRU, some aircraft systems temporarily revert to VOR/DME-based navigation before reverting to inertial coasting. When the VOR is within 40 NM from the route/procedure and there is insufficient DME/DME navigation infrastructure, the impact of VOR radial accuracy has been evaluated by the FAA and determined to not affect aircraft position accuracy.		Installed equipment, new (S)TC applicant, and operator	Applicable only to installations with DME/DME/IRU. In FMS 3.3.1 and later versions, the FMS annunciates "CHK POS" in yellow on the PFD and "VOR/DME DIST >40.0NM" in yellow on the CDU when navigation is based solely on a VOR/DME that is greater than 40.0NM from the aircraft position. The AFM or POH, as applicable, should contain a statement prohibiting AC 90-100A RNAV operations when this condition exists.
6.b(3)	b(3) The available navigation infrastructure supporting the procedure will be clearly designated on all appropriate charts (for example, GPS or DME/DME/IRU).		Operator	It is the operator's responsibility to only operator on routes for which the installed equipment is capable and authorized. FMS versions prior to FMS 3.3.1 are not capable of AC 90-100A operations with DME/DME/IRU.
6.b(4)	(4) The FAA will monitor the navigation infrastructure and issue timely warnings of outages (NOTAM).		Operator	It is the operator's responsibility to operate in accordance with NOTAMs.
6.b(5)	b(5) The navigation standard (for example, RNAV 1 or RNAV 2) required for all RNAV procedures/routes will be clearly designated on all appropriate charts. However, SIDs, ODPs, and STARs will be flown with RNAV 1 procedures.		Operator	It is the operator's responsibility to operate in accordance with RNAV 1 procedures on SIDs, ODPS, and STARs.

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6.b(6)	b(6) All routes and procedures referenced in this AC are intended to be flown by DME/DME/IRU and/or GPS/GNSS equipped aircraft meeting the performance requirements in this AC.		Operator	It is the operator's responsibility to only operator on routes for which the installed equipment is capable and authorized. FMS versions prior to FMS 3.3.1 are not capable of AC 90-100A operations with DME/DME/IRU.
6.c	6.c If any critical DME facilities exist, they are identified within the relevant U.S. Flight Information Publications (FLIP).		Operator	Applicable to FMS 3.3.1 and later versions when operations are based on DME/DME/IRU navigation. The operator should be aware that the availability of critical DMEs (NOTAM conditions) will impact the ability of the FMS to perform DME/DME/IRU navigation. As separately identified herein, the FMS annunciates when navigation does not meet the requirements of AC 90-100A, including "IRS ONLY", or "CHK POS" with "VOR/DME DIST >40.0nm", or "FMS DR" when no position fixing sensors are available.
6.d	6.d Unless the RNAV route, DP, or STAR specifically requires GPS or GNSS equipage, aircraft on the RNAV route, DP, or STAR must be within ATC radar surveillance and communication.		Operator	
6.e	6.e. All DME ground stations maintained by the FAA and used to define the availability of these RNAV routes, DPs, and STARs comply with applicable ICAO standards.	N/A	N/A	
6.f	6.f. All routes/procedures must be based upon WGS 84 coordinates.	N/A	N/A	
6.g	g. The navigation data published for the routes, procedures and supporting navigation aids must meet the requirements of ICAO Annex 15.	N/A	N/A	
7.0 RNAV System Eligibility		N/A	N/A	Title Line
7.a	a. Aircraft with a statement of compliance to this AC in their Aircraft Flight Manual (AFM), Pilot Operating Handbook (POH), or the operating manual for their avionics meet the performance and functional requirements of this AC.		New (S)TC applicant or operator	
7.b	b. Aircraft with P-RNAV approval based on GNSS capability meet the functional requirements of this AC. Due to differences in radio navigation infrastructure in the United States, if the approval is based on DME/DME or DME/DME/IRU, the operator should ensure the equipment meets the criteria in appendix 1 or 2, as applicable.	According to AFM, POH, or operating manual, as applicable.	New (S)TC applicant or operator	All FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100 meet the JAA TGL-10 and FAA AC 90-96A equipment requirement for P-RNAV based on GNSS capability, provided there is no installed, intermixed equipment that is incompatible with the intermixed equipment requirements in JAA TGL-10 or FAA AC 20-138a.
7.c	c. The following systems meet many of the requirements defined in this AC. Such equipment still requires evaluation by the manufacturer against all the functional and performance requirements in this AC.	As stated below	As stated below	

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7.c (continued)	The RAIM prediction program should comply with the criteria in AC 20-138A, paragraph 12.	Yes	RAIM Prediction program	Options are 1) Collins RAIM Prediction program CPN 832-3443-008 or later, 2) FAA en route and terminal RAIM prediction website: www.raimprediction.net , 3) by contacting a Flight Service Station.
7.c(1)	c(1) Aircraft with TSO-C129/C129a sensor (Class B or C) and the requirements in a TSO-C115b FMS, installed for IFR use IAW AC 20-130A.	Yes, if GPS-4000 or GPS-4000A is installed for IFR use IAW AC 20-130A.	Installed equipment	
7.c(2)	c(2) Aircraft with TSO-C145a sensor, and the requirements in a TSO-C115b FMS, installed for IFR use IAW AC 20-130A or AC 20-138A.	Yes, if GPS-4000S is installed for IFR use IAW AC 20-130A.	Installation	
7.c(3)	c(3) Aircraft with TSO-C129/C129a Class A1 (without deviating from the functionality described in Appendix 3 of this document) installed for IFR use IAW AC 20-138 or AC 20-138A.	N/A	N/A	Class A1 does not apply to subject installations.
7.c(4)	c(4) Aircraft with TSO-C146a (without deviating from the functionality described in Appendix 3 of this document) installed for IFR use IAW AC 20-138A.	N/A	N/A	
7.c Note	NOTE: Refer to paragraph 5 for TSO and AC references.	N/A	N/A	
7.d	d. Aircraft with a statement from the manufacturer documenting compliance with the criteria in this AC (appendix 1 or 2, as applicable, and appendix 3) meet the performance and functional requirements of this AC. These statements should include the airworthiness basis for compliance. Compliance with the sensor requirements in paragraph 8 will have to be determined by the equipment or aircraft manufacturer, while compliance with the functional requirements in Appendix 3 may be determined by the manufacturer or by inspection by the operator.		OEM, (S)TC applicant, or Operator	
7.d Note 1	NOTE 1: Aircraft with a demonstrated RNP capability will announce when no longer satisfying the performance requirement associated with the operation. However, for DME/DME/IRU-based procedures, the manufacturer still has to determine compliance with appendix 1 or 2 to support evaluation of the DME infrastructure.	N/A	N/A	

<i>Source Para</i>	<i>Requirement</i>	<i>Compliant?</i>	<i>Applicability</i>	<i>Notes and Comments</i>
7.d Note 2	NOTE 2: Aircraft with a TSO-C129 GPS sensor and a TSO-C115 or C115a FMS may not meet all of the requirements defined in this AC. Such equipment would require further evaluation by the manufacturer against all the functional and performance requirements in this AC.	See comments	OEM or (S)TC applicant	FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100 are capable when installed with GPS-4000() and approved for IFR use in accordance with AC 20-130A. The FMS must be receiving useable GNSS signals. Aircraft must be operated in accordance with AC 90-100A, including use of flight director and/or autopilot. Operator must confirm validity Type 2 LOA for the navigation database for the intended operations. Reference: http://www.rockwellcollins.com/fms/navalerts.asp
8. RNAV System Approval Process	RNAV System Approval Process	N/A	N/A	
8.a	a. Navigation System Accuracy. The navigation system accuracy is dependent on the total system error, defined in paragraph 4 of this AC.	N/A	N/A	Explanatory text
8.a(1)	a(1) RNAV Routes: Aircraft operating on RNAV routes must maintain a total system error bounded by the RNAV value for 95% of the total flight time. A flight technical error (FTE) of 1.0 NM (95%) is acceptable for RNAV 2 operations. RNAV 2 will be used for en route unless otherwise specified.		OEM, (S)TC applicant, Operator	The installation is capable for FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100 equipment when installed with GPS-4000() and approved for IFR use in accordance with AC 20-130A. The FMS must be receiving useable GNSS signals. Aircraft must be operated in accordance with AC 90-100A, including use of flight director and/or autopilot. Note: FMS 3.3.1 and later versions meet the equipment requirements [of Appendix 2] for DME/DME/IRU, but the capability for DME/DME/IRU navigation has not yet been demonstrated.
8.a(2)	a(2) RNAV 1 DPs and STARs. Aircraft operating on RNAV 1 DPs and STARs must maintain a total system error of not more than 1 NM for 95% of the total flight time. An FTE of 0.5 NM (95%) is acceptable for RNAV 1 operations. RNAV 1 will appear on all RNAV SID and STAR charts.		OEM, (S)TC applicant, Operator	The installation is capable for FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100 equipment when installed with GPS-4000() and approved for IFR use in accordance with AC 20-130A. The FMS must be receiving useable GNSS signals. Aircraft must be operated in accordance with AC 90-100A, including use of flight director and/or autopilot. Note: FMS 3.3.1 and later versions meet the equipment requirements [of Appendix 2] for DME/DME/IRU, but the capability for DME/DME/IRU navigation has not yet been demonstrated.
8.b	b. Navigation Sensors. U.S. RNAV operations are based upon the use of RNAV equipment that automatically determines aircraft position in the horizontal plane using inputs from the following types of positioning sensors (no specific priority).	As stated in following subsections	As stated in following subsections	

<i>Source Para</i>	<i>Requirement</i>	<i>Compliant?</i>	<i>Applicability</i>	<i>Notes and Comments</i>
8.b(1)	b(1) Global Navigation Satellite System (GNSS) in accordance with TSO-C145a, TSO-C146a, and TSO-C129/C129a. Positioning data from other types of navigation sensors may be integrated with the GNSS data provided it does not cause position errors exceeding the total system error requirements. The use of GPS equipment approved to TSO-C129() is limited to those which include the minimum system functions specified in Appendix 3. As a minimum, integrity should be provided by ABAS. In addition, GPS stand-alone equipment should include the following additional functions: <ul style="list-style-type: none"> o Pseudorange step detection o Health word checking. 	See comments	Installed equipment	The installation is capable for FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100 equipment when installed with GPS-4000() and approved for IFR use in accordance with AC 20-130A. The FMS must be receiving useable GNSS signals.
8.b(1) (continued)	b(1) (continued) For procedures requiring GPS and/or aircraft approvals requiring GPS, if the navigation system does not automatically alert the flight crew of a loss of GPS, the operator must develop procedures to verify correct GPS operation.	See comments	Operator	The operator must recognize indications that either the FMS is not navigating with GPS or GPS operations are not authorized. The FMS automatically alerts the crew, including the following CDU messages: "GPS NOT AVAILABLE", "NO GPS RAIM", "GPS-FMS DISAGREE". Messages displayed on the PFD, in addition to the "MSG" for a new CDU message, include "IRS ONLY", "FMS DR", and "CHK POS". FMS 3.3.1 and later versions also display "V/D ONLY" or "CHK POS" on the PFD with "VOR/DME DIST >40.0NM" on the CDU, as appropriate.
8.b(2)	DME/DME RNAV equipment complying with the criteria in appendix 1. Based on current DME availability evaluations, coverage is not sufficient to support DME/DME RNAV operations without additional IRU augmentation or using GPS.	N/A	N/A	
8.b(3)	DME/DME/IRU RNAV equipment complying with the criteria in appendix 2.	See comments	Installed equipment	Applicable only to FMS 3.3.1 and later versions when installed as multi-sensor with DME and IRU equipment interfaces to the FMS. Note: FMS 3.3.1 and later versions meet the equipment requirements [of Appendix 2] for DME/DME/IRU, but the capability for DME/DME/IRU navigation has not yet been demonstrated at the aircraft system level.
8.b Note	NOTE: LORAN-C criteria have not been developed.	N/A	N/A	
8.c	Functional criteria listed in Appendix 3. The requirements of Appendix 3 help ensure aircraft RNAV system performance meets procedure design criteria.			Compliance is as detailed for Appendix 3
9.0 Operator Approval Process	Operator Approval Process		Operator	The operator must address compliance with this section.
10.0 U.S. RNAV Flight Crew Operation Procedures	U.S. RNAV Flight Crew Operation Procedures		Operator	The operator must address compliance with this section.

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11.0 Pilot Knowledge Requirements and Training	Pilot Knowledge Requirements and Training		Operator	The operator must address compliance with this section.
Appendix 1	Appendix 1. Criteria for Approval of Baseline Area Navigation (RNAV) Systems Using Distance Measuring Equipment (DME)		Installed equipment	Applicable on the FMS 3.3.1 and later versions when installed as multisensor with DME equipment interfaces to the FMS in accordance with AC 20-130A.
Appendix 2	Appendix 2. Criteria for Approval of Baseline Area Navigation (RNAV) Systems Using Distance Measuring Equipment (DME) and Inertial Reference Unit		Installed equipment	Applicable on the FMS 3.3.1 and later veresions when installed as multisensor with DME and IRU equipment interfaces to the FMS in accordance with AC 20-130A.
Appendix 3	Appendix 3. Navigation Displays and Functions	As detailed in the following subsections	Installed Equipment	
Appendix 3, 1.	Navigation data, including a to/from indication and a failure indicator, must be displayed on a lateral deviation display such as CDI, (E)HSI and/or a navigation map display. These shall be used as primary flight instruments for the navigation of the aircraft, for maneuver anticipation and for failure/status/integrity indication. They shall meet the following requirements:	Yes	Installed Equipment	
Appendix 3, 1.a	1.a Non-numeric lateral deviation display (for example, CDI, (E)HSI), with a To/From indication and a failure annunciation, for use as primary flight instruments for navigation of the aircraft, for maneuver anticipation, and for failure/status/integrity indication, with the following five attributes:	Yes	Installed Equipment	
Appendix 3, 1.a(1)	1.a(1) The displays shall be visible to the pilot and located in the primary field of view (± 15 degrees from pilot's normal line of sight) when looking forward along the flight path.	See comments	Installed Equipment	Yes, provided the equipment is installed in accordance with AC 20-130A
Appendix 3, 1.a(2)	1.a(2)The lateral deviation scaling should agree with any alerting and annunciation limits, if implemented.	See comments	Installed Equipment	Yes. The FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100, perform the normal function of stand-alone GNSS equipment when in stalled with GPS-4000(). Terminal Lateral Deviation scaling and GNSS Horizontal Alert Limit is 1nm within 30nm of the origin or destination airport. En route Lateral Deviation scaling is 5nm with a GNSS Horizontal Alert Limit of 2nm. FMS 3.3.1 and later versions have appropriate annunciations related to DME/DME/IRU navigation as detailed herein for other items.
Appendix 3, 1.a(3)	1.a(3) The lateral deviation display must also have a full-scale deflection suitable for the current phase of flight and must be based on the required total system accuracy.	See comments	Installed Equipment	Yes, as detailed Appendix 3, item 1.a(2)

<i>Source Para</i>	<i>Requirement</i>	<i>Compliant?</i>	<i>Applicability</i>	<i>Notes and Comments</i>
Appendix 3, 1.a(4)	1.a(4) The display scaling may be set automatically by default logic or set to a value obtained from a navigation database. The full-scale deflection value must be known or must be available for display to the pilot commensurate with en route or terminal values.	See comments	Installed Equipment	Yes, as detailed Appendix 3, item 1.a(2)
Appendix 3, 1.a(5)	(5) The lateral deviation display must be automatically slaved to the RNAV computed path. The course selector to the deviation display should be automatically slewed to the RNAV computed path or the pilot must adjust the OBS or HSI selected course to the computed desired track.	Yes	Installed Equipment	
Appendix 3, 1.a Note	NOTE: The normal function of stand-alone GNSS equipment meets this requirement.	N/A	Installed Equipment	When installed with GPS-4000(), the FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100 perform the normal function of stand-alone GNSS equipment detailed for other items in Appendix 3.
Appendix 3, 1.b	1.b If using a navigation map display, it should give equivalent functionality to a lateral deviation display as described above, (Appendix 3, paragraph 1.a. (1-5)), readily visible to the pilot, with appropriate map scales (scaling may be set manually by the pilot).	See comments	Installed Equipment	The CDI/HSI is used for navigation, not the FMS map display. The map display is readily visible to the pilot and has appropriate scales which may be set manually by the pilot.
Appendix 3, 2.	2. The following system functions are required as a minimum within RNAV equipment:	As detailed in the following subsections	Installed Equipment	
Appendix 3, 2.a	a. The capability to continuously display to the pilot flying, on the primary flight instruments for navigation of the aircraft (primary navigation display), the RNAV computed desired path and aircraft position relative to the path.	Yes	Installed Equipment	
Appendix 3, 2.b	b. For operations where the required flight crew is two pilots, means for both pilots to verify the desired path and the aircraft position relative to the path.	Yes	Installed Equipment	
Appendix 3, 2.c	c. A navigation database, containing current navigation data officially promulgated for civil aviation, which can be updated in accordance with the Aeronautical Information Regulation and Control (AIRAC) cycle and from which terminal airspace procedures can be retrieved and loaded into the RNAV system. The stored resolution of the data must be sufficient to achieve the required total system error. The database must be protected against pilot modification of the stored data.	See comments	Operator and Installed equipment	The equipment complies when a current navigation database is loaded for which a Type 2 LOA is valid. It is the operator's responsibility that the loaded navigation database be current and that the Type 2 LOA for the navigation database be valid for the U.S. RNAV routes and/or procedures. Refer to http://www.rockwellcollins.com/fms/naalerts.a.sp regarding Type 2 LOA for navigation databases delivered by Rockwell Collins, Inc.
Appendix 3, 2.d	The means to display the validity period of the navigation data to the pilot.	Yes	Installed equipment	
Appendix 3, 3.	3. The means to retrieve and display data stored in the navigation database relating to individual waypoints and navigation aids, to enable the pilot to verify the route/procedure to be flown.	Yes	Installed equipment	

<i>Source Para</i>	<i>Requirement</i>	<i>Compliant?</i>	<i>Applicability</i>	<i>Notes and Comments</i>
Appendix 3, 4.	4. The entire RNAV segment of the DP or STAR to be flown must be extracted from the navigation database. In this document, the RNAV segment begins at the first occurrence of a named waypoint, track, or course and ends at the last occurrence of a named waypoint, track, or course. Heading legs, prior to the first named waypoint or after the last named waypoint of a procedure, are not part of the RNAV segment and do not have to be loaded from the database. Similarly, direct-to-fix legs prior to the first named waypoint of a procedure are not part of the RNAV segment. While not required, the ability to extract the entire RNAV procedure, including heading and direct-to-fix legs, from the database is a recommended function.	See comments	Operator and Installed equipment	The FMS-3000, FMS-4200, FMS/AMS-5000, FMS-6000, and FMS-6100 extracts the entire RNAV segment from the navigation database, as coded in the navigation database, including any heading or direct-to legs coded in the navigation database. It is the operators responsibility to operate the FMS using the data extracted from the navigation database.
Appendix 3, 5.	5. The means to display the following items, either in the pilot's primary field of view, or on a readily accessible page on a multi-function control display unit (MCDU).	As detailed in the following subsections	Installed equipment	
Appendix 3, 5.a	5.a The active navigation sensor type	Yes	Installed equipment	
Appendix 3, 5.b	5.b The identification of the active (To) waypoint	Yes	Installed equipment	
Appendix 3, 5.c	5.c The ground speed or time to the active (To) waypoint	Yes	Installed equipment	
Appendix 3, 5.d	5.d The distance and bearing to the active (To) waypoint	Yes	Installed equipment	
Appendix 3, 6	6. Where the MCDU is used to support accuracy checks by the pilot, the capability of displaying lateral deviation with a resolution of at least 0.1 NM.	Yes	Installed equipment	The CDU PROGRESS page 2/2 displays numeric lateral deviation with a resolution of 0.01 NM.
Appendix 3, 7	7. The capability for the navigation system to execute a "Direct to" function.	Yes	Installed equipment	
Appendix 3, 8	8. The capability for automatic leg sequencing with display of sequencing to the pilot.	Yes	Installed equipment	LEGS page 1 displays the toggle selection SEQUENCE AUTO/INHIB. The FMS annunciates SEQ INHB on the PFD when sequencing is inhibited other than for a discontinuity.
Appendix 3, 9	9. The capability to execute procedures extracted from the onboard database including the capability to execute fly-over and fly-by turns.	Yes	Installed equipment	
Appendix 3, 10	10. The capability to execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators:	As detailed in the following subsections	Installed equipment	
Appendix 3, 10a	10.a. The aircraft must have the capability to automatically execute leg transitions and maintain tracks consistent with the following ARINC 424 path terminators, or their equivalent: <ul style="list-style-type: none"> • Initial Fix (IF) • Course to Fix (CF) • Direct to Fix (DF) • Track to Fix (TF) 	Yes	Installed equipment	

<i>Source Para</i>	<i>Requirement</i>	<i>Compliant?</i>	<i>Applicability</i>	<i>Notes and Comments</i>
Appendix 3, 10a Note 1	NOTE 1: Path terminators are defined in ARINC Specification 424, and their application is described in more detail in RTCA documents DO 236B and DO-201A.	N/A	N/A	Explanatory text
Appendix 3, 10a Note 2	NOTE 2: Numeric values for courses and tracks must be automatically loaded from the RNAV system database. However, automatic CF capability is not required for approval to fly: (1) all RNAV routes covered by this AC as these are constructed using TF path terminators, or (2) those ODPs using a DF or TF path terminator for the first segment.	Yes	Installed equipment	Full CF leg capability from the navigation database is provided.
Appendix 3, 10b	10.b. The aircraft must have the capability to automatically execute leg transitions consistent with VA, VM and VI ARINC 424 path terminators, or must be able to be manually flown on a heading to intercept a course or to go direct to another fix after reaching a procedure-specified altitude.	Yes	Installed equipment	Full VA, VM, and VI capability from the navigation database is provided.
Appendix 3, 10c	10.c The aircraft must have the capability to automatically execute leg transitions consistent with CA and FM ARINC 424 path terminators or the RNAV system must permit the pilot to readily designate a waypoint and select a desired course to or from a designated waypoint.	Yes	Installed equipment	Full CA and FM capability from the navigation database is provided.
Appendix 3, 11	11. The capability to load a named RNAV route into an RNAV system from the database is a recommended function. However, if all or part of the RNAV route (not DP or STAR) is entered through the manual entry of fixes from the navigation database, a TF leg type must be used to define the path between a manually entered by name fix and the preceding and following fixes.	Yes	Installed equipment	Full route capability from the navigation database is provided. If instead the pilot uses manual entry of fixes from the navigation database, the FMS defaults to the TF leg type to define the path, as described for this item.
Appendix 3, 12	12. The capability to display an indication of the RNAV system failure, including the associated sensors, in the pilot's primary field of view.	Yes	Installed equipment	Refer to AFM, POH, operators manual, or FMS Pilots Guide, as appropriate.
Appendix 3, 13	For multi-sensor systems, capability for automatic reversion to an alternate RNAV sensor if the primary RNAV sensor fails. NOTE: This does not preclude providing a means for manual navigation source selection.	See comments	Installed equipment	Yes, for systems installed as multi-sensor with DME and/or IRU.
Appendix 3, 14	15. Database Integrity. The navigation database should be obtained from a database supplier holding an FAA Letter of Acceptance (LOA) in accordance with AC 20-153. This LOA provides recognition of a data supplier's compliance with the data quality, integrity and quality management practices of RTCA DO-200A, Standards for Processing Aeronautical Data. The operator's supplier (e.g., FMS manufacturer) must have a Type 2 LOA.	See comments	Rockwell Collins, Inc	Type 2 LOA validity for the current navigation database as delivered by Rockwell Collins, Inc, is available at http://www.rockwellcollins.com/fms/navalerts.asp

<i>Source Para</i>	<i>Requirement</i>	<i>Compliant?</i>	<i>Applicability</i>	<i>Notes and Comments</i>
Appendix 3, 14 (continued)	Discrepancies that invalidate a procedure must be reported to the database supplier and affected procedures must be prohibited by an operator's notice to its flight crew. Aircraft operators should consider the need to conduct ongoing checks of the operational navigation databases in order to meet existing quality system requirements. NOTE: AC 20-153 contains procedures for database LOAs.		Operator	
Appendix 3, 15	15. It is recommended RNAV systems provide lateral guidance so aircraft remain within the lateral boundaries of the fly-by transition area as defined in DO-236B, section 3.2.5.4.1.	See comments	Operator, installed equipment, airframe aerodynamics, and environmental conditions	The installed equipment performs as recommended within the operational and design limitations. Operational conditions, such as selecting HALF BANK or TURB autopilot modes, impact the ability of the installed equipment to comply. Operational and environmental conditions, such as airspeeds and wind resulting in high ground speeds, also impact the ability to comply.