

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 91

[Docket No. 26112; Notice No. 90-2]

RIN 2120-AD26

Sole Radio Navigation System;
Minimum Standards for CertificationAGENCY: Federal Aviation
Administration, DOT.ACTION: Advance notice of proposed
rulemaking.

SUMMARY: The Federal Aviation Administration (FAA) is developing a regulation that will establish minimum standards under which a radio navigation system may be certified as the sole radio navigation system required in an aircraft conducting instrument Flight Rules (IFR) en route, and terminal area operations, including nonprecision approach, in controlled airspace in the United States. The regulation is being developed in response to the Airport and Airway Safety and Capacity Expansion Act of 1987.

A sole radio navigation system is a radio navigation system that would be used to conduct IFR en route and terminal area operations, including nonprecision approach, in controlled airspace without the need for any other navigation system. Use of such a system, once approved, would be optional. Because of the difficulty or resolving complex technical considerations, the FAA is inviting comments on the appropriate form and content of minimum standards for certifying such a system.

DATE: Comments must be submitted on or before May 22, 1990.

ADDRESS: Comments on this advance notice of proposed rulemaking should be mailed or delivered, in triplicate, to: Federal Aviation Administration, Office of Chief Counsel, Attn.: Rules Docket (AGC-10), Room 915-G, Docket No. 26112, 800 Independence Ave., SW., Washington, DC 20591.

Comments may be examined in the Rules Docket, Room 915-G, weekdays (except Federal holidays) between 8:30 a.m. and 5 p.m.

FOR FURTHER INFORMATION CONTACT: Roy Grimes, Flight Standards Service (AFS-430), Federal Aviation Administration, 800 Independence Ave., SW., Washington, DC 20591; telephone (202) 267-3722.

SUPPLEMENTARY INFORMATION:

Comments Invited

This advance notice of proposed rulemaking (ANPRM) is being issued in accordance with the FAA's policy of encouraging early public participation in rulemaking proceedings. An ANPRM is issued when there is a need or a requirement to consider rulemaking but reasonable outside inquiry and FAA resources do not provide a sufficient basis upon which to propose a specific course of action. It is helpful, therefore, to invite public participation in identifying and selecting a course of action before a Notice of Proposed Rulemaking (NPRM) is developed and issued.

Interested persons are invited to participate in these preliminary rulemaking procedures by submitting such written data, views, or arguments as they desire. Comments that provide the factual basis supporting the views and suggestions presented are particularly helpful in developing reasoned regulatory decisions on the proposal.

Availability of Document

Any interested person may obtain a copy of this ANPRM by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Inquiry Center (APA-430), 800 Independence Ave., SW., Washington, DC 20591, or by calling (202) 267-3484. Requests must identify the notice number of this ANPRM.

Persons interested in being placed on the mailing list for future proposed rules should request from the above office a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

Background

This advance notice or proposed rulemaking discusses—

1. The FAA's study efforts since the enactment of Public Law 100-223.
2. The overall objectives of air navigation.
3. Current regulations pertaining to air navigation (both generic and equipment-specific).
4. The FAA's proposed actions regarding—
 - a. Development of regulations appropriate to all types of navigation systems (ground-based and space-based);
 - b. Revision and update of current regulations to accommodate all types of navigation systems; and
 - c. Establishment of the criteria (navigation system characteristics) by which a system could be judged capable

of serving as the sole means of navigation within the National Airspace System (NAS).

Introduction

Instrument Flight Rules (IFR) navigation within the National Airspace System (NAS) is currently based on Very High Frequency Omnidirectional Radio (VOR) and VOR/Distance Measuring Equipment (DME). An operator who wishes to navigate from a departure airport to a destination airport under IFR (on a route that is based on VOR) is authorized to do so if the aircraft is equipped with VOR or VOR/DME equipment (depending on the proposed altitude), and that equipment is operable. (If the intended route is based on nondirectional beacon (NDB), then automatic direction finder (ADF) airborne equipment is required also.) VOR and VOR/DME may be used to conduct en route, terminal, and nonprecision approach operations without reference to any other navigation aid. Thus, the VOR and VOR/DME systems currently serve as a sole means of Instrument Flight Rules (IFR) navigation for those phases of flight in the NAS today.

In the near future, other navigation systems may prove capable of providing the same function as VOR/DME. For example, Loran C and Global Positioning System (GPS), or a hybrid of the two systems, may prove to be equivalent to VOR/DME in navigation system capability. It is the FAA's task to develop the criteria by which a navigation system will be judged capable of fulfilling the functions of VOR/DME. When the criteria are developed for a navigation system such as GPS, an aircraft could use that equipment to conduct IFR operations during the en route, terminal, and nonprecision approach phases of flight.

Public Law 100-223 requires that the FAA establish by regulation the criteria by which a navigation system would be judged to be capable of serving the function that VOR/DME fulfills today. This ANPRM seeks public comment to aid the FAA in implementing the provisions of Public Law 100-223.

FAA Efforts Since Enactment of Public Law 100-223

Section 310(c) of the Airport and Airway Safety and Capacity Expansion Act of 1987 (Pub. L. 100-223) requires that—

Not later than September 30, 1989, the Administrator shall establish by regulation minimum standards under which a radio navigation system may be certified as the sole radio navigation system required in an

aircraft for operation in airspace in the United States.

For the past 18 months, the FAA has been studying generic performance criteria (minimum standards) for airworthiness and operational approval of a radio navigation system required in an aircraft for IFR operation in the NAS. The FAA has studied requirements for en route and terminal area operations (including nonprecision approach). This study has required the evaluation of ground and space-based navigational system characteristics (such as signal coverage, reliability, integrity, and accuracy), as well as the evaluation of airborne navigation equipment. The FAA has considered not only single source systems (for example, Loran C) but also hybrid systems (such as a combination of Inertial Navigation System (INS), Loran C, and/or GPS). Also, in order to prepare for the application of GPS, the FAA has expanded its study to include the criteria for en route oceanic operations. The FAA has not included the study of precision approach criteria in its study because it does not foresee navigation systems other than Instrument Landing System (ILS) and Microwave Landing System (MLS) providing precision approach capability any time in the near future.

Because of the complexity of the task assigned to the FAA by Public Law 100-223 and the far-reaching consequences of its resolution, the FAA believes it is in the best interest of the public and the aviation community to seek comments before proceeding further with its efforts.

Objectives of Air Navigation

In aviation, navigation systems must satisfy two safety objectives. The first objective is to enable an aircraft to avoid all obstacles while en route. The second objective is to enable the pilot to align the aircraft with an intended route with enough precision to permit Air Traffic Control (ATC) to separate aircraft and prevent collisions.

In order to satisfy these two objectives, the Federal Aviation Administration and the International Civil Aviation Organization (ICAO) apply the following concepts. These concepts are fundamental to the FAA's Federal Aviation Regulations (FAR) and the ICAO's Standards and Recommended Practices (SARP) that regulate air navigation operations and requirements for air navigation equipment. The purpose of the FAR and the SARP is to establish requirements through which the objectives of navigation are met. The concepts are—

1. *ATC clearance*—When an air traffic controller issues an IFR clearance, he agrees to reserve a three-dimensional block of airspace along the route defined in the clearance. If the aircraft deviates outside that airspace, the deviation creates a potential hazard.

2. *Navigation performance*—Navigation performance is measured by the deviation (for any cause) from the exact centerline of the route and altitude specified in the ATC clearance. Such deviation includes errors due to design and maintenance of ground and airborne equipment and errors due to flight crew competency.

3. *Degree of navigational accuracy required for control of air traffic*—An aircraft is required to remain within a three dimensional block of airspace assigned by ATC. Should the aircraft deviate outside the assigned block of airspace for any reason, then it has not been navigated to the degree of accuracy required for Air Traffic Control.

Advisory Circular 90-45A—Approval of Area Navigation Systems for Use in the U.S. National Airspace System

Prior to discussing regulations pertaining to air navigation, it is important to understand the status of Advisory Circular (AC) 90-45A, Approval of Area Navigation Systems for Use in the U.S. National Airspace System (NAS). Advisory Circular 90-45A establishes a means to obtain airworthiness approval of navigation systems and procedures for Area Navigation System (RNAV) operations. Area Navigation Systems certified in accordance with the criteria listed in AC 90-45A can be used to conduct IFR en route, terminal, and nonprecision approach operations within the NAS. Area Navigation System equipment and operations are approved using AC 90-45A criteria, but current air navigation regulations provide the basis for compliance and enforcement.

Current Air Navigation Regulations

The following discussion of air navigation regulations is not intended to be exhaustive; however, it does cover the more important regulations on equipment requirements. Note: The discussion of sections within part 91 of the FAR apply to the version of Part 91 currently in effect on the date of publication of this advance notice of proposed rulemaking in the Federal Register. A revised version of Part 91 was published on August 18, 1989 (54 FR 34284), and will become effective August 18, 1990.

Section 91.33(d)(2) of the FAR requires air navigation equipment to be

“appropriate to ground facilities to be used.” The current U.S. National Airspace System is based on VOR and VOR/DME ground facilities. Therefore, depending on the ground facilities to be used, VOR or VOR/DME equipment (depending on the proposed altitude), or an area navigation system which meets the criteria of AC 90-45A must be installed in an aircraft and must be operable if used for IFR flight in the NAS. If the route to be flown is based on NDB, then ADF airborne equipment is also required.

Section 91.33(e) of the FAR requires approved DME equipment when operating at or above 24,000 feet mean sea level (MSL) if the route or route segment is based on VOR; however, DME is not required when navigation is based on the use of an RNAV that meets AC 90-45A en route performance and reliability criteria (or the equivalent) without input from DME.

Section 91.123 of the FAR states that unless otherwise authorized by ATC, navigation on a Federal airway or on a direct course between fixes must be conducted on the centerline of the route.

Section 135.165 of the FAR establishes navigation equipment requirements for air taxi and commercial operators (under Part 135) conducting IFR operations in the NAS. This section requires that the aircraft be equipped with two independent receivers for navigation which are appropriate to the facilities to be used. Unless the route is navigated using an area navigation system certified for IFR flight in accordance with AC 90-45A, two independent VOR systems must be installed and operable if the route is based on VOR, and two independent ADF systems must be installed and operable if the route is based on NDB.

Sections 121.103 and 121.121 of the FAR address en route requirements for domestic, flag, and supplemental air carriers and commercial operators of large aircraft under part 121. These sections state that part 121 operators must demonstrate that nonvisual ground aids are available and located so as to allow navigation to the degree of accuracy required for ATC and for the type of operation involved. Nonvisual ground aids are electronic navigational aids (NAVAIDS) that include not only VOR, DME, and NDB but also Omega and Loran C.

Section 121.349 of the FAR requires that Part 121 aircraft be equipped to receive radio navigation signals from all primary en route and approach navigation facilities intended to be used. This regulation requires redundant airway navigation capability (VOR,

VOR/DME, NDB) to ensure the ability to navigate to the degree of accuracy required for air traffic control. Section 121.349 is intended to apply to routes based on VOR, VOR/DME, and NDB. Dual independent RNAV systems that are certified under AC 90-45A also meet the requirements of § 121.349 of the FAR.

Long Range Navigation Requirements

The following are the major regulations that are applicable to long range navigation requirements. The basic requirements for all operations outside the United States are established in part 91, General Operating and Flight Rules. Part 121, Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft, contains additional requirements. Part 135, Air Taxi Operators and Commercial Operators, does not contain additional requirements, however, as these are established in each operator's operations specifications.

Section 91.1 of the FAR states that each person operating a civil aircraft of U.S. registry over the high seas shall comply with "Annex 2—Rules of the Air" to the Convention on International Civil Aviation. Paragraph 5.1.1 of Annex 2 states that for all IFR flights the aircraft shall be equipped with suitable instruments and with navigation equipment appropriate to the route to be flown. Paragraphs 3.6.2.1.1 (a) and (b) restate the § 91.123 requirement that aircraft be operated on the centerline of an airway or on a direct route between fixes.

Section 91.20 of the FAR states that no person may operate an aircraft in North Atlantic Minimum Navigation Performance Specifications (MNPS) airspace unless the aircraft has approved navigation performance capability in accordance with Appendix C of FAR part 91.

Section 135.3 of the FAR states that while operating outside the United States, operators under FAR part 135 must comply with Annex 2 to the Convention on International Civil Aviation.

Sections 121.103 and 121.121 of the FAR, which establish basic requirements for airways navigation, also provide the basis for long range navigation. These sections state that each Part 121 operator must show that nonvisual ground aids are available and located to allow navigation to the

degree of accuracy required for ATC and for the type of operation involved. Long range navigation operations using Loran C, Omega, and, by extension, future operations using GPS, are conducted under these regulations. Sections 121.103 and 121.121 also provide for operation on en route segments where nonvisual ground aids are not required. These sections state that on these route segments either celestial or other specialized means of navigation may be used provided it is approved by the FAA.

Section 121.355 of the FAR states that for operations outside the United States, specialized means of navigation, such as INS or a Doppler radar navigation, must have been approved in accordance with Appendix G of part 121.

FAA's Proposed Actions

As stated previously, the FAA believes that it is in the best interest of the public and the aviation community to seek public comment prior to proceeding further with its rulemaking efforts. The FAA plans to undertake the following three actions to establish by regulation the minimum standards under which a radio navigation system may be certified as the sole radio navigation system required in an aircraft for conducting IFR en route and terminal area operations, including nonprecision approach, in controlled airspace in the United States.

1. Adopt revised regulatory standards that would accommodate new navigational systems in the NAS as paragraph (g) under § 91.33 (§ 91.205 as published August 18, 1989; 54 FR 34291) to read as follows:

Section 91.33 (section 91.205) Powered civil aircraft with standard category U.S. airworthiness certificates; instrument and equipment requirements

(g) *Radio navigation system rules (all airspace).* (1) For the purposes of this paragraph, a radio navigation system shall include the navigation facilities and the appropriate airborne instruments and navigation equipment necessary to navigate to the degree of accuracy required for the operation.

(2) No person may operate a civil aircraft of U.S. registry using the radio navigation system required for IFR operations under paragraph (d) of this section unless—

(i) The navigation equipment has been approved by the Administrator for IFR operations, and the operation is in compliance with any operating limitations relating to the use of the equipment;

(ii) The navigation equipment is appropriate to the navigation facilities to be used for navigation along the route to be flown; and

(iii) The navigation facilities have been approved by the Administrator and provide the coverage, integrity, accuracy, and any other characteristics identified by the Administrator as necessary for the operation and as required for Air Traffic Control.

2. Update existing rules to eliminate wording such as "ground" facilities, and eventually eliminate reference to specific systems such as VOR and DME. This would be a long-term measure.

3. Proceed with the development of navigation system criteria to be published as national policy.

The FAA has defined a list of parameters and criteria for evaluation of technical radio navigation system performance criteria (see the Radio Navigation System Parameters Table below). The FAA believes that this table, when complete, should be published as national policy in the form of generic and system-specific advisory circulars. This is in keeping with a precedent for establishing national policy in advisory circulars such as AC 90-45A.

The FAA believes that it can best serve the public and fulfill the requirements of Public Law 100-223 by using its resources to develop these advisory circulars. Draft circulars would be coordinated with the aviation community then published in the *Federal Register* for comment prior to final adoption.

The FAA believes that existing operational rules, revised as proposed, and the updating of national policy will provide an adequate basis for the regulation and certification of navigational systems.

Issue for Public Consideration

Comments are requested on the parameters against which any radio navigation system requirements, including hybrid systems, should be evaluated for each phase of flight. These parameters and some suggested values are shown in the Radio Navigation System Parameters Table below.

Comments are also requested on any other parameters which the FAA should consider prior to the development and issuance of a Notice of Proposed Rulemaking. Comments on this Advance Notice of Proposed Rulemaking must be received on or before May 22, 1990.

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RADIO NAVIGATION SYSTEM PARAMETERS

PARAMETER	OCEANIC ENROUTE	DOMESTIC ENROUTE	TERMINAL AREA	NON-PRECISION APPROACH	REMOTE AREAS	LOW ALTITUDE HELICOPTER
ACCURACY (2dRMS) 95-98% Probability	Better than 12.6nm	1000m	500m	100m	1000-4000m	500m
RELIABILITY	Near 100%					
INTEGRITY (Time to Alarm)	120s	60s	30s	10s	60s	30s
AVAILABILITY	Near 100%					
COVERAGE Near 100%	Route Being Flown	Controlled Airspace	Controlled Airspace	Defined Procedure Airspace	Route Being Flown	Route Being Flown
FIX RATE (Time)	10s	10s	10s	1s	10s	10s
FIX DIMENSIONS	Two Dimensions					
CAPACITY	Unlimited					
AMBIGUITY	Resolvable by Operator	None				
TIME TO RECOVER NAVIGATION	10s	5s	5s	2s	5s	5s
HUMAN OPERABILITY	Acceptable to the pilot for aircraft guidance and compliance with air traffic control instructions.					

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Radio Navigation System Parameters Defined

All of the systems considered are defined in terms of system performance parameters which determine the utilization and limitations of the individual navigation systems.

- Accuracy
- Availability
- Coverage
- Reliability
- Fix Rate
- Fix Dimension
- Capacity
- Ambiguity
- Integrity
- Time To Recover
- Human Operability

These parameters characterize the signal in space and are principally signal power levels, frequencies, signal formats, data rates, and any other data sufficient to completely define the means by which a user derives navigational information.

Accuracy

In navigation, the accuracy of an estimated or measured position of an aircraft at a given time is the degree of conformance of that position with respect to the geographic, or geodetic, coordinates of the earth. Since accuracy is a statistical measure of performance, it includes a statement of the uncertainty in position which applies. Two-dimensional accuracies use the 2 drms (distance root mean square) uncertainty estimate. Two drms is twice the radial error, drms. The radial error is defined as the root-mean-square value of the distances from the true location point of the position fixes in a collection of measurements.

Availability

The availability of a navigation system is the percentage of time that the services of the system are usable by the navigator. Availability is an indication of the ability of the system to provide usable service within the specified coverage area. Signal availability is the percentage of time that navigational signals transmitted from external sources are available for use. It is a function of both the physical characteristics of the environment and the technical capabilities of the transmitter facilities.

Coverage

The coverage provided by a radio navigation system is that surface area or space volume in which the signals are adequate to permit the navigator to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions and other factors which affect signal availability.

Reliability

The reliability of a navigation system is a function of the frequency with which failures occur within the system. It is the probability that a system will perform its function within defined performance limits for a specified period of time under given conditions. Formally, reliability is one minus the probability of system failure.

Fix Rate

The fix rate is defined as the number of independent position fixes or data points available from the system per unit time.

Fix Dimension

This characteristic defines whether the navigation system provides a linear, one-dimensional line-of-position, or a two- or three-dimensional position fix.

System Capacity

System capacity is the number of users that a system can accommodate simultaneously.

Ambiguity

System ambiguity exists when the navigation system identifies two or more possible positions of the vehicle, with the same set of measurements, with no indication of which is the most nearly correct position. The potential for system ambiguities should be identified along with a provision for users to identify and/or resolve them.

Integrity

Integrity is the ability of a system to provide timely warnings to users when the system should not be used for navigation.

Time To Recover Navigation

The time required for restoration of navigation service after signal interruption.

Human Operability

The navigation system is acceptable to the pilot for aircraft guidance and the pilot is able to comply with air traffic control instructions.

Regulatory Evaluation Summary

The FAA has determined that this proposal is significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). Based on the limited information available at this time, a regulatory evaluation of the economic impacts of this proposal is not currently feasible. A full regulatory evaluation will be prepared with the assistance of comments received as a result of this ANPRM and in conjunction with further rulemaking proceedings on this subject. In order to fully develop a regulatory evaluation, the FAA requests parties to comment on the costs, costs savings, and other benefits that may result from any proposed changes.

Federalism Implications

The regulations discussed herein, if adopted, would not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

List of Subjects in 14 CFR Part 91

Air traffic control, Aircraft, Airmen, Airports, Aviation safety.

Authority: 49 U.S.C. 1301(7), 1303, 1344, 1348, 1352 through 1355, 1401, 1421 (as amended by Pub. L. 100-223), 1422 through 1431, 1471, 1472, 1502, 1510, 1522, and 2121 through 2125; Articles 12, 29, 31, and 32(a) of the Convention on International Civil Aviation (61 Stat. 1180); 42 U.S.C. 4321 *et seq.*; E.O. 11514; Pub. L. 100-202; 49 U.S.C. 106(g) (Revised Pub. L. 96-449, January 12, 1983).

Issued in Washington, DC, on January 12, 1990.

Daniel C. Beaudette,

Director, Flight Standards Service.

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