



# ADVISORY CIRCULAR

## DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

SUBJECT: SELF -CONTAINED NAVIGATION SYSTEMS (LONG RANGE)

- 
1. PURPOSE. This Advisory Circular states an acceptable means, not the **only** means, of compliance with the referenced Sections of the FAR as they apply to persons operating under Parts **121** or **123** who desire approval of Doppler RADAR navigation systems or Inertial Navigation Systems (INS) for use in their operations.
  2. REFERENCES. Federal Aviation Regulations **121.355**, **121.389**, **121.411**, **121.412**, **121.413**, **121.415**, **121.417**, **121.418**, and AC **25-4**.
  3. CANCELLATION. Advisory Circulars **121-10** and **121-11** dated **3/23/67** are canceled.
  4. INFORMATION. Doppler RADAR and Inertial Navigation Systems (INS) are self-contained navigation systems which are not continuously dependent on information derived from ground-based or exterior aids. However, exterior aids, such as LORAN and **CONSOL** or Celestial Navigation are required for periodic updating of Doppler. Updating of Inertial is permissible if the operator so desires, provided the updating technique is demonstrated and approved, and accounted for in the determination of the absolute accuracy of the system. Requests for approval of INS **as** the sole means of navigation, or in combination with other **self-** contained aids, may be made. Adequate terminal ground-based radio navigational aids **are** necessary to support either INS or Doppler **approvals**. Under the provisions of FAR Sections **121.355** and **121.389**, **cockpit** navigation over international routes previously requiring a **navigator** may be approved using Doppler RADAR or Inertial Navigation Systems.
  5. GENERAL. The operator desiring approval for use of Doppler RADAR or Inertial Navigation Systems should contact the local Air Carrier District Office or International Field Office for advice in the preparation of an initial written request for FAA evaluation of its proposal. The information needed is described in item 6 of this
-

circular. Thirty days **saould** be allowed for review and **evaluation** of the initial request. Subsequent to approval of the initial request, the operator may submit an application for approval of operations specifications, en route flight procedures following the guidelines established in item 7 of this circular.

6. INITIAL REQUEST FOR EVALUATION. The initial request for evaluation of an operator proposal for use of Doppler RADAR or Inertial Navigation Systems should contain information concerning the following:
- a. Experience. Prior to presenting its initial request, **an operator** should have accumulated sufficient experience with the equipment to establish a history of the accuracy and reliability of the system **it** proposes to use. The applicant may include previous **or** related operational experience of other operators, and operational experience gained during type certification of the aircraft. Once a particular system has received an equipment approval, evaluation and approval **in** subsequent similar installations **may** be **adjusted** or omitted to avoid duplication of the lengthy accuracy and **reliability** data gathering process involved in **the issuance of the original approval.** A comprehensive **summary** of this experience should be provided to **show competency** in the operation and maintenance of the **equipment** and feasibility of the proposed operation.
  - b. Training Program. The operator should outline the training program he plans to set up to comply with Sections **121.411, 121.412, 121.413, 121.415, 121.417, and 121.418.** Under these rules, the training program for Doppler or Inertial Navigation Systems is acceptable if:
    - (1) It encompasses all phases of the operation and the responsibilities of flight crewmembers, dispatchers and maintenance personnel.
    - (2) Its technical content, for pilots, covers:
      - (a) Theory and procedures, limitations, detection of malfunctions, **pre-flight** and in-flight testing, cross-checking methods, etc., relating to the operation;
      - (b) The **use of** computers, an explanation of all **systems**, compass limitations at high latitudes, a review of navigation, flight planning and applicable meteorology;
      - (c) The methods for updating by means of reliable fixes; and,
      - (d) The actual plotting of fixes.

10/21/50

- (3) Its recurrent training program includes training and line checks using ~~the self-contained~~ navigation system.
- \* (4) ~~Each~~ pilot assigned as an operating ~~crewmember~~ completes as ~~many~~ trips over a route or area (either in actual operation, or in a simulator, or training ~~device, approved~~ for conducting the required pilot training and qualifications in the use of these systems) , under the supervision of a check airman, as may be necessary to: \*
- (a) Ensure his qualification in the system; and,
- (b) Enable certification of his proficiency in the system, as required by Section 121.401.
- (5) Training ~~of flight~~ crewmembers ~~is~~ acceptable during evaluation flights.
- c. Maintenance Program. The applicant should provide an outline of the training to be given maintenance personnel on the new equipment, proposed intervals for inspection and overhaul, test and inspection procedures as specified in Subpart L of FAR 121, the stationing of spare parts and test equipment, and revisions to the maintenance manual.
- d. Equipment Installation.
- (1) The installation should include a navigation computer for ~~each~~ Doppler RADAR or Inertial Navigation System required. Cockpit arrangement should be such as to afford easy viewing and ~~manipulation~~ of necessary controls consistent with priority of existing equipment.
- (2) Dual Inertial Navigation Systems (including navigational computers and reference units) are acceptable under FAR 121.355 when installed in accordance with the criteria set forth in AC 25-4. Dual Doppler RADAR equipment (including dual antennas or a ~~combined~~ antenna designed for dual operation) are also acceptable. For Doppler , a single operating transmitter with a standby capable of operation is acceptable in lieu of two operating transmitters.
- (3) When dual Doppler is installed, it will be permissible to utilize single heading source information to both equipments, providing a compass comparator system is installed, and operational procedures call for frequent cross-checks of all compass heading indicators by ~~crewmembers~~.

7/31/70

(4) Currently, other navigational aids are considered necessary to update the Doppler RADAR, such as LORAN, **CONSOL, DME, VOR** or **ADF**. Such facilities should be available for the proposed route and the cockpit arranged so as to **afford easy** manipulation of the necessary controls. If a **single** LORAN is used for this purpose, it should be accessible to both pilots at their duty stations.

(5) **Cockpit** arrangements should provide for adequate **lighting**, suitable charts, plotting, necessary forms and related equipment .

e. Operations Manual. Revisions to the Operations Manual should outline **all** normal and emergency procedures **relative to use of the** proposed system. Detailed methods for continuing the navigational **function** with partial or complete equipment failures, and methods for **determining** the most accurate system **when an unusually** large divergence occurs should be included.

f. Minimum Equipment List (MEL). A proposal for revising the operator's approved MEL should be included. Items which are not required to **be** opera **tive** for dispatch, including existing items which can affect the operation of the proposed **equipment, should be** fully justified on the basis of an acceptable Level of safety. Any exceptions should be as **specifically** itemized in the "\*Remarks" column of the minimum equipment list for the aircraft **concerned. In** any event, **the** operator's MEL should not authorize items **to be inoperative that are** not authorized by the Master MEL- If the proposal submitted by the operator should include such items, they should be referred to the proper **FOEB** with complete **justification** and recommendations for **necessary** action. \*

g. Routes or Areas.

(1) Each route or area being proposed for self-contained **cockpit** navigation should be analyzed with respect to length, **magnetic** compass reliability, availability of en route **aids, and** adequacy of gateway and terminal radio facilities to support **the** system used. Every available **facility, including radar,** should be used to **ensure navigational accuracy, particularly** where a route is proximate to restricted **airspace**.

(2) Routes based **on** heading information from slaved magnetic compasses **will not be** authorized for Doppler **navigation in** areas having a weak or unreliable earth **magnetic field. If** free-gyro **operation is** proposed ; detailed procedures for **transition** to, and use of **this** form of navigation, **should be applied\***

(3) The use of INS into **airports** at latitudes above **76° 30'** should be covered by procedures for **high** latitude platform realignment.

- (4) Precise coordinates accurate to within one minute of arc should be established for a designated geographic fixed position on each airport to be used for the establishment of alignment and insertion of present position data in the aircraft's INS prior to takeoff.
- h. Demonstration of Operational Ability. The operator should provide a schedule of flights which shows his ability to use cockpit navigation in his operations, instead of a navigator or a previously approved specialized means of navigation. During these flights, the pilots should navigate the aircraft using the self-contained system and their navigational duties should not encroach significantly on other required duties. The pilots should be relieved of any workload associated with any previously approved specialized means of navigation. This should be done by adding a navigator or other navigationally qualified flight crewmember as appropriate. This additional flight crewmember should track the flight independent of the Doppler or Inertial System, and give the information obtained to the pilot-in-command. The pilot-in-command decides if changes in course are necessary to remain within allowable navigational limits. Self-contained systems should not be used in Parts 121 or 123 operations until the agency approves amended operations specifications (see paragraph 7.a.). Systems installed and approved during type certification of the aircraft may secure operational approval during the aircraft proving flights.
- i. Equipment Accuracy and Reliability.
- (1) Self-contained navigation units should be maintained within the accuracies appropriate for the specific air route structures in which they are to be used and the accuracy tolerances specified in the operator's maintenance manual. Specifically, the accuracy appropriate for use over the North Atlantic has been considered as a maximum error of  $\pm 20$  nautical miles cross-track and  $\pm 25$  miles long-track for 95% of the flights completed.
- (2) Compass heading information to the Doppler RADAR should be maintained to an accuracy of  $\pm 1.0$  degree and total system deviation should not exceed 2 degrees.
- j. FM evaluation should ensure:
- (1) Adequacy of operational procedures.
- (2) Operational accuracy and reliability of equipment and feasibility of the system over proposed routes or areas.

- (3) **Availability** of terminal, gateway, area and en route **ground-based aids** to **support the self-contained system.**
- (4) **Acceptability** of **cockpit** workload.
- (5) Adequacy of flight crew qualifications.
- (6) Adequacy of maintenance training and placement of **spare** parts.

k. **FAA observations :**

- (1) Air carrier **operations inspectors** will observe • efficient **flight or simulator** qualification **checks** given to the first flight crews qualified during an **Initial evaluation program to ensure valid appraisal** of the **items listed** in paragraph **6.3.**
- (2) Inspectors will observe enough flight checks after operational approval to ensure that the operator **maintains** the overall quality of **his maintenance** and training programs.
- (3) When the **operator** applies for additional routes or areas, **inspectors** will **observe** enough **flights** to **ensure** the adequacy of the terminal, gateway, area and en route facilities to **support** the self-contained system.
- (4) **Carriers** will be expected to make available to the agency, records of accuracy and reliability for the **systems** being evaluated for a reasonable period before and after the operational evaluation.

7.. **REQUEST FOR APPROVAL.**

- a. The operator may forward a request for approval of **its proposal following** FAA observation of a representative number of **satisfactory pilot** qualification **checks and resolution of all items arising** during the initial evaluation program. Final FAA approval **is** indicated by approval of amended operations specifications, en route flight **procedures**, defining the new **operations**. Approval **is limited** to those **routes or areas** over which the adequacy of the equipment and the **feasibility** of cockpit navigation **has** been demonstrated.
- b. Proposed **operations** specifications authorizing **cockpit** navigation should **contain** the following:
  - (1) Specific points (**gateways**) fixed by an acceptable ground-based navigational aid where **use** of Doppler **RADAR** navigation will **commence** and terminate.

- (2) Latitude limits for the system used. Type heading reference authorized for Doppler navigation, i.e., Slaved Magnetic Compass or Free Gyro,
- (3) Requirement that pilots be qualified in the ~~navigation~~ **navigation system**.
- (4) Specific ~~navigation~~ equipment **that may** be inoperative for dispatch.

8. COORDINATION WITH WASHINGTON OFFICE.

- a. The appropriate Air ~~Carrier~~ District Office (ACDO) or ~~International~~ Field Office (IFO) advises **FS-400**:
  - (1) When an application for evaluation is received;
  - (2) When any problem areas exist; and,
  - (3) Concerning the status of the program as it ~~progresses~~ **progresses**.
- b. Before approving the ~~use~~ of Doppler or Inertial navigation over any route or area, the ~~ACDO or IFO~~ coordinates its ~~recommendations~~ **with FS-400**.

  
acting Director  
Flight Standards Service



FEDERAL AVIATION AGENCY											
OPERATIONS SPECIFICATIONS - EN ROUTE FLIGHT PROCEDURES											
ROUTE OR ROUTE SEGMENT	VIA	OPERATION AUTHORIZED				TYPE OF AIRCRAFT AUTHORIZED	SPECIAL REQUIREMENTS			TYPE NAVIGATION <sup>1</sup>	
		DAY	NIGHT	MOCA	MEA		MAA	OTHER			
		VFR	IFR	VFR	IFR						
<p><u>"Western Gateway</u> Goose Bay NDB/VOR, Gander NDB/VOR, Nantucket Consol VOR, Torbay NDB, Keflavik NDB/VOR (8), Santa Maria NDB/VOR (8), Saglek NDB, St. Anthony NDB, Sydney VOR/NDB, Boston VOR/NDB <u>"Eastern Gateway</u> Keflavik NDB/VOR (8), Stornaway NDB, Skipness NDB/VOR, Bushmills Consol, Belfast NDB, Shannon IFR/VOR, Cork VOR, Jersey NDB, Dublin VOR/NDB, Fioneis Consol, Gognac NDB/VOR, Lugo Consol, Lisbon NDB/VOR, Santa Maria NDB/VOR (8), St. Nawgan VOR/NDB, Bilbao NDB, Madrid/Del Ray NDB via Santiago NDB, Lajes VOR/NDB, Strumble VOR/NDB, Nantes VOR, New Galloway NDB</p>	<p>All routes over North Atlantic between Eastern and Western Gateways with the limits of operation between latitude 65°N and latitude 35°N</p>	NA	LX	NA	LX	B-707	<p>NOTES: "Cockpit navigation authorized with the following equipment operating satisfactorily, at dispatch: 1. Dual Doppler and Computer Systems (Except one 10-mile alert light may be inoperative, and one offset indicator may be inoperative, provided the associated offset miles indicator is operative.) 2. Dual Polar Path Compasses 3. ADF 4. VOR 5. One Loran receiver operable from both of the two pilot stations. (Except Eastbound out of Santa Maria.) 6. Both pilots will be Doppler qualified in accordance with approved training programs, except that when navigation is being performed under the supervision of an approved Doppler-qualified check pilot, the pilots performing such supervised navigation need only have satisfactorily completed the approved Doppler ground school curriculum. 7. Operation of overwater portion of transatlantic flights is authorized up to and including 42,000 feet. 8. Following route segments approved without an alternate: (a) Eastbound only-U.S. &amp; Canada terminals to Keflavik or Santa Maria. (b) Westbound only-European terminals to Keflavik or Santa Maria.</p>				Doppler
EFFECTIVE DATE	NAME OF AIR CARRIER		1 Where a navigator or special cockpit navigation and equipment is required, so specify: Navigator, Cockpit (Doppler - Loran), (Insert D).								
	XYZ AIRLINES, INC.										



DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION  
**OPERATIONS SPECIFICATIONS - EN ROUTE FLIGHT PROCEDURES**

Form Approved  
Budget Bureau No. ~~WAFD~~ 3.1

ROUTE OR ROUTE SEGMENT	VIA	OPERATION AUTHORIZED				TYPE OF AIRCRAFT AUTHORIZED				SPECIAL REQUIREMENTS				
		DAY		NIGHT		DC-8	B-707			MOCA	MEA	MAA	OTHER	TYPE NAVIGATION
		VFR	IFR	VFR	IFR									
<b>Approved routes and oceanic areas will be listed here. Example:</b>  <b>Frobisher to Churchill to Edmonton</b>  or  <b>North Atlantic Ocean</b>	Direct	NA	X	NA	X									Inertial
	All routes over North Atlantic between Eastern and Western Gateways.	NA	X	NA	X									
Notes: Cockpit (INS) navigation authorized with the following equipment operating satisfactorily at dispatch: 1. Dual INS and Computer Systems (Items of equipment that may be inoperative will be included in the operators approved MEL and shown on this operations specification (below)). 2. Both pilots will be Inertial qualified in accordance with approved training programs, except that when navigation is being performed under the supervision of an approved Inertial qualified check pilot, the pilots performing such supervised navigation need only have satisfactorily completed the approved Inertial ground school curriculum. 3. Operation of overwater portion of transatlantic flight is authorized up to and including 42,000 feet. 4. Ground alignment limited to 76°, 30' N&S latitude which is the highest latitude at which satisfactory ground alignment has been demonstrated.														
EFFECTIVE DATE	NAME OF AIR CARRIER					If there is a navigator or special cockpit navigation and equipment is required, so specify; ie Navigator, Cockpit (Doppler - Lowan), (Inertial) etc.								
	XYZ AIRLINES, INC.													

