

# Federal Aviation Agency



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AIRCRAFT

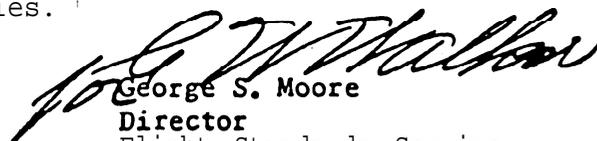
EFFECTIVE :  
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**SUBJECT :** INERTIAL NAVIGATION SYSTEMS (INS)

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1. PURPOSE. This circular sets forth an acceptable means for **complying** with rules governing the installation of inertial navigation systems **in transport category aircraft**. Other criteria which will afford a demonstration **of** compliance with applicable requirements are also acceptable,
  2. REFERENCES. Federal Aviation Regulations **25.1301, 25.1309, 25.1431, and 25.1581.**
  3. DEFINITIONS. For the purposes of this advisory circular, the following definitions apply:
    - a. Inertial Navigation System (INS). A self-contained navigation system which provides airplane position and other significant navigation information in response to signals resulting from inertial effects on components within the system.
    - b. Sole Means of Navigation. The navigation system installation used exclusively and without any other navigation data inputs, **on which** specific operations under the applicable operating rules are predicated.
    - c. Optional Navigation System. A navigation system not required for **safe operation of**, or used in the predication of aircraft operations.
  4. DISCUSSION. Existing guidelines for evaluation of airborne navigation systems do not provide adequate **criteria for use** in determining the airworthiness of INS installations. The criteria contained in this circular are directed toward the unique features of INS installations and **a means of** demonstrating compliance with the applicable rules.
  5. ACCEPTABLE MEANS OF COMPLIANCE (INS AS SOLE MEANS OF NAVIGATION DURING A SIGNIFICANT PORTION OF FLIGHT). When installed for use as the sole means **of** navigation during a significant portion **of** flight, the INS installation is acceptable under **the referenced** regulations if -
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- a. it provides, in readily usable form, **the** following:
- (1) valid ground **alignment** at **all** latitudes appropriate for intended use of the installation.
  - (2) a display **of** alignment status to **the** flight crew.
  - (3) the present position of the airplane, in suitable coordinates,
  - (4) information on destination(s) or **waypoint** position.
  - (5) ~~the information~~ needed to gain and maintain desired track and to determine deviation from desired **track**.
  - (6) ~~the~~ information needed to determine the estimated time of arrival (ETA).
- b. its accuracy in the inertial mode **is -**
- (1) appropriate for the specific air route structures in which it is to be used. Specifically, the INS ~~installation~~ accuracy appropriate for use **over** the North Atlantic is obtained by limiting cross-track error **to** a maximum of **+ 20** nautical miles and along-track ~~error~~ to a maximum ~~of **+ 25**~~ nautical miles.
  - (2) determined on a **95** percent probability basis for flights of typical durations, on selected routes, and at appropriate latitudes (including the highest for which certification is sought), over the representative speed and altitude range. An acceptable combination of laboratory data and flight demonstrations may be used for this determination.
  - (3) based upon a comparison of INS installation readout at destinations with position fixes obtained by visually sighting ground reference points and/or by using other navigation equipment (such as **LORAN, TACAN, VOR, DME,** or ground radar),
  - (4) specified in the airplane flight manual for duration of time representative **of** intended use.
- c. for INS installations that do **not** have memory or other in-flight alignment means, a separate electrical power source (independent of the main propulsion **system**) is provided which can supply, for at least **5** minutes, **enough** power (as shown by analysis and demonstrated in the airplane) to maintain **the** INS in such **condition** that its full capability is restored upon reactivation of the normal electrical supply.

- d. 'upon occurrence **of** reasonably probable failures or **malfunctions** within the **system -**
    - (1) the equipment provides, by visual, mechanical, or electrical output signals, indications of the invalidity of output **data, or**
    - (2) the equipment provides such visual, mechanical, or electrical output signals, or devices, as may be required to permit **the** flight crew to detect significant deviations between similar systems or the invalidity **of** output data from **a single** system.
  - e. a reasonably probable failure **or malfunction**' within the system does not result in loss **of** the aircraft's required navigation capability.
  - f. the system alignment and/or navigation computer functions are not invalidated by normal aircraft **power** interruptions and transients.
  - g. it is not the source or **cause** of objectionable radio frequency **interference**, and is not adversely **affected** by radio frequency interference from other aircraft systems.
  - h. the FAA approved airplane flight manual, or supplement thereto, includes pertinent material as required to define the normal and emergency operating procedures and applicable operating limitations associated with INS performance (such as maximum latitude at which ground alignment capability is provided).
6. ACCEPTABLE MEANS OF COMPLIANCE (INS USED WITH OTHER MEANS OF NAVIGATION). When installed for use in association with other navigation services, such as **VOR/DME**, the INS installation is acceptable under the referenced regulations if it satisfies all conditions set forth in paragraph 5 of this circular, except the **one** in subparagraph **5.c.**
7. ACCEPTABLE MEANS OF COMPLIANCE (INS AS AN OPTIONAL INSTALLATION). **When** installed as an optional installation, the INS installation is acceptable **if -**
- a. it functions properly in the aircraft,
  - b. there are no unsafe features.
  - c. it presents no hazards **to** the operation of the aircraft.
  - d. it causes no derogation of performance of systems in other aircraft or ground facilities.

  
George S. Moore  
Director  
Flight Standards Service

- d. upon occurrence **of** reasonably probable failures or **malfunctions** within the system -
    - (1) the equipment provides, **by visual**, mechanical, or electrical output signals, indications **of** the invalidity of output **data, or**
    - (2) the equipment provides such visual, mechanical, or electrical output signals, or devices, as **may be required to permit the** flight crew to detect significant deviations between similar systems or **the invalidity of output data from a single** system,
  - e. a reasonably probable failure or malfunction within the system does not result in loss **of** the aircraft's required navigation capability.
  - f. the system alignment and/or navigation computer functions are not invalidated by normal aircraft **power** interruptions and transients.
  - g. it is not the source or cause of objectionable radio frequency interference, and is not adversely **affected** by radio frequency interference from other aircraft systems.
  - h. the FAA approved airplane flight manual, or supplement thereto, includes pertinent material as required to define the normal and emergency operating procedures and applicable operating limitations associated with INS performance (such as maximum latitude at which ground alignment capability is provided).
6. ACCEPTABLE MEANS OF COMPLIANCE (INS USED WITH OTHER MEANS OF NAVIGATION). When installed for use in association with other navigation services, such as **VOR/DME**, the INS installation is acceptable under the referenced regulations if it satisfies all conditions set forth in paragraph S of this circular, except the one in subparagraph **S.c.**
7. ACCEPTABLE MEANS OF COMPLIANCE (INS AS AN OPTIONAL INSTALLATION). **When** installed as an optional installation, the INS installation is acceptable **if -**
- a. it functions properly in the aircraft,
  - b. there are no unsafe features.
  - c. it presents no hazards to the operation of the aircraft.
  - d. it causes no derogation **of** performance of systems in other aircraft or ground facilities.

  
George S. Moore  
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