

ADVISORY CIRCULAR



DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

FAR GUIDANCE MATERIAL

Subject: OPERATIONAL AND AIRWORTHINESS APPROVAL OF AIRBORNE OMEGA
RADIO NAVIGATION SYSTEMS AS A SOLE MEANS OF OVERWATER
LONG RANGE NAVIGATION

1. PURPOSE. This advisory circular establishes an acceptable means, but not the only means, of obtaining airworthiness and operational approval of Airborne OMEGA Navigation Systems as a sole means of long range navigation for operations conducted outside the United States in accordance with FAR 121, 123 or large aircraft operated under FAR 135.2.
2. REFERENCES. Federal Aviation Regulations (FAR) 121.355, 121.389, 121.103, 121.121, 121.405, 121.411, 121.413, 121.414, 121.433, 123.27, 135.2, 21.111, 25.1301, 25.1309, 37.205 and AC 120-31A, AC 120-33.
3. INFORMATION.
 - a. OMEGA is a radio navigation system which uses a worldwide network of very low frequency signals from eight ground-based transmitters. The principal attributes of the OMEGA system are the high degree of signal stability and low signal attenuation which produce reliable position information over great distances. Experience has shown airborne OMEGA equipment is capable of producing accurate navigation information.
 - b. Various methods of signal processing are used by different manufacturers to develop position information and navigation guidance (i.e., rho-rho, hyperbolic, single frequency, 3.4 KC tracker, etc.). Since these variations in processing methods exist, each design should be evaluated and approved individually. When OMEGA systems meet the provisions described below, they may be used as sole means of long range navigation for operations in oceanic and/or remote land areas where adequate accuracy and reliability have been demonstrated. U.S. Navy VLF Communications stations may be utilized to supplement OMEGA navigation solutions. However, the U.S. Navy VLF stations are not dedicated to navigation and their signals may not be available at all times. Therefore, systems approved in accordance with this circular should be capable of operating on OMEGA signals alone.

c. This advisory circular is divided into two sections. The first section deals with the airworthiness approval under FAR 25, and the second section deals with operational approval under FAR 121.

d. Guidance concerning compliance with FAR 91.20 regarding the North Atlantic (NAT) Minimum Navigation Performance Specifications (MNPS), and a description of the applicable airspace, is contained in Advisory Circular 120-33.

e. This circular only addresses dual OMEGA installations. Installations which propose to use one OMEGA system in combination with one or more other types of sensors or units should be evaluated on an individual basis, considering the performance of the proposed system.

SECTION 1 - AIRWORTHINESS APPROVAL

4. GENERAL. Applicants desiring airworthiness approval of dual airborne OMEGA navigation systems in accordance with this advisory circular should contact the appropriate FAA Regional Engineering and Manufacturing Office at least 30 days prior to start of the evaluation for processing a supplemental type certificate (STC) or type certificate (TC) amendment. A dual OMEGA installation includes two receiver processor units, two control display units, and two antennas.

5. MINIMUM FUNCTIONS NECESSARY WHEN USED FOR POSITION FIXING AND SOLE MEANS OF NAVIGATION. Dual independent OMEGA navigation systems used as a position-fixing device or position-keeping device and sole means of navigation should meet the performance requirements of FAR 37.205 (TSO C-94) titled "Airborne OMEGA Receiving Equipment;" particularly section three of Radio Technical Commission for Aeronautics Document No. DO-164 entitled "Minimum Performance Standards Airborne OMEGA Receiving Equipment" dated March 19, 1976. When installed in aircraft, the system should satisfy the following conditions:

a. System Data Inputs and Functions. The system should provide a means of entry for at least the following data inputs and functions:

- (1) Present position (initialization, reinitialization and update)
- (2) Waypoints
- (3) Heading, wind and TAS; or track and ground speed; or other external information required for operation in the secondary mode (dead reckoning)
- (4) Time
- (5) Date
- (6) Deselection and reselection of any station. Automatic deselection and reselection is acceptable if shown to be effective and reliable.
- (7) Lane ambiguity resolution. Automatic lane ambiguity resolution is acceptable if shown to be effective and reliable.

b. Systems Displays. The system should provide a means of displaying to the operator the following information:

- (1) Present position
- (2) Time
- (3) Date
- (4) Synchronization Status
- (5) Station(s) deselected - station(s) selected
- (6) Time and position recall in event of power failure for up to 7 minutes
- (7) Annunciation when system is not operating in the primary OMEGA navigation mode
 - (8) A warning by adequate visual or aural signals of system failure, malfunctions, power interruption, lack of synchronization or operation without adequate signals
 - (9) Coordinates of waypoints
 - (10) Bearing and distance between waypoints
 - (11) Deviation from desired course
 - (12) Distance and time to go to selected waypoint
 - (13) Track angle and/or error
 - (14) Drift angle
 - (15) Wind, True Airspeed (TAS) and Heading; or Track and Ground Speed (GS)
 - (16) Stations currently being utilized to determine position
 - (17) Steering information on the horizontal situation indicator (HSI) or equivalent
 - (18) Confirmation of data insertion

6. EQUIPMENT INSTALLATION.

a. Location of OMEGA Displays and Controls. System controls and data display should be visible to, and usable by each pilot while seated at his duty station if the equipment is to be operated by the pilot.

b. Failure Protection. Any probable failure of the airborne OMEGA navigation system should not derogate the normal operation of equipment connected to it nor should normal operation of OMEGA result in failure or degraded performance of interfaced equipment. Likewise, the failure of interfaced equipment should not render an OMEGA system inoperative.

c. Environmental Conditions. The OMEGA equipment should be capable of performing its intended function over the environmental ranges expected to be encountered in actual operations. The RTCA Document No. DO-160 should be utilized for appropriate guidelines.

d. Electromagnetic Interference. The OMEGA navigation system should not be the source of objectionable electromagnetic interference, nor be adversely affected by electromagnetic interference from other equipment in the aircraft.

e. Antenna Performance. The antenna design and installation should minimize the effects of precipitation (p) static and other noise or disturbances.

f. Dynamic Responses. The system operation should not be adversely affected by aircraft maneuvering or changes in attitude encountered in normal operations.

g. System Controls. The system controls should be arranged to provide adequate protection against inadvertent system turnoff.

h. Preflight Test. A preflight test capability should be provided to inform the flight crew of system status.

i. Aircraft Electrical Power Source. One OMEGA system should be installed so that it receives electrical power from a bus that provides maximum reliability for operation of the OMEGA equipment without jeopardizing essential or emergency loads assigned to that bus. The other OMEGA system should be installed so that it receives power from a different bus that provides a high degree of reliability. Any electrical power transient, including in-flight selection of another source of power for either OMEGA system, should not adversely effect the operation of either OMEGA system.

j. Power Interruption to the Omega System.

(1) After a power interruption of 7 ± 2 seconds, the OMEGA equipment should automatically resynchronize and resume normal operation within 3 minutes without operator intervention.

(2) After a power interruption of greater than 7 seconds and up to 7 minutes, the OMEGA equipment should either automatically resume normal operation (including proper lane resolution) or, retain the last "power-on" OMEGA equipment position and time for display on command. A battery, if shown to be of sufficient capacity, may be used to perform this function.

k. Steering Outputs. The OMEGA system should provide steering outputs to the autopilot and/or horizontal situation indicator or equivalent so that the equipment interface is compatible.

l. Airplane Flight Manual. The Airplane Flight Manual should contain the following information on the OMEGA equipment:

- (1) Normal procedures for operating the equipment;
- (2) Equipment operating limitations;
- (3) Emergency/abnormal operating procedures (if applicable).
- (4) Procedures for reacquiring the proper lane after power outages.

7. SYSTEM ACCURACY. The system should meet the accuracy stipulated for long range navigation systems in FAR 37.205 (TSO C-94) per (RTCA DO-164 Section III para. 3.8).

8. DEMONSTRATION OF PERFORMANCE. An applicant for approval of dual OMEGA navigation system installation should show that the installed OMEGA system can demonstrate adequate performance by a combination of ground and flight evaluations defined below:

a. Ground Evaluation.

(1) After installation, an operational/functional check should be performed to demonstrate compatibility between the OMEGA system and aircraft electrical and electronic systems. This test should be conducted with all electrical/electronic equipment operating normally on aircraft power. A ground location should be selected that minimizes the presence of external electromagnetic interference. In addition, it should be demonstrated that the OMEGA equipment will not adversely affect other systems to which it may be connected, i.e., air data, autopilot, flight director, and compass system.

(2) The OMEGA velocity and heading (or track) information presented on the Control/Display Unit and other interfacing instruments, should have reasonable comparison to the primary indications on other flight deck instruments. During these tests the primary velocity and heading inputs to the OMEGA system should be slewed through their operating range to assure compatibility of input to interfaced equipment. This evaluation may be conducted in flight.

(3) Displays of all data basic to the installed OMEGA systems should be demonstrated to show no instability or discontinuity when utilizing those stations identified by the systems as usable and necessary for navigation. This evaluation may be conducted in flight.

b. Flight Evaluation.

(1) The OMEGA navigation system should be checked in flight to determine that the design and installation criteria are met. All modes of operation should be functionally checked. The Airplane Flight Manual procedures should be evaluated in flight including abnormal and emergency procedures. This evaluation should include: reinitialization, lane ambiguity resolution, etc., during normal and adverse conditions. Interfaced equipment should be evaluated to assure proper operation. Normal flight maneuvering should include 180° turns for verifying dynamic response.

(2) The applicant for airworthiness approval should provide data from sufficient flights in the anticipated area of intended use to show that the OMEGA navigation system can be used to meet the accuracy requirements stipulated for long range navigation systems in FAR 37.205

(TSO C-94) i.e., RTCA DO-164, Section III, para. 3.8. Consideration should be given to time of day, season, station outages, station geometry and poor signal to noise ratio.

(3) It should be demonstrated that operation of the system does not impose an unacceptable workload in a normal in-flight environment on the flight crew. This aspect should receive careful scrutiny relative to crew workload during power outages, dead reckoning (DR) operation and detecting/resolving lane ambiguities.

(4) The Dead Reckoning (DR) mode should be evaluated to determine the maximum period for which interim use is permissible. That information should be included in the Airplane Flight Manual.

NOTE. Evaluation of a specific operator's procedures should be accomplished under Section II Operational Approval.

9.-19. RESERVED.

SECTION 2 - OPERATIONAL APPROVAL

20. GENERAL.

a. The basic requirements under FAR Part 121 for en route navigation facilities are contained in Sections 121.103 and 121.121.

b. Applicants desiring operational approval for use of dual OMEGA systems should contact the Air Carrier District Office, Flight Standards District Office or General Aviation District Office charged with the administration of their operating certificate a minimum of 30 days prior to the proposed start of evaluation flights.

21. REQUEST FOR OPERATIONAL APPROVAL. The request should contain the following information:

a. Evidence of an FAA Airworthiness Approval of the system, including a description of the system installation.

b. Experience.

(1) Prior to presenting the initial request, an operator should have accumulated sufficient experience with the equipment to establish a history of the accuracy and reliability of the system proposed for use. The applicant may include previous or related operational experience of other operators, using the same equipment on the same type aircraft, and operational experience gained during type certification or supplemental type certification of the aircraft. Once a particular system has received an

equipment approval, evaluation and approval in subsequent same type aircraft installations may be adjusted to avoid duplication of part of the accuracy and reliability data gathering process involved in the issuance of the original approval.

(2) A comprehensive summary of any flight experience which will establish a history of adequate signal coverage during day or night operations, accuracy, lane ambiguity detection/resolution, and service reliability should be provided to show competency in the proposed operation and maintenance of the equipment.

c. Proposed revisions to the Operations Manual describing all normal and abnormal system operating procedures, flight crew error protection procedures including cross-checking of data insertion, detailed methods for continuing the navigation function with partial or complete OMEGA system failure and reacquiring the proper lane after any power outages, and procedures for continuing operations in the event of a divergence between systems.

d. Proposed revisions to the Minimum Equipment List (MEL) concerning OMEGA, with appropriate justification.

e. A list of operations to be conducted using the system, containing an analysis of each with respect to signal reception for ground synchronization and en route operation, signal absorption by the Greenland icecap, sufficient redundancy of signal coverage to permit continued operation during station outages, procedures for operating in areas of magnetic compass unreliability (if applicable), availability of other en route aids, and adequacy of gateway facilities to support the system. For the purpose of this Advisory Circular, a gateway is a specific navigation fix where the use of the long range navigation system commences or terminates.

f. Procedures for timely dissemination of OMEGA NOTAM information to crewmembers.

g. A training program curriculum to include initial and recurrent training and checking for those crewmembers who are to operate the OMEGA equipment.

h. An outline of the maintenance program for the equipment, including training of maintenance personnel, positioning of spares and test equipment, maintenance manual revision procedures if applicable, and the other means of compliance with the requirements of Subpart L of FAR Part 121.

22. EQUIPMENT AND EQUIPMENT INSTALLATION.

a. OMEGA navigation systems should be installed in accordance with the airworthiness approved system installation requirements.

b. If evaluation flights are made in operations on which a long range navigation system is required, a navigation system already approved for the operator under Part 121 should be used as the primary means of navigation.

23. TRAINING PROGRAMS.

a. Initial training programs should include the following:

(1) Instruction regarding responsibilities of flight crewmembers, dispatchers, and maintenance personnel.

(2) For those crewmembers who are to operate the OMEGA equipment (pilots and navigators, as appropriate), instruction in the following:

(a) Description of the OMEGA network, airborne system description, limitations, and detection of malfunctions.

(b) Normal operating procedures including preflight procedures and testing, data insertion and cross-checking, en route procedures including periodic cross-checking of system position display and comparison between systems.

(c) Updating procedures, if applicable.

(d) Operations in areas of magnetic compass unreliability, if applicable.

(e) Abnormal and emergency procedures including: airborne conditions, procedures for assessing and resolving divergences between systems, and procedures for reacquiring the proper lane in case of power outages in excess of 7 seconds.

(f) A review of navigation, including flight planning and applicable meteorology as necessary, if not addressed in another approved training program.

(g) Compilation of terminal and/or gateway system errors.

b. Procedures for operating the OMEGA navigation system should be incorporated into the recurrent training program for those crewmembers who are to operate the OMEGA equipment (pilots or navigators, as appropriate).

c. For flight crewmembers (pilots or navigators, as appropriate) without previous OMEGA experience, the training and qualification program should include an inflight qualification check based on the training program.

Accomplishment of such training during evaluation flights is acceptable. Sufficient flight crews considered fully qualified by the applicant should be observed in flight by the FAA to determine the overall effectiveness of the training and qualification program. Flight crews possessing current operational experience with the installed OMEGA equipment need only receive training specifying any differences in procedures created by using OMEGA as a sole means, if applicable.

d. Annual line checks as required by FAR 121.440 should include a check of OMEGA operating procedures. Required annual checks of flight navigators should also include a check of OMEGA operating procedures.

24. ACCURACY AND RELIABILITY. The applicant should show:

a. That an adequate inflight service reliability rate, stated in terms of inflight mean time between failures (MTBF), is in existence, with no significant unresolved problems remaining.

b. That in the areas of proposed operation the OMEGA navigation system meets accuracy requirements stipulated for OMEGA navigation systems in the airworthiness section of this circular. If the system is proposed to be operated in areas requiring special navigation requirements (i.e., MNPS), the accuracy required for those areas must also be demonstrated. Systems which become exceedingly inaccurate without displaying a warning indication should be included in the accuracy accounting. Systems which display a failure warning and are subsequently shut down or disregarded should be included in the accounting of failed systems in paragraph 24a, but excluded from the accuracy accounting.

c. That OMEGA navigation systems which are subject to lane ambiguity have a reliable means of reacquiring the proper lane.

d. That the OMEGA sole means systems can meet navigation separation requirements and have sufficient signal redundancy to continue navigation during OMEGA station outages. Equipment having the capability to process the U.S. Navy VLF signals may utilize that feature to refine OMEGA information to assist in meeting this stipulation.

e. That within the proposed area of operation, navigation capability is not predicated on the dead reckoning (DR) mode, and that any interim operation in DR does not degrade navigation accuracy and reliability beyond that required to comply with ATC requirements.

25. EVALUATION PROGRAM AND FINAL APPROVAL.

a. Prior to final approval for the use of OMEGA as a sole means of long range navigation, a thorough evaluation should be made of the operator's training program and a flight evaluation should be conducted by FAA personnel.

A flight evaluation should be requested as a part of the application for operational approval for the use of OMEGA as a sole means of long range navigation.

b. The evaluation should ensure the adequacy of operating procedures, training programs, availability of terminal, gateway, area and enroute ground-based navigation aids, operational accuracy, equipment reliability, and acceptable maintenance procedures. OMEGA equipment operations should be closely analyzed to ensure that an unacceptable workload is not imposed upon the flight crew by the use of the OMEGA equipment in normal and abnormal operations.

c. The applicant should provide data from sufficient flights which demonstrates the ability to use the particular type of OMEGA as a sole means system in operations so that the requirements of FAR 121.103 and 121.121 for the area of intended operation are met.

d. After the evaluation is completed, FAA approval is indicated by issuance of operations specifications, or amendments thereto, authorizing the use of dual OMEGA as a sole means of long range navigation in the areas in which operations were demonstrated. Approval is limited to those operations or areas where compliance with FAR 121 requirements was demonstrated.

e. The operations specifications should contain applicable limitations or special requirements needed for particular routes or areas, and, where necessary, a list of a sufficient number of OMEGA ground transmitters required to be in operation to provide the necessary amount of signal redundancy.



J. A. FERRARESE

Acting Director, Flight Standards Service