Federal Aviation Administration
Aviation Rulemaking Advisory Committee

General Aviation Certification and Operations Issue Area
Operations Over the High Seas Working Group

Task 1 – Operating Over the High Seas

FILE COPY

Aviation Rulemaking Advisory Committee; General Aviation Operations Subcommittee; Operations Over the High Seas Working Group

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of establishment of Operations over the High Seas Working Group.

SUMMARY: Notice is given of the establishment of an Operations over the High Seas Working Group by the General Aviation Operations Subcommittee of the Aviation Rulemaking Advisory Committee. This notice informs the public of the activities of the General Aviation Operations Subcommittee of the Aviation Rulemaking Advisory Committee.

FOR FURTHER INFORMATION CONTACT: Mr. Ron Myres, Executive Director, General Aviation Operations Subcommittee, Flight Standards Service (AFS-850), 800 Independence Avenue, SW., Washington, DC 20591, Telephone: (202) 267–8150; FAX: (202) 267–5230.

SUPPLEMENTARY INFORMATION: The Federal Aviation Administration (FAA) established an Aviation Rulemaking Advisory Committee (56 FR 2190, January 22, 1991) which held its first meeting on May 23, 1991 (56 FR 20492, May 3, 1991). The General Aviation Operations Subcommittee was established at that meeting to provide advice and recommendations to the FAA regarding the operation of general aviation aircraft and certification of airmen under parts 61, 91, 125, 133, 137, 141, and 143 of the Federal Aviation Regulations. At its first meeting on May 24, 1991 (56 FR 20492, May 3, 1991), the subcommittee established the North Atlantic Minimums Working Group.

Specifically, the working group's task is the following:

On 9/5/90 an ANPRM entitled "Operation over the high seas and within the North Atlantic Minimum Navigation Performance Specification Airspace" was published in the Federal Register. The required comment period closed 1/3/91. Evaluate the advantages and disadvantages of developing advisory material and/or further regulations that provide an adequate level of safety and assure international standards are met by U.S. civil operators when operating over the high seas. Within 90 days of establishment of the subcommittee, the subcommittee should receive a detailed review of the working group's activities, planned future activities, and the timetable for those activities.

The Operations over the High Seas Working Group will be comprised of experts from those organizations having an interest in the task assigned to it. A working group member need not necessarily be a representative of one of the organizations of the parent General Aviation Operations Subcommittee or of the full Aviation Rulemaking Advisory Committee. An individual who has expertise in the subject matter and wishes to become a member of the working group should write the person listed under the caption **FOR FURTHER INFORMATION CONTACT** expressing that desire and describing his or her interest in the task and the expertise he or she would bring to the working group. The request will be reviewed with the subcommittee chair and working group leader, and the individual advised whether or not the request can be accommodated.

The Secretary of Transportation has determined that the formation and use of the Aviation Rulemaking Advisory Committee and its subcommittees are necessary in the public interest in connection with the performance of duties imposed on the FAA by law. Meetings of the full committee and any subcommittees will be open to the public except as authorized by section 10(d) of the Federal Advisory Committee Act. Meetings of the Operations over the High Seas Working Group will not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. No public announcement of working group meetings will be made.

Issued in Washington, DC, on October 7, 1991.

Ron Myres,

Executive Director, General Aviation Operations Subcommittee, Aviation Rulemaking Advisory Committee.

[FR Doc. 91–24735 Filed 10–11–91; 8:45 am]

BILLING CODE 4910-13-M

AIRCRAFT OWNERS AND PILOTS ASSOCIATION
421 Aviation Way • Frederick, MD 21701-4798
Telephone (301) 695-2000 • FAX (301) 695-2375

June 24, 1994

Mr. Anthony Broderick
AFS-1
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Dear Mr. Broderick:

During the last meeting of the Aviation Rulemaking Advisory Committee (ARAC) General Aviation Operations Subcommittee meeting, the proposed Advisory Circular entitled "Operations Over the High Seas" was approved unanimously.

A copy of the proposed Advisory Circular was mailed to all the voting subcommittee members, not present at that meeting, requesting their comments: none were received. Therefore, the Subcommittee recommends the FAA adopt and publish this document as an Advisory Circular.

Sincerely,

Steven J. Brown
Chairman

cc Mr. Ronald Myres

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave.. S.W.
Washington, D.C. 20591

AUG 1 1994

Mr. Steven J. Brown
Senior Vice President
Governmental and Technical Affairs
Aircraft Owners and Pilots Association
Frederick, MD 21701-4798

Dear Mr. Brown:

Thank you for your June 24 letter confirming Aviation Rulemaking Advisory Committee (ARAC) unanimous approval of the proposed Advisory Circular (AC), "Operations Over the High Seas," and recommending its adoption and publication by the Federal Aviation Administration (FAA).

The recommendation was submitted in a format suitable for processing and, therefore, will be presented to FAA management as quickly as possible. If management agrees with the recommendation, the proposed Advisory Circular will be issued.

I would like to thank the aviation community for its commitment to ARAC and its expenditure of resources to develop the recommendation. We in the FAA pledge to process the recommendation expeditiously, as a high-priority action.

Again, let me thank the ARAC and, in particular, the Operations Over the High Seas Working Group for prompt and complete action on this task.

Sincerely,

Anthony J. Broderick
Associate Administrator for
Regulation and Certification

U.S. Department
of Transportation
Federal Aviation Administration

Advisory Circular

Subject: **OCEANIC OPERATIONS** Date: AC No: **91-XX**
Initiated by: **AFS-550**

1. PURPOSE. This advisory circular (AC) provides guidance for planning oceanic flight.

2. CANCELLATION. AC 20-121A, "Airworthiness Approval of Airborne Loran-C Navigation Systems for Use in the U.S. National Airspace System;" AC 90-76B, "Flight Operations in Oceanic Airspace;" AC 90-79, "Recommended Practices for the Use of Electronic Long-Range Navigation Equipment;" AC 90-80A, "Approval of Airborne Radar Approach (ARA) Procedures for Helicopters to Offshore Platforms;" AC 90-86, "Announcement of Availability: North Atlantic MNPS Airspace Operations Manual, Fourth Edition;" AC 91-49, "General Aviation Procedures for Flight in North Atlantic Minimum Navigation Performance Specifications Airspace;" AC 120-31, "Operational and Airworthiness Approval of Airborne Omega Radio Navigation Systems As a Means of Updating Self-Contained Navigation Systems;" AC 120-37, "Operational and Airworthiness Approval of Airborne Omega Radio Navigation Systems As a Sole Means of Long-Range Navigation Outside the United States;" and, AC 121-13, "Self-Contained Navigation Systems (Long-Range)" have been canceled.

3. RELATED READING MATERIAL. Order 8700.1, General Aviation Operations Inspector's Handbook. This document may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC, 20402.

4. BACKGROUND. Presently there are several issues that are significant to the Federal Aviation Administration (FAA) and foreign nations relative to oceanic flight operations. The majority of these issues involve the large amount of air traffic over the North Atlantic (NAT) between Europe and the United States. Most air carriers plan eastbound flight departures in the evenings so that morning arrival in Europe will permit a full day's business or touring. Air carriers plan westbound flight departures for just the reverse reason, leaving in the morning so passengers arrive in the United States at a convenient local time. The westbound flights do not create a problem in air traffic congestion due to the breadth of the eastern coast of the United States. However, eastbound flights arriving in Europe from North America converge on the relatively small geographic area of the United Kingdom and have to be filtered onto extremely crowded European routes (ER's). Because of this situation, traffic control across the NAT is strictly regulated by International Civil Aviation Organization (ICAO) rules adopted following agreement between member states. Flights in the airspace designated as **Minimum Navigation Performance Specification** (MNPS) airspace and/or (future) **Reduced Vertical Separation Minimum** (RVSM) airspace require aircraft to obtain a Letter of

Authorization (LOA) to fly in this airspace. In the past, these letters were issued by FAA Flight Standards District Offices (FSDO's) in a manner and form determined by that office. There was no suspense date or numbering system required on the letters. This situation caused a great deal of international concern because letters stayed with aircraft for an indefinite period of time and were impossible to track. Pressure by ICAO member states has caused the FAA to reevaluate the process of issuing these letters, and to standardize the format and procedures for issuance.
Another area of concern in the NAT, as well as other areas, is that of general aviation oceanic navigation performance experienced by nonturbine light aircraft. Search and rescue missions conducted by ICAO member states for U.S.-registered aircraft that have strayed off course have imposed a severe strain on those states. This situation has demanded action on the part of the U.S. Government. This situation had also had a negative impact on international relations between the United States and other ICAO member states. U.S.-registered aircraft making oceanic flights and departing from the United States are not required to have an LOA and/or an inspection unless they are to penetrate MNPS airspace. These aircraft are required, however, to submit to an inspection of both the aircraft and the flightcrew if departing from or overflying Canada.

Flights in the Northern Pacific (NOPAC) en route to Asia do not have to contend with the same traffic density as NAT operations. Although navigation in the NOPAC once involved serious political implications if a navigation error occurred, this is no longer the case. However, the length of the overwater routes makes it imperative that aircraft flying in the Pacific have well-trained flightcrews, high quality communication equipment, high quality long-range navigation equipment, and more than adequate fuel supplies on board. The same requirements apply to U.S. west coast - Hawaii routes and Hawaii - Tokyo routes.

Flights in the Caribbean and the Gulf of Mexico do not involve long distances over water, but they often encounter severe tropical weather, exceed the service volume of navigation facilities, and encounter the sensitivity of national defense agencies to the southern borders of the United States.

5. ACTION. In response to the concerns discussed above, the FAA has taken the following actions:

- Publication of this AC as a single source document for flightcrews planning oceanic flight
- Standardization of LOA's for flights into MNPS airspace
- Establishment of a tracking system and statistical database of overseas navigation error reports (ONER's), oceanic altitude deviation reports (OADR's), reports of erosion of longitudinal separation, and LOA verification requests.
- Standardization of format and issuance procedures for LOA's by FAA inspectors by providing guidance in FAA inspector's handbooks

This document is designed to be comprehensive; however, not all chapters are applicable to all operations. The publications cycle of this AC is such that it is impossible for up-to-the-minute details of all political, geographic, navigation, and communication information to be included. It is imperative, therefore, that operators use this document for general guidance and verify specifics by consulting the most recent Aeronautical Information Publication (AIP), international Notice to Airmen (NOTAM), and information from the U.S. Department of State.

6. OVERVIEW. To facilitate use of this AC without reading unnecessary chapters, the following summaries are presented.

- Chapter 1 is useful to those interested in the legal foundations for oceanic regulatory control.

- Chapter 2 is an overview of all oceanic operations. All operators should scan this chapter and read in detail those sections pertinent to their operations.

- Chapter 3 should be read by all operators planning NAT flights, regardless of the nature of the operation. It is imperative that anyone flying in the NAT have a detailed knowledge of the special airspace in this oceanic area.

- Chapter 4 should be read by all operators planning NOPAC flights.

- Chapter 5 should be read by all operators planning flights in the Pacific outside the NOPAC area.

- Chapters 6 and 7 contain details on Caribbean and Gulf of Mexico operations.

- Chapter 8 provides detailed navigation information. Not all sections will pertain to all operators. It is recommended that this chapter be scanned by all operators, and that the information pertinent to their operations be read in detail.

- Chapter 9 discusses helicopter oceanic operations.

- Chapter 10 is important to all oceanic operations. ICAO requirements for flightcrew training and foreign nation's individual requirements (Canada, for example) demand varying degrees of training for flightcrews. It is imperative that all flightcrews receive the level of training required for their operation.

- Chapter 11 includes specific guidance for Federal Aviation Regulations (FAR) Part 91 operations.

- Chapter 12 describes the polar track system and includes some food for thought from Admiral Byrd.

- Chapter 13 - Caution should be exercised when planning flights to the former Soviet Union. The ever-changing political situation of the destination countries necessitates close scrutiny of AIP's, international NOTAM's, and contact with the Department of State prior to planning operations in those areas.

• The four appendices are included to provide operators with copies of necessary documents, charts, references, and definitions that may be difficult to obtain from other sources.

The FAA's efforts will be meaningless without the cooperation of flightcrews and operators involved with oceanic operations. Therefore, individuals planning this type of operation should avail themselves of the contents of this AC and of the resource materials listed in the appendices. It is only through the cooperative efforts of flightcrews, operators, industry groups, and the FAA that safe operations can be conducted in oceanic airspace.

In the spirit of partnership between government and industry, the following associations, agencies and corporations provided input and assistance that aided in the development of this document.

Aircraft Owners and Pilots Association
ARINC, Inc.
Aviation Rules Advisory Committee
Bristol-Meyers Squibb Company
Citibank Flight Department
Delta Air Lines
Dresser Air Transport
Emerson Electric
Flight Safety International, Inc.
459th Wing Air Force Reserve, Andrews AFB
Helicopter Safety Advisory Conference
Jeppesen Sanderson, Inc.
National Business Aircraft Association
NBAA International Operators Committee
Northwest Airlines
Simuflite
United Kingdom Civil Aviation Authority
U.S. Mission to ICAO
Wayfarer Ketch Corporation

Thomas C. Accardi
Director, Flight Standards Service

ADVISORY CIRCULAR 91-XX: OCEANIC OPERATIONS

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CHAPTER 1. UNITED STATES AVIATION AND THE INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

1. BACKGROUND.

An understanding of oceanic operations demands a knowledge of the International Civil Aviation Organization (ICAO) and the U.S. involvement in this organization. This background is needed to understand the relationship between U.S. policy and international policy.

World War II had a major impact on the technical development of aircraft, telescoping one quarter century of peacetime development into 6 years. There were many political and technical problems to be resolved to support a world at peace. Safety and regularity in air transportation necessitated airports, installation of navigational aids (navaids), and weather reporting systems. Standardization of methods for providing international services was vital to preclude unsafe conditions caused by misunderstanding or inexperience. Establishment of standards for air navigation, air traffic control (ATC), personnel licensing, airport design, and for many other important issues related to air safety required international action. Questions concerning the commercial and legal rights of developing airlines to fly into and through the territories of another country led the United States to conduct exploratory discussions with other allied nations during early 1944. On the basis of these talks, invitations were sent to allied and neutral states to meet in Chicago in November 1944. The outcome of this Chicago Convention was a treaty requiring ratification by 26 of the 52 states that met. By ratifying the treaty, contracting states agreed to pursue certain stated objectives, assume certain obligations, and establish the international organization that became known as ICAO.

As a charter member of ICAO, the United States has fully supported the organization's goals from its inception, being especially concerned with technical matters. Through ICAO, the United States works to achieve the highest practical uniform air regulations, standards and procedures for aircraft, personnel, airways, and aviation services throughout the world. At the same time, the United States depends upon ICAO to ensure that navigation facilities, airports, weather, and radio services provided by other nations meet international standards.

Through active support and participation in ICAO, the Federal Aviation Administration (FAA) strives to improve worldwide safety standards and procedures to make international flying more efficient and economical. The FAA also provides technical assistance to other nations when needed. As of January 1988, the FAA had 168 agreements with 62 foreign countries to provide technical assistance in areas such as flight inspection, training, air traffic development, loan of equipment and navaids, and supply support. The specific terms of these arrangements are detailed in memorandums of agreement. These memorandums include descriptions of the services, special conditions, financial provisions, liability information, effective dates, termination dates, and other information required for particular situations. Agreements involving international activities are negotiated and signed by the Director of International Aviation on behalf of the FAA.

2. ICAO AND THE ICAO ANNEXES.

a. ***ICAO Objectives.*** The objectives of ICAO are to develop the principles and techniques of international air navigation and to foster the continued development of international air transportation through the following means.

- Promote safe and orderly growth of civil aviation throughout the world

- Foster the technical arts of aircraft design and operation for peaceful purposes

- Encourage the development of airways, airports, and air navigation facilities for international civil aviation

- Meet the needs of the world's people for safe, regular, efficient, and economical air transportation

- Prevent economic waste caused by unreasonable competition

- Ensure that the rights of contracting states are fully respected and that every contracting state has an equal opportunity to operate international airlines

- Avoid discrimination among contracting states

- Promote the development of all aspects of international civil aeronautics

b. ***Obligations of Member States.*** Ratifying the Convention obligated member states to abide by "certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner, and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically." Ninety-six articles, created and accepted at the Chicago Convention, established the privileges and obligations of the member states. Some of these articles are summarized as follows:

(1) Contracting states recognize that each state has complete and exclusive sovereignty over the airspace above its territory (Article 1).

(2) The Convention, including the articles and annexes, applies only to civil aircraft. Each member state will require its state aircraft to operate with "due regard" for the safety of navigation of civil aircraft (Article 3).

(3) International air navigation laws and regulations of a contracting state pertaining to the operation and navigation of such aircraft while within its territory shall apply to the aircraft of all contracting states without distinction to nationality. These laws and regulations shall be complied with by such aircraft while entering, within, or departing from the territory of that state (Article 11).

(4) Each contracting state adopts measures to ensure that every aircraft maneuvering over or within its territory, and every aircraft carrying a nationality marking, wherever it operates, shall comply with the rules and regulations of that country relating to the flight and maneuver of aircraft. This article also requires that, in operations over the high seas, the rules in force shall be those established under this Convention. Each contracting state undertakes to ensure the prosecution of all persons violating the applicable regulations (Article 12).

(5) Each contracting state undertakes not to discriminate in the availability of, or charges for, airports and other air navigation facilities (Article 15).

(6) Each contracting state undertakes to provide airports, radio services, meteorological services, and other air navigation facilities in its territory to facilitate international air navigation in accordance with ICAO standards and practices (Article 22).

(7) Each contracting state undertakes to adopt and put into operation appropriate standard systems of communication, codes, markings, signals, lighting, and other operational practices and rules recommended or established by ICAO (Article 28).

(8) Each contracting state recognizes the validity of Certificates of Airworthiness and Licenses of Competency issued by other contracting states, when issued under conditions that comply with ICAO standards (Article 33).

(9) Each contracting state collaborates in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft, personnel, airways, and auxiliary services when uniformity will facilitate and improve air navigation (Article 37).

(10) Each contracting state undertakes to immediately notify ICAO of any differences between national regulations and any ICAO standards (Article 38).

c. ***Organizational Structure.*** ICAO is recognized by the United Nations (U.N.) as a specialized agency for international civil aviation. An agreement between these organizations ensures an efficient working relationship and a mutual recognition of their respective roles. ICAO is not subordinate to, and does not receive any line-of-command authority from, the United Nations.

(1) ***Assembly.*** The Assembly is the sovereign body of ICAO. It meets every 3 years for a detailed review of the organization's technical, economic, legal, and technical assistance programs, and offers guidance concerning the future work of other ICAO bodies. Each nation has one vote in the assembly and, unless the convention provides otherwise, a majority rules. In 1987 there were 157 ICAO member nations, and therefore 157 assembly votes.

(2) ***Council.*** The Council is composed of elected representatives from 33 member states. It investigates situations that might create obstacles to international air navigation, and takes action as necessary to protect global air safety and order. When required, it also serves as an arbiter between member states on aviation matters.

(3) ***Air Navigation Commission.*** The Air Navigation Commission is composed of 15 individuals, each an expert in a technical field of aviation. This group is concerned with the development of ICAO Standards and Recommended Practices (SARP's).

(4) ***Air Transport Committee.*** The Air Transport Committee's prime concern is economic matters relating to airports, route facilities, and air carrier tariffs. This information is used to promote fair and equal opportunities for all international carriers.

(5) ***Joint Support Committee.*** The Joint Support Committee provides for financial arrangements for certain air facilities or services when member states have inadequate resources. Most funding comes from direct user charges to air carriers. This committee studies air service problems and makes suitable arrangements between user and provider states.

(6) *Legal Committee.* The Legal Committee interprets questions on the Chicago Convention and public and private law. Some of its main concerns are hijackings and other acts of air terrorism, air carrier liability, and jurisdiction over offenses on international flights.

(7) *Unlawful Interference with International Civil Aviation.* The Committee on Unlawful Interference with International Civil Aviation and its facilities assist and advise the council on all activities relating to aviation security.

(8) *Secretariat.* The Secretariat, headed by a council appointed Secretary General, provides for ICAO's daily administrative needs. The most demanding job is its foreign language service. Other areas include the preparation of documents for meetings and special studies.

d. *ICAO Publications.*

(1) *The ICAO Bulletin.* This document is published 12 times annually and contains a digest of ICAO meetings and activities for the previous period. Semiannually, it contains a table showing the status of all ICAO publications involving air navigation.

(2) *Final Reports of Meetings.* The final reports of divisional, regional, and panel meetings include the proceedings and recommendations of each meeting. These recommendations are not effective until reviewed by the Air Navigation Commission or another appropriate committee and approved by the Council. Approved recommendations are separately referred to the affected states for implementation.

(3) *Annexes to the Convention.* ICAO SARP's are designated as Annexes to the Convention and are published separately for each technical field after adoption by the Council.

(4) *Procedures for Air Navigation Services (PANS).* The uniform application of certain operating procedures is necessary for safe and efficient air navigation. Operating procedures covering aircraft operations, construction of visual and instrument flight procedures, ICAO abbreviations and codes, rules of the air, and air traffic services have been adopted by ICAO. They are kept up-to-date by action at divisional and panel meetings. Some of these procedures, services, and rules are requirements that have been incorporated in the annexes. Additional requirements become a part of the annexes as they mature.

(5) *Supplementary Procedures.* Certain procedures apply only in specific regions and are published as Supplementary Procedures. A Supplementary Procedure can explain and amplify, but cannot conflict with international standards. For convenience, all regional Supplementary Procedures have been included in a single document and similar procedures applicable to two or more regions are grouped together.

(6) *Field Manuals.* These manuals have no formal status by themselves but derive their status from the international SARP's and PANS from which they are compiled. They are prepared primarily for the use of personnel engaged in field operations. The most extensive manual is on training of crewmembers.

(7) *ICAO Circulars.* ICAO Circulars are issued by the Secretary General to make specialized information available to contracting states. This information is not adopted or approved by the

Council. Circulars include studies of statistics, summaries of treaties or agreements, analyses of technical documents, and studies of technical subjects.

The publications discussed in this paragraph and other publications distributed by ICAO are available at the following address:

Public Information Office
International Civil Aviation Organization
1000 Sherbrooke Street West, Suite 400
Montreal, Quebec
Canada H3A, 2R2

e. ***Annexes to the Convention.*** Since ICAO was created, a main technical feature of the organization has been operational standardization of safe, regular, and efficient air services. This has resulted in high levels of reliability in the many areas that collectively shape international civil aviation, particularly with respect to aircraft, the aircraft crews, and the ground-based facilities and services. Standardization has been achieved through the creation, adoption, and amendment of Annexes to the Convention on International Civil Aviation, identified as international SARP's. Standards are directives which ICAO members agree to follow. If a member has a standard different from an ICAO standard, that member must notify ICAO of the difference. Recommended practices are desirable practices but not essential. The basic criterion for deciding whether a particular issue should be a standard is an affirmative answer to the question, "Is uniform application by all contracting states essential?" The applicability of a standard may be subject to certain conditions relating to such areas as terrain, traffic density, stages of flight, and climate. A standard should, however, be applied equally by any contracting state when those specified conditions are encountered, unless the contracting state notifies ICAO of a difference.

ICAO Annexes contain the standards and recommended practices that have been adopted through international agreement. The 18 annexes are described as follows:

(1) Annex 1, Personnel Licensing, provides information on licensing of flightcrews, air traffic controllers, and aircraft maintenance personnel.

(2) Annex 2, Rules of the Air, contains rules relating to conducting visual and instrument flight.

(3) Annex 3, Meteorological Service for International Air Navigation, provides for meteorological services for international air navigation and reporting of meteorological observations from aircraft.

(4) Annex 4, Aeronautical Charts, contains specifications for aeronautical charts used in international aviation.

(5) Annex 5, Measurement Units Used in Air and Ground Operations, lists dimensional systems to be used in air and ground operations.

(6) Annex 6, Operation of Aircraft, enumerates specifications to ensure a level of safety above a prescribed minimum in similar operations throughout the world. The three parts of this Annex include the following:

- Part I - International Commercial Air Transport - Airplanes
- Part II - International General Aviation - Airplanes
- Part III - International Operations - Helicopters

(7) Annex 7, Aircraft Nationality and Registration Marks, specifies requirements for registration and identification of aircraft.

(8) Annex 8, Airworthiness of Aircraft, specifies uniform procedures for certification and inspection of aircraft.

(9) Annex 9, Facilitation, provides for simplification of border-crossing formalities.

(10) Annex 10, Aeronautical Telecommunications, Volume 1, provides for standardizing communications equipment and systems. Volume 2 standardizes communications procedures.

(11) Annex 11, Air Traffic Services, includes information on establishing and operating ATC, flight information, and alerting services.

(12) Annex 12, Search and Rescue, provides information on organization and operation of facilities and services necessary for search and rescue (SAR).

(13) Annex 13, Aircraft Accident Investigation, provides for uniformity in notifying, investigating, and reporting on aircraft accidents.

(14) Annex 14, Aerodromes, contains specifications for the design and equipment of aerodromes.

NOTE: Most countries outside of North America designate "airports" as "aerodromes."

(15) Annex 15, Aeronautical Information Services, includes methods for collecting and disseminating aeronautical information required for flight operations.

(16) Annex 16, Environmental Protection, Volume 1, contains specifications for aircraft noise certification, noise monitoring, and noise exposure units for land-use planning. Volume 2 contains specifications for aircraft engine emissions.

(17) Annex 17, Security-Safeguarding International Civil Aviation Against Acts of Unlawful Interference, specifies methods for safeguarding international civil aviation against unlawful acts of interference.

(18) Annex 18, The Safe Transport of Dangerous Goods by Air, contains specifications for labeling, packing, and shipping dangerous cargo.

3. ICAO REGIONAL PLANS AND AERONAUTICAL INFORMATION PUBLICATIONS.

a. ***Regional Planning.*** Although ICAO is involved with civil aviation on a worldwide scale, there are many subjects it considers on a regional basis. Regional air navigation meetings are held periodically to consider the requirements of air operations in specified areas. Facilities, services, and the formulation of supplementary procedures necessary to support increases in traffic density, new air routes, and the introduction of new types of aircraft are among the topics considered. These meetings identify the numerous facilities and services to be provided by states in the nine ICAO regions. After review of the meeting recommendations by the Air Navigation Commission and approval by the Council, the recommendations are presented in Air Navigation Plan publications covering the nine regions.

b. ***Air Navigation Plans.*** Air Navigation Plans provide details of facilities, services, and procedures required for international air navigation within specified areas. Each Air Navigation Plan also contains recommendations for providing air navigation facilities and services within a specific area. Affected governments can be assured that, if the recommended facilities and services are furnished in accordance with the plan, the facilities will become part of an integrated air navigation system adequate for the foreseeable future. The plans are amended periodically to reflect changes in requirements and in the implementation status of the facilities and services.

c. ***Aeronautical Information Publications (AIP's).*** Each state is responsible for developing an AIP that satisfies international requirements for the exchange of aeronautical information essential to air navigation. Each AIP contains information on air traffic, airports, navaids, special use airspace, weather, and other data vital to flightcrews coming into or flying through the airspace of a particular state. Each AIP should provide information that is adequate, accurate, timely, and designed for in-flight use. AIP's contain lists of significant differences between the national regulations and practices of the state and ICAO standards, recommended practices, and procedures. Notices to Airmen (NOTAM's) are issued when information is temporary or cannot be made available quickly enough by an AIP amendment.

4. U.S. PUBLIC LAW, INTERNATIONAL AGREEMENTS, AND STANDARDS RELATED TO AIR NAVIGATION.

a. ***The Federal Aviation Act of 1958, as Amended (The FA Act).*** The FAA authorities and responsibilities related to air navigation and navigation systems, practices, and procedures originate in the FA Act. Two important sections of the Act are Sections 307 and 601. Section 307 of the FA Act states that "The Secretary of Transportation is authorized and directed to develop plans for and formulate policy with respect to the use of the navigable airspace; and assign by rule, regulation, or order the use of the navigable airspace under such terms, conditions, and limitations (operational procedures and navigation performance requirements) as he may deem necessary in order to ensure the safety of aircraft and the efficient utilization of such airspace." Section 601a of the FA Act empowers the Secretary to "promote safety of flight of civil aircraft in air commerce by prescribing and revising from time to time ... minimum standards governing the ... performance of aircraft ... and appliances (navigation performance and navigation systems) as may be required in the interest of safety ... reasonable rules and regulations, or minimum standards, governing other practices, methods, and procedure ... necessary to provide adequately for national security and safety in air commerce."

b. ***Protection of Persons and Property.*** The need to ensure protection of persons and property, both during flight and on the ground, is fundamental to the Federal Aviation Regulations (FAR). Many of the design and performance requirements in aircraft certification rules are established to provide this protection. This protection is also extensively addressed in the operating and equipment rules related to air navigation. It is important that the regulations provide this protection equally to persons and property both during flight and on the ground. Approvals of route and areas of en route operation must take into account the need to protect persons and property on the ground as well as during flight.

c. ***Equipment Redundancy.*** Each airplane must have enough navigation equipment installed and operational to ensure that, if one item of equipment fails at any time during the flight, the remaining equipment will be sufficient to enable navigation to the degree of accuracy required for ATC. Additionally, failure of any single unit required for communication or navigation purposes or both, must not result in the loss of another required unit.

d. ***Relationship Between the FAR, ICAO SARP's, and National Regulations.*** The FA Act is the authority for the FAR. The FAR represent the regulatory implementation of the responsibilities assigned by the FA Act and the implementation of the principles derived from the ICAO Convention. The relationship between the FAR, ICAO SARP's, and foreign national regulations are discussed in the following subparagraphs.

(1) FAR Part 91 regulates the operation of aircraft other than moored balloons, kites, unmanned rockets, and unmanned free balloons that are governed by FAR Part 101, and ultralight vehicles operated in accordance with FAR Part 103. The following are examples of Part 91 regulations applicable outside the United States.

(a) FAR § 91.703(a)(1)(2) requires each person operating a U.S.-registered aircraft to comply with ICAO Annex 2 when over the high seas and to comply with the regulations of a foreign country when operating within that country's airspace.

(b) FAR § 91.703(a)(3) requires compliance with FAR § 91.703 when not in conflict with the regulations of a foreign nation or Annex 2 of the Convention on International Civil Aviation.

(c) FAR § 91.703 (a)(4), FAR § 91.705 and FAR 91 Appendix C specify regulatory requirements and minimum standards for operation in North Atlantic (NAT) Minimum Navigation Performance Specification (MNPS) airspace.

(2) For operators conducting operations under FAR Part 135, FAR § 135.3 (a) requires compliance with the applicable rules of that chapter while operating within the United States. FAR § 135.3 (b) specifies that while operating outside of the United States, operators must comply with the following:

(a) Annex 2, Rules of the Air, to the Convention on International Civil Aviation

(b) Rules of a foreign country when operating within that country

(c) All the regulations of FAR Parts 61, 91, and 135 that are more restrictive than Annex 2 or regulations of a foreign country when compliance with these U.S. regulations would not violate requirements of Annex 2 or the foreign country.

(3) For operators conducting operations under FAR Part 121, FAR § 121.1 requires compliance with that part while operating within or outside the United States. FAR § 121.11 specifies that these operators, when operating within a foreign country, must comply with the air traffic rules of the country concerned and any local airport rules which may be in force. FAR § 121.11 also requires that all rules of FAR Part 121 that are more restrictive than a foreign country's rules must be followed, if it can be done without violating the rules of that country. Additionally, air carriers operating under FAR Part 121 must comply with Annex 2 when over the high seas according to FAR § 91.1.

5. RELATIONSHIP OF U.S. OPERATIONAL FAR TO AIR NAVIGATION.

a. *Background.* Many FAR evolved to satisfy two basic objectives of air navigation. FAR related to air navigation have been promulgated and frequently changed to accommodate the need to efficiently handle a continuous growth in air traffic. Significant advances in air navigation technology, ATC techniques, and ATC equipment have permitted and required these regulations to evolve to their current status. Numerous operational FAR have been adopted to specifically satisfy the critical air navigation objective of safely separating aircraft. Certain FAR, such as those requiring filing an ATC flight plan and complying with ATC clearances, are clearly related to this objective. Other FAR are not as clearly related, but bave a direct bearing on the overall plan used to separate aircraft. The ATC system presumes compliance with all of the regulations related to air navigation. Any noncompliance with these regulations can seriously degrade the ability to separate aircraft. Examples of operational FAR related to air navigation and the objective of safely separating aircraft include the following:

(1) FAR § 91.123 - Compliance with ATC clearances and instructions

(2) FAR § 91.153 - Visual flight rules (VFR) and FAR § 91.169 - instrument flight rules (IFR) - Flight plan; information required

(3) FAR § 91.129 - Operation at airports with operating control towers

(4) FAR § 91.131 - Terminal control areas

(5) FAR § 91.137 - Temporary flight restrictions

(6) FAR § 91.135 - Positive control areas (PCA's) and route segments

(7) FAR § 91.709 - Operations to Cuba

(8) FAR § 91.143 - Flight limitation in the proximity of space flight operations

(9) FAR § 91.157 - Special VFR weather minimums

(10) FAR § 91.159 - VFR cruising altitude or flight level

(11) FAR § 91.173 - ATC clearance and flight plan required

(12) FAR § 91.179 - IFR cruising altitude or flight level

(13) FAR § 91.181 - Course to be flown

Subpart B of FAR Part 91 (Sections 91.101 through 91.193) does not, for the most part, apply to operations outside the United States. However, FAR § 91.1 makes FAR §§ 91.117(c), 91.130, and 91.131 applicable to operations technically outside the United States (for example, operations more than 3 statute miles offshore). This is necessary because terminal control areas (TCA's) and airport radar service areas (ARSA's) often extend more than 3 miles outside the continental United States. FAR § 91.703(a)(2), FAR § 135.3(b), and FAR § 121.11 all require compliance with the operational and maneuver rules of a foreign country when operating in the airspace of that country. Most foreign countries have operational and maneuver rules which are similar to U.S. rules related to air navigation as previously discussed.

b. ***FAR Specifying Air Navigation Equipment Requirements.*** Many FAR require certain aircraft equipment. These requirements relate directly to the air navigation objective of safely separating aircraft. Some of these equipment rules specifically relate to the operational requirement of navigating to the degree of accuracy required for ATC. The air navigation equipment rules of FAR Parts 121 and 135 are often supplemented by operations specifications which contain specific authorizations, limitations, and conditions that must be complied with by operators conducting flights under those parts. The discussion which follows references air navigation equipment requirements and provides direction, guidance, and clarification as appropriate.

c. ***FAR Part 91.*** FAR Part 91 specifies navigation equipment necessary to be compatible for operations in the U.S. national airspace system. The following is a list of FAR Part 91 requirements, with clarification when appropriate. Consult the appropriate FAR in addition to this material.

(1) FAR § 91.215 - ATC transponder and altitude reporting equipment and use.

(2) FAR § 91.171 - Very high frequency (VHF) omnidirectional radio range (VOR) equipment check for IFR operations.

(3) FAR § 91.205 - Powered civil aircraft with standard category U.S. airworthiness certificates; instrument and equipment requirements.

(a) FAR § 91.205(d)(2) requires air navigation equipment to be appropriate to the ground facilities to be used. The current U.S. national airspace system is based on VOR/distance measuring equipment (DME) ground facilities. Therefore, this regulation requires that VOR and/or VOR/DME equipment, or an area navigation (RNAV) system that meets the en route criteria of Advisory Circular (AC) 90-45, "Approval of Area Navigation Systems for Use in the U.S. National Airspace System," be installed in the aircraft and operable if it is to be used for IFR flight in U.S. national airspace. This navigational equipment is necessary to navigate to the degree of accuracy required for ATC. If the route to be flown is predicated on nondirectional radio beacon (NDB), then automatic direction finder (ADF) airborne equipment is also required.

(b) FAR § 91.205(e) requires approved DME when operating at or above 24,000 feet mean sea level (MSL) if the route or route segment is predicated on VOR. DME is not required, for example, when navigation is based on the use of an RNAV system which meets AC 90-45 en route performance and reliability criteria (or equivalent) without input from DME.

(4) FAR § 91.217 - Data correspondence between automatically reported pressure altitude data and the pilot's altitude reference.

(5) FAR § 91.219 - Altitude alerting system or device (turbojet powered civil airplanes).

(6) FAR § 91.209 - Aircraft lights.

d. ***FAR Part 135.*** FAR Part 135 specifies the navigational equipment necessary for all operations under Part 135, including operations outside the United States. These requirements are in addition to the navigational equipment requirements of FAR Part 91, but do not require duplication of any equipment specified in Part 91. The following is a list of FAR Part 135 navigation equipment requirements, with clarification as appropriate. Consult the appropriate FAR in conjunction with this material.

(1) FAR § 135.143 - General requirements.

(2) FAR § 135.149 - General equipment requirements.

(3) FAR § 135.159 - Equipment requirements: Carrying passengers under VFR at night or under VFR over-the-top conditions.

(4) FAR § 135.161 - Radio and navigation equipment: Carrying passengers under VFR at night or VFR over-the-top. FAR § 135.161 requires radio navigational equipment able to receive radio signals from the ground facilities to be used. The ground facilities and airborne equipment used must enable navigation to the degree of accuracy required for ATC. Airborne equipment requirements must also comply with Part B of the operations specifications.

(a) If the route is navigated using an RNAV system approved under the en route criteria of AC 90-45, the RNAV equipment must be installed and operable. VOR and/or ADF equipment are not required for en route operation if an RNAV system certified for IFR flight in accordance with AC 90-45 is installed and operable and all ground-based or space-based elements of the support system are serviceable.

(b) Unless the route is navigated using an RNAV system certified for IFR flight in accordance with AC 90-45, VOR equipment must be installed and operable if the route is predicated on VOR. ADF equipment must be installed and operable if the route is predicated on NDB.

(5) FAR § 135.163 - Equipment requirements: Aircraft carrying passengers under IFR.

(6) FAR § 135.165 - Radio and navigation equipment: Extended overwater or IFR operation.

(a) The requirements of FAR § 135.165 are not Class II navigation equipment requirements. This rule addresses Class I navigational requirements (VOR, DME, NDB). Part 135 does not have a rule which specifically addresses Class II navigation requirements. Part 135 Class II navigation requirements are specified in Part B of the operations specifications.

(b) This regulation requires two independent receivers for Class I navigation compatible with the facilities to be used. For en route navigation (excluding terminal operations), the facilities which must be used, whether self-contained, ground-based, or space-based, must enable navigation to the degree of accuracy required for ATC. Airborne equipment requirements must also comply with Part B of the operations specifications.

(c) If the route is navigated using an RNAV system approved under the en route criteria of AC 90-45, two independent RNAV systems must be installed and operable. Dual VOR and/or dual ADF equipment is not required for en route operations when two independent RNAV's systems, certified for IFR flight in accordance with AC 90-45, are installed and operable, and all elements of the support facilities are serviceable. For example, two independent Loran-C systems or one independent Loran-C system and some other approved independent RNAV system such as Omega would be acceptable configurations.

(d) Under specified conditions, Part B of the operations specifications permits an approved RNAV system fix to be substituted for an ICAO standard navaid when that facility is temporarily out of service.

(e) Unless routes are navigated using an RNAV system certified for IFR flight in accordance with AC 90-45, two independent VOR systems must be installed and operable if the route is predicated on VOR, and two independent ADF systems must be installed and operable if the route is predicated on NDB.

(7) FAR § 135.175 - Airborne weather radar equipment requirements. Airborne weather radar is normally used for thunderstorm detection and avoidance; however, Part B of the operations specifications requires weather radar to be installed, operational, and used for ground mapping to assist in navigation when conducting certain operations in the North Pacific (NOPAC) near Soviet airspace.

(8) FAR § 135.215 - IFR Operating limitations. This regulation specifies the degree of accuracy required when operating IFR outside controlled airspace. It also reflects the concept of "demonstrated ability" to safely conduct operations.

e. ***FAR Part 121.*** Part 121 specifies the navigational equipment necessary for all operations conducted under that part, including operations outside the United States. These requirements are in addition to the navigational equipment requirements of Part 91, but do not require duplication of any equipment specified in Part 91. All Part 121 en route requirements reflect the concept of "demonstrated ability." The following is a list of Part 121 navigation equipment requirements, with clarification as appropriate. Consult the appropriate FAR in conjunction with this material.

(1) FAR §§ 121.93 and 121.113 - Area and route requirements: General. The air carrier must demonstrate its ability to conduct satisfactory operations over the routes and areas in which it operates. Approvals in areas and on specific routes are granted in operations specifications and listed by "area of en route operation" and by specific route when appropriate. The general requirements

specified in FAR §§ 121.93 and 121.113 are not applicable to Class II navigation. Parts B and C of the operations specifications stipulate requirements for operations outside controlled airspace.

(2) FAR §§ 121.95 and 121.115 - Route width. These regulations specify the degree of lateral navigation precision necessary for the control of air traffic in Class I navigation. Part B of the operations specifications also stipulates certain route width requirements.

(3) FAR §§ 121.103 and 121.121 - En route navigational facilities. FAR §§ 121.103 and 121.121 are the basis of all other Part 121 regulations for en route navigation requirements.

(a) FAR §§ 121.103(a) and 121.121(a) implement the concept of "navigation performance" when conducting IFR Class I navigation and certain types of Class II navigation that use nonvisual ground aids. Nonvisual ground aids are electronic navaids, but are not necessarily limited to VOR, DME, or NDB. Omega and Loran-C are examples of navigation systems considered nonvisual ground aids. Each Part 121 operator must show that nonvisual ground aids are available and that they are located to allow navigation to the degree of accuracy required for ATC and for the type of operation involved.

(b) RNAV systems certified in accordance with the criteria in AC 90-45A meet the intent of FAR §§ 121.103 and 121.121 when conducting Class I navigation (including space-based systems such as NAVSTAR Global Positioning System (GPS)).

(c) Certain long-range operations may be conducted under these regulations using one or more of the following navigational equipment:

- Omega systems certificated under AC 120-37
- Automatic Loran-C systems certificated under AC 20-121
- Future operations using satellite-based systems such as NAVSTAR GPS

(d) When operating in the U.S. PCA, RNAV systems which have not been demonstrated to meet the criteria in AC 90-45 meet the intent of these rules provided the ATC radar is serviceable and dual airborne VOR/DME equipment is installed and operable. Operations specifications provide authorization to conduct operations in the U.S. PCA using these RNAV or long-range navigation systems.

(e) FAR §§ 121.103 and 121.121 do not specifically state or imply a redundant navigation equipment capability. In addition, these regulations do not apply to VFR pilotage operations, operations with a flight navigator, or long-range navigation operations using inertial navigation systems (INS) or Doppler.

(4) FAR § 121.305 - Flight and navigational equipment.

(5) FAR § 121.323 - Instrument and equipment for operations at night.

(6) FAR § 121.325 - Instruments and equipment for operations under IFR or over-the-top.

(7) FAR § 121.345 - Radio equipment.

(8) FAR § 121.347 - Radio equipment for operations under VFR over routes navigated by pilotage. FAR § 121.347(b) specifies that for night VFR pilotage operations the airplane must be equipped with the radio equipment necessary to receive radio navigational signals applicable to the route flown.

(a) If the route is navigated using an RNAV system, radio navigational signals compatible with the airborne RNAV system must be available if required for the system to perform its intended function. Unless the route is navigated using an RNAV system certified for IFR flight in accordance with criteria in AC 90-45, airborne VOR equipment is required when the route is predicated on VOR. Airborne ADF equipment is required when it is predicated on NDB.

(b) Although FAR § 121.611 permits VFR en route operations, Part 121 operators are generally prohibited from conducting VFR en route operations by Part B of the operations specifications. Certain FAR Part 121 operators may be specifically authorized to conduct VFR en route operations in special situations.

(c) This rule does not apply to Class II navigation.

(9) FAR § 121.349. Radio equipment for operations under VFR over routes not navigated by pilotage or for operations under IFR or over-the-top. The essential requirement of this regulation is that airplanes must be equipped to receive radio navigational signals from all primary en route and approach navigational facilities intended to he used.

(a) The intent of this regulation is to require redundant airways navigation capability (VOR, VOR/DME, NDB) to ensure the ability to navigate to the degree of accuracy required for ATC when conducting Class I navigation. FAR §§ 121.103 and 121.121 clearly state that nonvisual ground aids are not required for operations over routes where celestial or other means of navigation are approved by the Administrator. Since all IFR primary en route and approach navigation facilities have historically been nonvisual ground aids (standard ICAO navaids), FAR § 121.349 is intended to apply only to operations over routes predicated on VOR, VOR/DME, or NDB.

(b) FAR § 121.349 applies only to Class I navigation operations and those Class II navigation operations predicated on VOR, VOR/DME, and/or NDB. FAR §§ 121.103, 121.121 and 121.389 apply to all other Class II navigation operations. The intent of FAR § 121.349 is met when any Class I navigation operation is predicated on the following:

- VOR, provided dual independent VOR equipment is installed and operable in the airplane

- NDB, provided dual independent ADF equipment is installed and operable in the airplane. However, if one ADF system and a dual independent VOR system are installed and operable, the intent of FAR § 121.349 is met provided VOR navaids are located at ground positions that would permit the flight to safely proceed (from any point along the route) to a suitable airport and complete an instrument approach without using ADF equipment

• RNAV systems, provided dual independent RNAV systems certified under AC 90-45 are installed and operable

• Part B of the operations specifications permits (under specified conditions) an RNAV system fix to be substituted for an ICAO standard navaid when that facility is temporarily out of service

(10) FAR § 121.351 - Radio equipment for extended overwater operations and for certain other operations. This regulation applies only to Class I navigation and those Class II navigation operations predicated on VOR, VOR/DME, and/or NDB. FAR §§ 121.103, 121.121, and 121.389 apply to all other Class II navigation operations.

(11) FAR § 121.357 - Airborne weather radar equipment requirements. Airborne weather radar is normally used for thunderstorm detection and avoidance; however, Part B of the operations specifications requires weather radar to be used for ground mapping to assist in navigation when conducting certain operations in the NOPAC near Soviet airspace.

(12) FAR § 121.355 - Equipment for operations on which specialized means of navigation are used. This regulation limits the definition of specialized means of navigation. It defines "specialized means of navigation" as INS and Doppler operations when operating outside the United States. FAR § 121.355 is referenced in FAR § 121.389, which requires specialized means of navigation (INS or Doppler) to be approved in accordance with FAR § 121.355. INS and Doppler are Class II navigational systems; however, other types of navigational systems are also approved for Class II operations.

(13) FAR § 121.389 - Flight navigator and specialized navigation equipment. The conceptual basis of this regulation is the phrase "when its position cannot be reliably fixed for a period of more than 1 hour."

(a) "Reliably fixed," as defined in the operations specifications, means station passage of a VOR, VORTAC, or NDB. A reliable fix also includes a VOR/DME fix, an NDB/DME fix, a VOR intersection, an NDB intersection, and a VOR/NDB intersection provided course guidance is available from one of the facilities and the fix lies within the operational service volume of both facilities that define the fix.

(b) FAR § 121.389 does not apply to those situations when the airplane's position can be reliably fixed at least once each hour to the degree of accuracy required for the control of air traffic. If the operator can show compliance with FAR §§ 121.103 and 121.121, the requirements of FAR § 121.389 are automatically met by providing fixes more frequently than once an hour. Therefore, Class II navigation operations using Omega systems or automatic Loran-C systems meet the requirements of FAR §§ 121.103 or 121.121 and are approved under these regulations.

(c) Class II operations with Doppler and INS systems are approved under FAR § 121.355 and FAR Part 121, Appendix G.

(d) Class II navigation systems are divided into two categories.

• INS and Doppler systems are defined as specialized means of navigation and are addressed in FAR §§ 121.389 and 121.355. They are self-contained, dead reckoning (DR) systems that have no position-fixing capabilities.

• Loran-C and Omega systems are position-fixing or position-keeping devices that receive signals from an external source. Loran-C and Omega are nonvisual ground aids and are addressed in FAR §§ 121.103 and 121.121, En route navigational facilities. In the future, GPS will also fit into this category.

(e) Class II navigation operations using VOR, VOR/DME, and/or NDB can be conducted under certain conditions, provided that the airplane's position is reliably fixed (at least once each hour) to the degree of accuracy required for the control of air traffic.

CHAPTER 2. OCEANIC OPERATIONS FOR ALL AIRCRAFT IN ALL GEOGRAPHIC AREAS

1. INTRODUCTION.

It is imperative for all pilots planning an oceanic flight to become familiar with the appropriate Federal Aviation Regulations (FAR) and the information contained in Notices to Airmen (NOTAM's), International Flight Information Manual (IFIM), Aeronautical Information Publication (AIP), International Civil Aviation Organization (ICAO) Annexes, and regulations of the foreign countries over which they intend to fly. In addition, customs procedures, cultural considerations, entry and overflight procedures, and immunization requirements must be considered. Pertinent FAR for various flight configurations are listed in this Advisory Circular (AC). Other referenced documents are listed in Appendix 3, with information on their contents and publishers.

a. ***Legal Basis for International Operations.*** During oceanic flights, pilots must adhere to the U.S. regulations, ICAO regulations, and the regulations of the nations that they overfly or in which they land. This requirement is based upon the Convention on International Civil Aviation, commonly known as the Chicago Convention. The General Principles and Application of the Convention were signed by the United States on December 7, 1944, ratified on August 9, 1946, and became effective on April 4, 1947 (see Chapter 1). This document defined numerous aspects of international operations. Flight regulations for oceanic operations are specifically covered in Annex 2, "Rules of the Air." FAR § 91.703 ensures that the Rules of the Air are binding to operators of U.S.-registered aircraft operating outside of the United States, and it is the FAA's responsibility to ensure that pilots of U.S.-registered aircraft comply with these regulations.

b. ***Information Sources.*** Member states follow ICAO guidelines by publishing statistical aeronautical information in the AIP for a flight information region (FIR). The AIP is the state's official publication that defines and describes the airspace, aeronautical facilities and services, and national rules and practices pertaining to air traffic. AIP's are available through the aviation departments of the publishing country. AIP's for each FIR to be flown over should be consulted during the planning of any international flight. Some ICAO member states jointly produce and publish AIP information in a single volume. Others do not publish AIP information in book form, but issue AIP information through NOTAM's. It is imperative that pilots and/or flight departments consult NOTAM's to determine if changes to published data have occurred. International NOTAM information is available from the U.S. International NOTAM office or through local flight service stations (FSS).

c. ***Precautions.*** Operators are advised to ensure full compliance with each country's requirements in advance. This ensures that all flights into, from, or over foreign territories comply with that territory's regulations. Particular attention should be given to the permissibility of night flights and operations between sunset and sunrise. The hours during which customs, immigration, and other services are operational should also be considered. Information on a country's normal work week may be obtained from the U.S. Embassy. All countries require some form of advance notification of arrival. If a number of days or hours advance notice is not specified, notification should be sent far enough in advance to permit processing and response. Pilots should carry a copy of the advance notification as well as confirmation that the notification was sent. This is particularly important for countries that do not normally return request approvals. Operators should ensure that all required entry documents are available for presentation upon arrival. Multiple copies may be needed of documents such as ownership papers, general declarations, passenger and cargo manifests, licenses, crewmember certificates, logbooks, radio licenses, etc. Availability, types, and duration of visas, tourist cards, and other entry documents should be determined before departure. Some countries require that a traveller have a visa for the next country of entry before departure, as well as proof of required immunizations for that country. This information can be obtained from the U.S. Embassy. Aircraft that will remain within the territorial limits of a country for an extended period of time may become subject to import regulations and may be impounded. Operators should determine in advance the number of days that an aircraft may remain in any country where the aircraft will land.

2. FEDERAL AVIATION REGULATIONS PERTINENT TO INTERNATIONAL OPERATIONS.

This section lists specific FAR that are pertinent to international operations. This listing is a compilation of FAR that have particular importance in international operations. Crews are advised to reference these FAR prior to planning an oceanic or international flight. This listing of FAR is for guidance only, and does not eliminate or provide relief from other FAR that are not listed. Pilots transporting aircraft internationally should also be aware of the contents of Chapter III, "Nationality for Aircraft," in the agreements of the Chicago Convention.

FAR PART 45 - IDENTIFICATION AND REGISTRATION MARKING

SUBJECT	FAR
Nationality and Registration Marks - General	§45.21
Display of Registration Marks - General	§45.23
Size of Registration Marks	§45.29
Marking of Export Aircraft	§45.31

* These regulations are especially noteworthy in regard to international operations. They each contain citizenship requirements relative to the legality of an aircraft registration and will be checked by inspectors upon application for any required Letter of Authorization (LOA).

FAR PART 47 - AIRCRAFT REGISTRATION

SUBJECT	FAR
Registration required	§47.3
Applicants for Aircraft Registration	§47.5
* Certification of U.S. Citizenship	§47.7
* Voting trust	§47.8
* Corporation not U.S. citizen	§47.9
Evidence of Ownership	§47.11
Effective Date of Aircraft Registration	§47.39
Invalid registration	§47.43
Cancellation of Certificate for Export	§47.47

FAR PART 91 - GENERAL OPERATION AND FLIGHT RULES

SUBJECT	FAR
Survival Equipment for Overwater Operations	§91.509
Radio Equipment for Overwater Operations	§91.511
Operation of Civil Aircraft of U.S. Registry Outside of the United States	§91.703
Operations Within the North Atlantic Minimum Navigation Performance Specifications Airspace	§91.705
Flights Between Mexico or Canada and the United States	§91.707
Operations to Cuba	§91.709

FAR PART 135 - AIR TAXI OPERATIONS AND COMMERCIAL OPERATORS

SUBJECT	FAR
Crewmember Certificate, International Operations: Application and Issue	§135.43
Aircraft Proving Tests	§135.145
Radio and Navigation Equipment: Extended Overwater or IFR Operations	§135.165
Emergency Equipment: Extended Overwater Operations	§135.167
Performance Requirements: Land Aircraft Operated Overwater	§135.183

FAR PART 121 - COMMERCIAL OPERATORS

SUBJECT	FAR
Rules Applicable to Operations in a Foreign Country	§121.11
En Route Navigation Facilities	§121.121
Emergency Equipment for Extended Overwater Operations	§121.339
Radio Equipment for Extended Overwater Operations and Certain Other Operations	§121.351
Emergency Equipment for Operations Over Uninhabited Terrain Areas	§121.353
Doppler Radar and Inertial Navigation Systems	Appendix G

FAR PART 125 - CERTIFICATION AND OPERATION OF AIRPLANES HAVING A SEATING CAPACITY OF 20 OR MORE PASSENGERS OR A MAXIMUM PAYLOAD CAPACITY OF 6,000 POUNDS OR MORE

SUBJECT	FAR
Emergency Equipment: Extended Overwater Operations	§125.209
Flight Release Overwater	§125.363

3. PLANNING.

Adequate planning is the key to a successful international flight, whether it be an airline or a single-engine light aircraft. The lead time required for planning varies with the experience and training background of the crew and the amount of assistance available from a company dispatcher or a planning agency. Planning can never start too early and should always be done within 30 days lead time if at all possible. Experienced crews flying the same route on a regular basis can reduce planning time significantly, but a new crew or a crew flying a new route should adhere to the 30 days rule of thumb.

Many crews utilize flight planning agencies for flight planning. While most agencies do an excellent job, planning agencies only provide the information that is requested, and they are not responsible for errors. The pilot-in-command (PIC) is ultimately responsible for the operation of the aircraft. Although an error may be caused by a planning agency, the PIC is still the responsible party. Some crews prefer to do their own planning, or do so for economic reasons. The following information is provided to assist in planning an oceanic operation.

a. ***Preflight Considerations.*** Pilots planning international flights should complete the following tasks:

(1) Research the IFIM.

(2) Arrange handling if the flight will be landing in several countries. This is extremely important if there are multiple passengers on the aircraft.

(3) Arrange hotel and ground transportation ahead of time. It is prudent to ensure that the correct grade of fuel is available at the planned arrival points.

(4) Prepare flight plan/logs and ICAO flight plans (see Appendix 1).

(5) Obtain and complete the required documents:

- general declarations.
- passenger/cargo manifests.
- ensure that all passengers have passports, visas (if required), and health cards.
- crew lists with certificate information, medical data and passport number. Ensure that the crew has all of the paperwork required of the passengers plus their pilot and medical certificates.

(6) Contact Customs as required.

(7) Complete the checklist and carefully review each of the items to ensure that all items are complete. A sample checklist is included at the end of this Chapter.

b. ***Itinerary Preparation.*** Preparing the itinerary is one of the most important aspects of an international flight. Experienced international pilots have often observed that the most difficult, but important, part of an international flight takes place before the aircraft departs. This paragraph presents some questions that a preflight planner must consider:

(1) What is the destination of the flight?

- Is an alternate destination available within range of the aircraft?
- Is lodging available at the destination?
- Is the appropriate grade of fuel available?
- Is a landing permit required at the destination?
- Is a visa required at the destination? Is cabotage allowed?
- Does a State Department warning exist for health, security, or other precautions?
- Are maintenance services available at the destination airport? Should spare parts be carried?

(2) En route airports - use the same guidelines as for the destination airport.

(3) Distance between stops - how was navigation distance determined?

- International Air Traffic Association (IATA) Distance Manual
- globe
- chart measurement
- long-range navigation system
- computer flight planning service
- other

(4) Equal time point (ETP) considerations:

- pressurization ETP where an altitude change is mandated
- loss of engine ETP in a multiengined aircraft

- combined problem (pressurization and loss of engine)

(5) Ground time at airports:

- passenger requirements
- turnaround capacity
- crew rest requirements, if applicable
- next stop arrival time

(6) Time considerations:

- local time
- UTC (Zulu) or Greenwich time
- local time at departure airport

c. ***The International Notice to Airmen (IN).*** The IN is a biweekly compilation of significant international information and special notices which could affect a pilot's decision to enter or use certain areas of foreign or international airspace. Of crucial important to those seeking to enter potentially dangerous areas of the world, this publication complements and expands upon data contained in the IFIM. The distribution of U.S. international NOTAM's to foreign international NOTAM offices (NOF's) and the receipt and distribution of foreign international NOTAM's are accomplished by the U.S. International NOTAM Office (U.S. NOF), a part of the National Flight Data Center (NFDC) in Washington, DC.

NOF's exchange Class I NOTAM's with the other NOF's via the Aeronautical Fixed Telecommunication Network (AFTN). Class I NOTAM's are distributed via telecommunication; Class II NOTAM's are delivered via the U.S. Postal Service. NOTAM's from foreign NOF are received via AFTN at the FAA National Communication Center in Kansas City, Missouri and relayed to the U.S. NOF in Washington, DC. The U.S. NOF receives all incoming Class I NOTAM's for processing and automatic distribution to U.S. aviation users.

The U.S. NOF reviews all Class I NOTAM's received to ensure their completeness, for conversion into English plain-text, and for distribution to aviation users in the conterminous United States, Alaska, Hawaii, and Puerto Rico. Upon distribution, all Class I NOTAM's are simultaneously entered into a computerized International NOTAM file at the National Communication Center in Kansas City according to both NOTAM number and location. Computer storage of Class I international NOTAM information allows the NOTAM's to be made available for instant recall by all FSS's and AFTN subscribers through the request-reply feature of the Service B and AFTN telecommunication networks.

Only current Class I NOTAM's are available by request-reply on Service B and AFTN. The Kansas City computerized NOTAM file may be queried for a list of all NOTAM's by geographic location or for a single NOTAM number (airspace NOTAM's are filed under the issuing NOF).

The United States does not exchange Class I international NOTAM's with all foreign international NOF's. A complete tabulation of international NOTAM exchanges among international NOF's and the areas of responsibility for each NOF is contained in Appendix 1 of this AC.

d. ***International Flight Plans.*** Flight plans are required for all flights into international and foreign airspace. The standard flight plan form is FAA Form 7233-4, "International Flight Plans," available at most U.S. Flight Service Stations. (A blank copy of this form is contained in Appendix 1). The FAA complies with the ICAO Format, except that it does not accept cruising speed/level in metric terms. (See Appendix 1 of this circular for conversion of U.S. measurements to metric measurements.) Flight plans must be transmitted to, and should be received by, air traffic control (ATC) authorities in each ATC region to be entered at least 2 hours prior to entry, unless otherwise required by an en route or destination country. It is extremely important that, when filing flight plans in countries outside the United States, inquiries be made by the pilot as to the method used for subsequent transmission of flight plan information to en route and destination points and of the approximate total elapsed time applicable to such transmissions.

The flight plan provides advance notice of foreign airspace penetration and facilitates effective ATC procedures. For some countries, the flight plan is the only advance notice required; other countries use the flight plan as a check against previously granted permission to enter national airspace. Acceptance of a flight plan and issuance of a flight clearance by a foreign ATC unit does not constitute official approval for airspace penetration if prior permission for airspace penetration is required by civil aviation authorities and such permission has not been previously secured. Airspace violations that occur in such instances are pursued, and in-flight interception may result.

In the case of flights outside of U.S. airspace, it is particularly important for pilots to leave a complete itinerary and flight schedule with a responsible person. That person should be kept apprised of the flight's progress and instructed to contact an FSS or the nearest U.S. Foreign Service Post (embassy and consular office) if serious doubt arises as to the safety of the flight. Whenever an aircraft of U.S. registry or any aircraft with U.S. citizens aboard is reported to be in distress or missing during flight in or over foreign territory or foreign territorial waters, all available information should be passed to the nearest U.S. Foreign Service Post as well as the search and rescue (SAR) facilities and services in that area.

e. ***Operation Reservations for High Density Traffic Airports (HDTA's).*** The Federal Aviation Administration (FAA), by FAR Part 93, Subpart K, as amended, has designated the John F. Kennedy, LaGuardia, Chicago O'Hare, Washington National and Newark Airports as high density airports and has prescribed air traffic rules and requirements for operating aircraft to and from these airports. (The quota for Newark Airport has been suspended indefinitely.) Reservations for Kennedy are required between 3 p.m. and 7:59 p.m. local time. Reservations at O'Hare are required between 6:45 a.m. and 9:15 p.m. local time. Reservations for LaGuardia and Washington National are required between 6 a.m. and 11:59 p.m. local time. Helicopter operations are excluded from the requirements for a reservation.

Operators planning on arriving or departing from any of the above airports during the reservation required time should reference Advisory Circular 90-43 and FAR Part 93, Subpart K, as amended. The filing of an instrument flight rules (IFR) or a visual flight rules (VFR) Flight Plan and/or an ATC clearance does not satisfy the reservation requirements. Reservations can be made, changed, canceled or confirmed on The Automated Voice Reservation System (AVARS). The AVARS is available 24 hours a day, can be called toll-free, and provides a reservation number that guarantees a slot. A touch-tone telephone is required to access the AVARS. A computer-synthesized voice will prompt all required inputs. To make a reservation though AVARS utilize one of the following numbers:

Within the continental U.S. dial 1-800-FAA-1212
Outside the continental U.S. dial (617) 576-9549

f. ***Civilian Use of U.S. Military Fields.*** U.S. Army, Air Force, Navy, Marine, and Coast Guard fields are open to civilian use in emergencies or with prior permission. The commanding officer authorizes civilian use of Army facilities. For use of Air Force installations, prior permission should be requested under the provisions of Air Force Regulation 55-20 at least 30 days prior to the first intended landing. This request should be made to U.S. Air Force (USAF) Headquarters, or may be made to the commander of the installation who has the authority to approve landing rights for certain categories of civil aircraft. For use of more than one Air Force installation, requests should be forwarded directly to: Headquarters USAF (PRPJA), Washington, DC 20330. Use of USAF installations must be specifically justified.

Prior permission for use of Navy or Marine Corps installations should be requested at least 30 days before the first intended landing. With minor exceptions, permission to use Navy and Marine Corps fields is granted only to aircraft on government business or when no suitable civil airport is available in the vicinity. An Aviation Facility License must be approved and executed by the Navy prior to any landing by civil aircraft. Requests must include an application for the Aviation Facility License (OPNAV Form 3770/1) in quadruplicate, and an official Certificate of Insurance (NAVFAC Form 7-11011/36) bearing the original signature of an official of the insurance company. Application forms may be obtained from any U.S. Navy or Marine Corps aviation facility. Applications should be forwarded to: Commander, Naval Facilities Engineering Command, Code 2041L, 200 Stovall Street, Room 10N45, Alexandria, VA 22332-2300. The telephone number is (703) 325-0475.

At Coast Guard fields, prior permission should be requested from the Commandant, U.S. Coast Guard, through the commanding officer of the field to be used. Use of Coast Guard fields is limited to persons on government business only when no suitable civil airport is in the vicinity.

When instrument approaches are conducted by civil aircraft at military airports, the approaches shall be conducted in accordance with the procedures and minimums approved by the military agency having jurisdiction over the airport.

g. ***Cabotage.*** Private pilots and commercial operators should understand "cabotage," formally defined as "air transport of passengers and goods within the same national territory." The definition adopted by ICAO at the Chicago Convention is, "Each state shall have the right to refuse permission to the aircraft of other contracting states to take on its territory passengers, mail, and cargo destined for another point within its territory." Although cabotage rules are different in various countries and usually incorporate the term "for hire," some countries do not allow even nonrevenue passengers to be carried by a foreign aircraft within their boundaries. The restrictions range from no restrictions as in Italy, to not allowed, as in Pakistan. The fines for cabotage can be extremely high; therefore, pilots and flight departments should be absolutely sure of a country's cabotage rules before carrying passengers. The cabotage requirements and restrictions of individual countries are listed in the corporate aircraft restraints section for each country in the IFIM. Refer to Chapter II, Article 7 of the Chicago Convention.

h. ***Flight Planning Firms and Ground Handling Agents.*** The assistance of fixed base operators or airport service organizations may be nonexistent at overseas destinations outside of western Europe. Many countries do not have sufficient general aviation traffic to require these services or to generate any profitability. Therefore, the assistance of a ground handling agent may be essential, and most always expedites handling. A domestic or regional airline or U.S. flag (international) airline with operations at the specific foreign destination airport can frequently provide some of the necessary services, such as help with customs, immigration, public health procedures, and expediting shipment of spare parts. Aircraft maintenance may also be arranged through these agents. Flight planning firms may also be able to provide for these services. A wide range of services is offered by firms that specialize in obtaining overflight and landing permits, security information, computerized flight planning, charts, international NOTAM's, communication services, flight following, weather, ground handling of passengers, and ground handling of aircraft. It is important to remember that the responsibility for a flight rests with the pilot, not with ground handlers and/or flight planning firms.

i. ***Journey Logbooks.*** Article 34 of the Chicago Convention requires that each aircraft engaged in international aviation carry a journey logbook in which is entered particulars of the aircraft, the crew, reporting points, communications problems, and any unusual circumstances surrounding the flight.

j. ***Significant Sections of the Chicago Convention.*** Pilots planning international flights should know the regulations of their country, special regulations for international flight, and the Articles of the Chicago Convention. Particular attention should be given to Article 1, "Sovereignty"; Article 12, "Rules of the Air"; and Article 40, "Validity of Endorsed Certificates and Licenses." These three Articles are singled out because of their importance in regulating international flights, and should be thoroughly understood by pilots flying internationally.

4. DOCUMENTATION.

a. ***Personal Documentation Requirements.*** When planning a trip to a foreign country, proper personal documentation for all participants, flightcrew and passengers alike, must be obtained. The flightcrew is required to carry at least a restricted radio telephone operator's license, even though the license is no longer required domestically. Requirements for individual countries may be found in the IFIM, the Travel Information Manual published by the International Air Transport Association (IATA), and other commercial publications. It is extremely important that flightcrews, if carrying passengers to foreign countries, make certain that passengers have all the required documents. Flights can be delayed and numerous other problems develop if all participants do not have the required documents. The responsibility for documentation varies with individual operations, but the

PIC will bear the responsibility either directly or indirectly because of the effect on the flight operation.

Territories subject to the jurisdiction of the United States, Canada, Bermuda and some Caribbean basin countries do not require passports. Mexico and some other countries may be visited for short periods of time using tourist cards (similar to a visa) issued by that country at the time of entry. Some ports of entry may require working visas for the flightcrew. Even when not required, it is always prudent to carry a current passport in a foreign country. Some countries require proof of nationality, and if the crew always carries their passports they will not be subjected to the difficulties of determining what form of identification is acceptable. In the case of children under the age of 18, consent of a parent, proof of citizenship, and positive identification are required. A passport or birth certificate is positive identification, but a driver's license is not acceptable.

b. ***Passports.*** A passport may be obtained by submitting an application in person to a passport agent, a clerk of any federal court, a clerk of any state court of record, a judge or clerk of any probate court, or a postal clerk designated by the Postmaster General. Under certain circumstances, a person holding an expired passport issued within the last 8 years can submit the expired passport and application by mail. Contact the nearest passport agent for more information. Telephone numbers are listed in the U.S. Government section of most telephone books.

The following documents are acceptable proof of U.S. citizenship:

(1) A passport previously issued to an applicant, or one in which he/she was included, is proof of U.S. citizenship in lieu of the documentary proof described in the following paragraphs.

(2) A person born in the United States may present his/her birth certificate. To be acceptable, the certificate must show the birth record was filed shortly after birth. The certificate must bear the registrar's signature and the raised, impressed, or multicolored seal of the registrar's office. Uncertified copies of birth certificates are not acceptable. If such primary evidence is not obtainable, a notice from the registrar stating that no birth record exists may be used. The notice shall be accompanied by the best obtainable secondary evidence such as a baptismal certificate, a certificate of circumcision, a hospital birth record, affidavits of persons having personal knowledge of the facts of the birth, or other documentary evidence such as early census, school, or family bible records, newspaper files and insurance papers. Secondary evidence should be documented as close as possible to the date of birth. All documents used as evidence of U.S. citizenship by birth must include the place and date of the applicant's birth and hear the seal of the office, if customary, and signature of the person before whom such documents were executed or by whom they were issued.

(3) A person who claims U.S. citizenship by naturalization may use their Certificate of Naturalization.

(4) If U.S. citizenship was acquired through naturalization of a parent or parents, or by birth abroad to a U.S. citizen, the Certificate of Citizenship issued by the Immigration and Naturalization Service may be used. If such a certificate is not available, citizenship may be supported by a parent's Certificate of Naturalization, the applicant's foreign birth certificate, and evidence of admission to the

United States for permanent residence. If citizenship was acquired through the naturalization of a sole parent, the other having been an alien, the applicant may present the divorce decree showing the naturalized parent has custody, or the death certificate of the alien parent, when appropriate.

(5) A Consular Report of Birth (Form FS-240) or Certificate of Birth (Form DS-1350 or Form FS-545) issued by the Department of State may be used if citizenship was acquired through birth abroad to a U.S. citizen. If neither of these are available, the foreign birth certificate, evidence of the U.S. citizenship of the parent, and an affidavit from the parent showing the periods and places of residence in the United States and abroad (specifying precise periods abroad in U.S. Armed Forces, in other U.S. Government employment with qualifying international organizations, or as a dependent of such persons) before birth of the applicant may be used.

c. ***Lost or Damaged Passports.*** The holder of a passport has a serious responsibility to guard that passport from loss or damage. Altered or damaged passports shall not be used for travel. Such passports shall be surrendered to a passport agent, clerk of the court, or other U.S. Government official. Any new passport issued to replace a lost valid passport will be limited to 3 months. The address and notification data appearing on the inside front cover of the passport may be changed by the passport bearer. The passport need not be submitted to a government official for such changes. All other entries or changes, however, must be made by an authorized official. The loss of a valid passport is a serious matter, and should be reported in writing immediately to: Passport Office, Department of State, Washington, DC 20524, or to the nearest U.S. consular office when abroad.

d. ***Visas.*** Visas are endorsements of a passport issued by an embassy or consulate of a country to be visited. These grant permission for the individual named on the passport to enter and exit that country. Some countries issue visas that grant multiple entries, while others authorize only a single entry. Various types of visas are issued, depending upon the nature of the visit and the intended length of stay. A valid passport must be submitted when applying for a visa of any type. A visa may be obtained from foreign embassies or consulates located in the United States. Visas are not always obtainable at the foreign airport of entry, and verification of visa issuance must be made in advance of departure. A visa service can help travelers obtain this document. The names of such organizations are listed in the telephone classified directory. The photographs accompanying visa applications should be full view and should not be larger than 3 x 3 inches nor smaller than 2.3 x 2.5 inches on white background.

e. ***Aircraft Document Requirements.*** The FAR require that the airworthiness certificate, aircraft registration certificate (a temporary registration certificate or "pink slip" is not acceptable for international travel), Federal Communication Commission (FCC) license (commonly referred to as "radio station license") and operator's manual with weight and balance information to be carried on board the aircraft during international flights. The radio station license has additional significance abroad, and its necessity should not be taken lightly. The airframe logbooks, the engine logbooks, and insurance certificates will also be needed. In the case of Mexico, the insurance certificates will need to be purchased from a Mexican firm. In operations of corporate aircraft, the company's aviation underwriter should be contacted for additional details. Some countries will require a LOA on the operating country's letterhead before the aircraft can be operated in those countries. In operations of private aircraft, if the owner is the pilot or is on board the aircraft, there are usually no difficulties. However, if the aircraft owner is not on board the aircraft, many countries require a letter from the owner that authorizes international flight in that specific country before they will allow operations within their country. Operations in North Atlantic (NAT) airspace require an Minimum Navigation Performance Specification (MNPS) airspace LOA or operation specifications approval. Details of NAT operations are covered in Chapter 4 of this AC.

Export licenses from the U.S. Department of Commerce are necessary for certain navigation systems and/or aircraft if the operations will include certain bloc countries. When aircraft have been manufactured abroad and are U.S.-registered, a copy of the import duty receipt should be retained in the aircraft's file. This receipt, which proves that the aircraft was legally imported into the United States, may be required for return to the United States. Aircraft entry requirements are delineated in the IFIM and numerous commercial publications. As previously stated, the flightcrew must also ensure that current and special notices relating to entry and overflight requirements are followed. In most cases outside North America and western Europe, prior permission to land in or overfly a country must be obtained directly from that country's civil aviation authority.

The American Embassy in a destination country may be of assistance in some instances and a required point of contact in others. Entry to most countries must be made through specific airports of entry that are agreed to by ICAO members and listed in the ICAO Regional Air Navigation Plan, the country's AIP, the IFIM, and other commercial publications. Depending upon the country, it may take 4 hours to 6 weeks to obtain overflight and landing permits. The requirements vary from country to country. Some countries will not allow overflights without a landing, usually to collect airspace user fees. Therefore, action to obtain landing and overflight permits must be one of the first steps in planning any flight outside of the United States. The following list of documents should be included as aircraft documentation. These documents should be on board any aircraft flying internationally. Items marked with a double asterisk (**) are specified in the Articles of the Chicago Convention. A checklist that includes required documents is included at the end of this Chapter.

(1) Airworthiness certificate. **

(2) Aircraft registration (no pink slips are allowed on international fights). **

(3) Radio station license. **

(4) Minimum equipment list (MEL) if operator plans on operating under this option.

(5) Aircraft flight manual with weight and balance information.

(6) MNPS LOA if planning on operating in MNPS airspace.

(7) Metric conversion tables (see Appendix 1) with preconverted aircraft size and weights.

(8) Copies of aircraft and engine logbooks.

(9) Certificates of insurance (original signature required), U.S. military and foreign as required (some foreign countries such as Mexico require that insurance be purchased from the country in which the travel is to take place).

(10) Export licenses for aircraft navigation equipment (U.S. requirement). Check with the U.S. Department of Commerce.

(11) Import papers for aircraft of foreign manufacture.

(12) Copies of overflight and landing permissions.

(13) Authorization letters from the operating company or the aircraft owner (original signature required).

(14) Journey logbook. **

(15) A passenger manifest containing complete names of passengers and places of embarkation and destinations of each. **

(16) If cargo is carried, a manifest and detailed declaration of the cargo. **

5. EQUIPMENT.

a. ***ICAO Requirements.*** Annex 6 (Part 1 - International Commercial Air Transport - Aeroplanes and Part 2 - International General Aviation - Aeroplanes) to the Convention on International Civil Aviation details ICAO rules with respect to required equipment. A listing of these requirements is included herein for immediate reference. This equipment is an ICAO requirement, and does not supersede the equipment requirements of the state of registry.

(1) Accessible and adequate medical supplies appropriate to the aircraft's passenger carrying capacity.

(2) Portable fire extinguisher of a type that, when discharged, will not cause dangerous contamination of the air within the airplane. At least one extinguisher shall be located in the pilot's compartment and in each passenger compartment that is not readily accessible to the flightcrew.

(3) A seat or berth for each person over an age to be determined by the state of the operator.

(4) A seatbelt for each seat and restraining belts for each berth.

(5) A seatbelt and a safety harness for each flightcrew seat. The safety harness shall incorporate a device that will automatically restrain the occupant's torso in the event of rapid deceleration.

(6) A means of ensuring that the following information and instructions are conveyed to passengers:

- when seatbelts are to be fastened;
- when and how oxygen equipment is to be used if the carriage of oxygen is required;

• restrictions on smoking;

• location and use of lifejackets or equivalent individual flotation devices when their carriage is required; and

• location and method of opening emergency exists.

(7) An operations manual or those parts of the manual that pertain to flight operations

(8) The airplane flight manual or other document(s) containing performance data required for the application of operating limitations, and any other information necessary for the operation of the airplane within the terms of its certificate of airworthiness.

(9) Current and suitable charts to cover the route of the proposed flight and any route along which it is reasonable to expect that the flight may be diverted.

(10) Flight recorders (data recorder and cockpit voice recorder) as specified below.

b. ***Oceanic Use of Traffic Alert and Collision Avoidance Systems (TCAS).*** Under the FAR, TCAS is required equipment for various domestic commercial operations. There is no requirement for the use of TCAS in oceanic airspace, although it is prudent for operators who have TCAS installed to take advantage of that equipment during oceanic operations. Although TCAS indications cannot be verified in nonradar environments, it does perform an alerting function that provides the crew with an exceptional aid to the "see and avoid" concept. Therefore, it is advisable that crews use TCAS equipment during oceanic operations whenever possible even though the equipment is not required by regulation.

c. ***Flight Recorders.*** A Type I flight data recorder records the parameters required to accurately determine the flight path, speed, altitude, engine power, configuration and operation. Types II and IIA flight data recorders record the parameters required to determine the airplane flight path, speed, altitude, engine power, and configuration of lift and drag devices. All flight data recorders shall be capable of retaining the information recorded during at least the last 25 hours of their operation, except for Type IIA flight data recorders which shall be capable of retaining the information recorded during at least the last 30 minutes of operation.

d. ***Flight Recorder Requirements.*** The following requirements apply to airplanes for which the individual certificate of airworthiness was first issued on or after January 1, 1989.

• All airplanes with a maximum certificated takeoff mass of over 27,000 kg (59,525 pounds) shall be equipped with a Type I flight data recorder.

• All airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds), up to and including 27,000 kg (59,525 pounds), shall be equipped with a Type II flight data recorder.

The following requirements apply to airplanes for which the individual certificate of airworthiness was first issued on or after January 1, 1987 but before January 1, 1989.

- All turbine engine airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds) shall be equipped with a flight data recorder that records time, altitude, airspeed, normal acceleration, and heading.

- All turbine engine airplanes with a maximum certificated takeoff mass of over 27,000 kg (59,525 pounds) for which the prototype was certificated by the appropriate national authority after September 30, 1969, shall be equipped with a Type II flight data recorder.

The following requirements apply to airplanes for which the individual certificate of airworthiness was first issued before January 1, 1987.

- All turbine engine airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds) shall be equipped with a flight data recorder that records time, altitude, airspeed, normal acceleration, and heading.

e. ***Cockpit Voice Recorders.*** The following requirements apply to airplanes for which the individual certificate of airworthiness was first issued on or after January 1, 1987.

- All turbine engine airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds) shall be equipped with a cockpit voice recorder, the objective of which is the recording of the aural environment on the flightdeck during flight time.

The following requirements apply to airplanes for which the individual certificate of airworthiness was first issued before January 1, 1987.

- All turbine engine airplanes with a maximum certificated takeoff mass of over 27,000 kg (59,525 pounds) for which the prototype was certificated by the appropriate national authority after September 30, 1969, shall be equipped with a cockpit voice recorder to record the aural environment on the flightdeck during flight time. A cockpit voice recorder shall be capable of retaining the information recorded during at least the last 30 minutes of operation.

f. ***Equipment Required for All Airplanes on Overwater Flights.***

(1) Seaplanes, including amphibians operated as seaplanes:

- One lifejacket, or equivalent individual flotation device, for each person on board, stowed in a position easily accessible from the seat or berth

- Equipment for making the sound signals prescribed in the International Regulations for Preventing Collisions at Sea, where applicable.

- One sea anchor (drogue)

(2) Landplanes:

• Criterion 1 - One power unit inoperative - If the critical power unit becomes inoperative during flight, the airplane must be able to continue the flight to an airport where the airplane can clear all obstacles in the approach path by a safe margin and land with the assurance that it can come to a safe stop.

• Criterion 2 - Two power units inoperative - In the case of airplanes having three or more power units, on any part of a route where the location of en route airports and the total duration of the flight are such that the probability of a second power unit becoming inoperative must be allowed for if the general level of safety implied by ICAO standards are to be maintained, the airplane shall be able, in the event of any two power units becoming inoperative, to continue the flight to an en route alternate airport and land.

• When flying over water and at a distance of more than 50 nautical miles (NM) (93 km) from shore, the aircraft shall carry one lifejacket or equivalent flotation device for each person on board, stowed in a position easily accessible from the seat or berth of the person for whose use it is provided.

• The following equipment must be carried on aircraft operated according to Criterion 1 or Criterion 2, above, when flying a route over water and at a distance of more time than 120 minutes at cruising speed or 400 NM (740 km), whichever is less, from a suitable emergency landing site. This equipment must also be carried on an aircraft flying over water at a distance of 30 minutes or 100 NM (185 km) from a suitable emergency landing site.

• Liferafts in sufficient numbers to carry all persons on board, stowed for their ready use in an emergency and provided with lifesaving equipment and pyrotechnic signalling devices appropriate to the flight.

• At least two sets of survival radio equipment, stowed for ready use in an emergency, that operates on very high frequency (VHF) and in accordance with the provisions of ICAO communications procedures. The equipment shall be portable, water resistant, self-buoyant, and have an independent power supply. The equipment must be capable of being operated away from the airplane by unskilled persons.

In addition to the specific equipment for overwater operations, Annex 8 to the Convention on International Civil Aviation details ICAO rules with respect to airworthiness of aircraft. Chapter 8 of Annex 8 details ICAO rules relative to "Instruments and Equipment."

Commercial operators should note that FAR § § 121.343, 121.353, and 121.359 may or may not be more stringent than the ICAO regulations. In either case, the more stringent regulations apply to U.S.-registered aircraft. Operators of large and turbine powered multiengine aircraft must note that FAR §§ 91.509 and 91.511 may also be more or less stringent than ICAO requirements, but the more restrictive regulations apply to U.S.-registered aircraft.

g. ***Weight and Balance Control for FAR Part 121 and 135 Operations.*** AC 120-27, "Aircraft Weight and Balance Control," includes a method and procedures for developing a weight and balance control system. It provides guidance to certificate holders that are required to have an approved weight and balance program by FAR Part 121 or elect to have an approved program under FAR Part 135. The significance of this AC to international operators is that emergency equipment for international operations is included in the empty weight of the aircraft.

h. ***Navigation Equipment.*** FAR § 91.1(b) states in part that each person operating an aircraft in the airspace overlying the waters between 3 and 12 NM from the U.S. coast shall comply with FAR § 91.703. FAR § 91.703 requires that civil aircraft comply with ICAO Annex 2 when operating over the high seas (beyond 3 NM under FAR § 91.1(b)). Annex 2 requires that "Aircraft shall be equipped with suitable instruments and with navigation equipment appropriate to the route being flown." In addition, ICAO Annex 6, Part II stipulates that an airplane operated in international airspace be provided with navigation equipment which will enable it to proceed in accordance with the flight plan and with the requirements of the air traffic services (ATS's). ICAO Annex 6, Part I contains standards and recommended practices adopted as the minimum standards for all airplanes engaged in air carrier operations. Part II contains the standards and practices for general aviation international air navigation. These Parts require that those airplanes operated under IFR at night, or on a VFR controlled flight (such as in control area (CTA)/FIR oceanic airspace) have installed and approved radio communication equipment capable of conducting two-way communications at any time during the flight with such aeronautical stations and on such frequencies as may be prescribed by the appropriate authority for the airspace where the flight is conducted. Additional ICAO regulations for aircraft radio equipment can be found in Article 30 of the Chicago Convention.

i. ***Specific Equipment Requirements.*** Specific operations such as flight regulated by FAR Parts 121, 125, and 135 require that aircraft have the equipment required by these Parts in addition to any ICAO requirements. A long-range navigation device is a navigation device approved for use in Class II airspace. (Refer to Chapter 8, of this AC for information on long-range navigation.) Pertinent regulations should be reviewed before beginning any international operation.

j. ***Legal Interpretation of the Statement, "Appropriate to the Facility to be Used."*** Concerns and questions have arisen related to interpretation of the statement "appropriate to the facility to be used." Effective October 31, 1990, AGC-200, the legal branch of the FAA, rendered "Legal Interpretation # 90-31." Although the interpretation is written with regard to a FAR Part 135 operation, it is important for all operators to be aware of the interpretation. The interpretation is reproduced in part as follows:

"Regarding the language of "appropriate to the facility to be used," by an interpretation dated July 16, 1969, concerning Section 135.159(a)(5), which is the predecessor to Section 135.165(a)(5), the Federal Aviation Administration (FAA) determined that the intent of that section is to require Part 135 operators conducting flights under instrument flight rules (IFR) or extended overwater flight operations to provide a complete secondary (backup) navigation system. The interpretation further stated that the test of compliance requires a check of the available ground facilities en route and at the airport of intended use. The interpretation gave the example that if the aircraft can be safely navigated over the same route independently using a VOR and independently using an ADF, the navigation equipment would be considered appropriate to the facilities being used, but if at any place along the route either navigation receiver is incapable of receiving at least one ground facility, the intent of that section would not be met."

k. ***Survival Equipment.*** Although the frequency of water landings requiring aircraft occupants to depend on overwater equipment for survival is rare, the possibility does exist. Information concerning overwater survival equipment is included in this AC. Additional information is contained in Technical Standards Orders (TSO's) C13, C69, C70, C85, and C91. Recommended equipment should meet the applicable TSO. The equipment includes the following items:

- Life preserver for each occupant

- Rafts or slide/rafts with appropriate buoyancy and sufficient capacity for all aircraft occupants. The rafts should be equipped with the following items:

(1) Lines, including an inflation/mooring line with a snaphook, rescue or lifeline, and a heaving or trailing line.

(2) Sea anchors

(3) Raft repair equipment such as repair clamps, rubber plugs, and leak stoppers

(4) Inflation devices including hand pumps and cylinders (carbon dioxide bottles)

(5) Safety/inflation relief valves

(6) Canopy and equipment for erecting the canopy

(7) Position lights

(8) Hook-type knife, sheathed and secured by retaining line

(9) Placards that give the location of raft equipment and that are consistent with placard requirements

(10) Propelling devices such as oars or glove paddles

(11) Water catchment devices including bailing buckets, reincatchment equipment, cups, and sponges

(12) Signalling devices (refer to Section 10 of this Chapter), including:

- at least one approved pyrotechnic signalling device

- one signalling mirror
- one spotlight or flashlight, spare bulb, and at least two "D" cell batteries or equivalent
- one police whistle
- one dye marker
- radio beacon with water-activated battery
- radio reflector

(13) One magnetic compass

(14) A 2-day supply of rations supplying at least 1,000 calories a day for each person

(15) One desalination kit for every two persons the raft is rated to carry, or two pints of water for each person the raft is rated to carry

(16) One fishing kit

(17) One book on survival appropriate for any area

(18) A survival kit, appropriately equipped. Some items that could be included in the kit are:

- triangular cloths
- bandages
- eye ointments
- water disinfection tablets
- sun protection balsam
- heat retention foils
- burning glass
- seasickness tablets
- ammonia inhalants
- packets with plaster

6. AIR TRAFFIC CONTROL.

This section contains information on flight operations in oceanic airspace and rescinds AC 90-76B, "Flight Operation in Oceanic Airspace." Detailed ICAO procedures for specific geographical areas may be found in the ICAO "Regional Supplementary Procedures," Document 7030-4 through Amendment 178 dated March 6, 1992, and in the following chapters in this AC. Navigation performance is monitored by the United States for all aircraft entering and/or departing international airspace under U.S. jurisdiction. All deviations of 20 NM or more are reported and investigated.

a. ***Oceanic Position Reporting.*** The United States provides ATS in oceanic airspace as follows:

(1) Atlantic Ocean: New York, Miami and San Juan FIR's

(2) Gulf of Mexico: Miami and Houston FIR's

(3) Pacific Ocean: Oakland and Anchorage FIR's

FAR § 91.1 states, in part, that "each person operating a aircraft in the airspace overlying the waters between 3 and 12 miles from the coast of the United States shall comply with FAR § 91.703," which states, in part, that "Each person operating a civil aircraft of U.S. registry outside the United States shall - When over the high seas, comply with Annex 2 (Rules of the Air) to the Convention on International Civil Aviation and with FAR § § 91.117(c), 91.130, and 91.131."

FAR § 91.705 states, in part, that "No person may operate a civil aircraft of U.S. registry in NAT airspace designated as MNPS airspace unless - The aircraft has approved navigation performance capabilities which complies with the requirements of Appendix C to this part." FAR § 99.3 states, in part, that "the Air Defense Identification Zone (ADIZ) is an area of airspace over land or water in which the ready identification, location, and control of all civil aircraft is required in the interest of national security." FAR § 99.11 states, in part, "unless otherwise authorized by ATC, no person may operate an aircraft into, within, or across an ADIZ unless that person has filed a flight plan with an appropriate aeronautical facility."

b. ***Flight Planning.*** A flight plan is required for all flights that cross international borders. Operations in oceanic airspace on a VFR flight plan are permitted only between sunrise and sunset and only within the following airspace:

(1) in Miami, Houston,and San Juan oceanic control areas (OCA's), at or below FL 180;

(2) in the New York OCA, at or below FL 050, except in the airspace east of 60 degrees west at or below FL 190; and

(3) in the Oakland and Anchorage OCA's, at or below FL 050.

Operations in offshore airspace (the airspace between the U.S. 12-mile limit and the OCA/FIR boundary) on a VFR flight plan are permitted only between sunrise and sunset and only at or below

FL 200. Even though flights may be legally conducted using VFR, experience indicates that instrument meteorological conditions (IMC) will be encountered at some point in a transoceanic flight. Consequently, it is recommended that the pilot be instrument rated, the aircraft meet the equipment requirements for IFR flight, and an IFR flight plan be filed.

c. *Navigation/Communication Equipment.* In most cases, aircraft operating over the high seas will not have adequate VHF radio and/or ICAO standard navigation aid (navaid) (VOR, VOR/DME, and NDB) coverage. High frequency (HF) communication capabilities, provided by Aeronautical Radio, Inc. (ARINC), are available throughout most of U.S.-controlled oceanic airspace. Notwithstanding the fact that pilots must comply with all FAR applicable to their flight, all aircraft operating over the high seas must be equipped with suitable instruments and navigation equipment appropriate to the route to be flown (FAR § 91.703, ICAO Annex 2, § 5.1.1, and Section 7 of this Chapter). Reference should also be made to the legal interpretation in Section 5 of this Chapter. The aircraft must also be equipped with a functioning two-way radio to maintain a continuous listening watch on the appropriate radio frequency of, and establish two-way radio communication with, the appropriate ATC unit (ICAO Annex 2 § 3.6.5.1). It should be noted that it is not acceptable to depend on radio relay operations to satisfy this requirement.

d. *Position Reporting.* Position reports shall be made to the ATS unit serving the airspace where the aircraft is operated. In addition, when so prescribed by the appropriate AIP or requested by ATC, the last position report before passing from one FIR or CTA to an adjacent FIR or CTA shall be made to the ATS about to be entered. If a position report is not received at the expected time, subsequent control shall not be based on the assumption that the estimated time is accurate. Immediate action shall be taken to obtain the report if it is likely to have any bearing on the control of other aircraft. Position reports shall be made when over, or as soon as passing, each designated compulsory reporting point. Additional reports over other points may be requested by the appropriate ATS unit when required for ATS purposes. On routes not defined by designated significant points, reports shall be made as soon as possible after the first half hour of flight and at hourly intervals thereafter. Additional reports at shorter intervals of time may be requested by the appropriate ATC unit when required for ATS purposes. In cases where adequate flight progress data is available from other sources such as ground radar, and in other situations where the omission of routine reports from selected flights is found to be acceptable, flights may be exempted from the requirement to make position reports at each designated compulsory reporting point or interval. However, account should be taken of the requirement for making, recording, and reporting of routine aircraft observations (see "Reporting of Operational and Meteorological Information" below).

Oceanic position procedures call for aircraft reporting of all designated reporting points when following a designated oceanic route. Otherwise, positions shall be reported at designated lines of latitude and longitude. Flights whose tracks are predominantly east and west shall report over each 5 or 10 degrees meridian of longitude. Flights whose tracks are predominantly north and south shall report over each 5 or 10 degree parallels of latitude. Reports over each 10 degrees parallel/meridian are to be made if the speed of the aircraft is such that 10 degrees will be traversed within 1 hour 20 minutes or less, and over each 5 degrees if the aircraft is slower. Position reports should be transmitted at the time of crossing the designated reporting point or designated reporting line, or as soon thereafter as possible. Flights operating within international airspace should make position reports, either directly or for relay (NOTE: Relay should not be done over the emergency frequency 121.5 except in an actual emergency when no other means of reporting is possible), in the following format.

Aircraft Position - For flights reporting coordinates rather than specified named reporting points, east-west oriented flights report latitude in degrees and minutes, longitude in degrees only. North-south oriented flights should report latitude in degrees only and longitude in degrees and minutes.

Time Over Position in Four Digits

Flight Level (FL) - Pilots should note that a FL request on a filed flight plan does not constitute authority to change FL en route without a specific clearance, even though the ATC clearance originally issued may specify "Cleared as filed" or "cleared via flight-planned route." These terms refer to routing requested and not to altitude requests contained in the flight plan.

Next Fix and Estimate over Next Fix in Four Digits

Name of Subsequent Fix

e. ***ATC Service.*** ATC separation is provided to all flights in oceanic controlled airspace by Air Route Control Centers (ARTCC) and San Juan Combined Center Approach Control (CERAP). These facilities issue clearances and instructions providing separation vertically and horizontally (laterally and longitudinally). The horizontal distances between aircraft being separated generally exceed those applied over land. The following separation variations are unique to oceanic ATC:

(1) Composite separation is a combination of vertical and lateral separation. Composite separation is currently used on the North Pacific (NOPAC) routes between Alaska and Japan and the Central East Pacific (CEP) routes between the U.S. west coast and Hawaii.

(2) MNPS airspace is specially designated airspace in the NAT. All aircraft must have FAA approval (see Chapter 3 of this AC) for flights within MNPS airspace. Within the designated area, lateral and longitudinal separation is significantly reduced.

(3) Controllers may apply reduced longitudinal minimums in oceanic airspace between turbojet aircraft cleared to maintain a specific mach speed. For example, in some cases initial longitudinal minimums applied between aircraft may be reduced from 20 minutes to 5 minutes depending on the speed of the aircraft when mach technique is used.

(4) ICAO Documents 7030, "Regional Supplementary Procedures" and 8168, "Aircraft Operations Volume I," state that transponders shall be operated as follows:

(a) when the aircraft carries serviceable Mode C equipment, the pilot shall continuously operate in this mode, unless otherwise directed by ATC;

(b) in NAT airspace, unless otherwise directed by ATC, pilots shall retain the previously assigned transponder code for a period of 30 minutes after entry into the airspace, then operate on code 2000;

(c) in oceanic airspace other than the NAT, pilots shall operate the transponder and select modes and codes as directed by the ATC unit which the pilot is in contact; or

(d) in the absence of any ATC directions, pilots shall operate the transponder on Mode A Code 2000.

f. *Warning Areas.* Warning areas are established in international airspace to contain operations hazardous to nonparticipating aircraft. Some of the these areas may be jointly used by the FAA and the military. The FAA will issue IFR clearances through these areas whenever hazardous operations are not taking place. Charts should be carefully reviewed for those area while flight planning, taking note of the area operating times and restrictions.

g. *Altimeter Settings.* Operations in international airspace demand that pilots are aware of and understand the use of the three types of altimeter settings.

(1) **QFE** (airport altitude) is an altimeter setting used in some nations that causes the altimeter to read zero feet when on the ground.

(2) **QNE** (en route) is the altimeter setting used at or above the transition altitude (FL 180 in the United States). The altimeter setting is always 29.92 for a QNE altitude. CAUTION - transition levels differ from country to country, and pilots should be particularly alert when making a climb or descent in a foreign area.

(3) **QNH** is the altimeter setting with which most general aviation pilots are familiar when operating in the United States. This setting causes the altimeter to read field elevation when on the ground and is determined by setting the altimeter to the local altimeter setting.

NOTE: Most overseas airports give altimeter settings in hectopascals (hPa)(millibars); therefore, it is imperative that pilots are able to convert inches of mercury to hectopascals or hectopascals to inches of mercury. A conversion chart is provided in Appendix 1 of this AC for convenience in performing this task.

For flights in the vicinity of airports, the vertical position of aircraft shall be expressed in terms of QNH at or below the transition altitude and in terms of QNE at or above the transition level. While passing through the transition layer, vertical position shall be expressed in terms of flight levels when ascending and in terms of altitudes when descending. After approach clearance has been issued and the descent to land has commenced, the vertical position of an aircraft above the transition level may be expressed by reference to QNH, provided that level flight above the transition altitude is not indicated or anticipated. When an aircraft that has been given a clearance as number one to land is completing its approach using QFE, the vertical position of the aircraft shall be expressed in terms of height above the airport elevation during that portion of its flight for which QFE may be used, except it shall be expressed in terms of height above runway threshold elevation under the following conditions:

- for instrument runways, if the threshold is 2 meters (approximately 7 feet) or more below the airport elevation

- for precision approach runways

For flights en route, if a transition altitude has not been established for that area through a regional air navigation agreement, the vertical position of aircraft shall be expressed in the following terms:

- FL's at or above the lowest useable FL

- altitudes below the lowest usable FL

h. ***Reporting of Operational and Meteorological Information.*** When operational and/or routine meteorological information is to be reported by an aircraft en route at points or times when position reports are required, the position report shall be given in the form of an air report (AIREP). Special aircraft observations shall be reported as special AIREP's as soon after the observations have been made as is practical. The format of messages and the terminology or data conventions shall be used by the flightcrew when transmitting AIREP's.

i. ***National Security.*** National security in the control of air traffic is governed by FAR Part 99. All aircraft entering domestic U.S. airspace must provide for identification prior to entry. To facilitate early identification of all aircraft in the vicinity of U.S./international airspace, Air Defense Identification Zones (ADIZ) have been established. Operational requirements for aircraft entering or flying within an ADIZ are as follows.

(1) Flight plan - Except as specified below, an IFR or defense VFR (DVFR) flight plan must be on file with the appropriate aeronautical facility for all operations that enter an ADIZ, and for operations that will enter or exit the United States and that will operate into, within, or across the contiguous U.S. ADIZ regardless of true airspeed (TAS). The flight plan must be filed before departure except for operations associated with the Alaskan ADIZ when the departure airport has no facility for filing a flight plan. In this case, the flight plan may be filed immediately after takeoff or when within range of the aeronautical facility.

(2) An operating two-way radio is required for the majority of operations associated with an ADIZ. Consult FAR § 99.1 for exceptions.

(3) Unless otherwise authorized by ATC, each aircraft flying into, within, or across the contiguous United States must be equipped with an operable radar beacon transponder having altitude reporting capability (Mode C). The transponder must be turned on and set to reply on the appropriate code or as assigned by ATC.

(4) Position reporting

- For IFR flight - normal IFR position reporting

- For DVFR flight - the estimated time of ADIZ penetration must be filed with the aeronautical facility at least 15 minutes prior to penetration. For flight in the Alaskan ADIZ, report prior to penetration.

- Foreign registry aircraft - for inbound flight by aircraft of foreign registry, the pilot must report to the aeronautical facility at least 1 hour prior to ADIZ penetration.

j. ***Aircraft Position Tolerances.*** Over land, the aircraft position tolerance is within plus or minus 5 minutes from the estimated time over a reporting point or penetration point, and within 10 NM from the centerline of an intended track over an estimated reporting/penetration point. Over water, the tolerance is plus or minus 5 minutes from the estimated time over a reporting/penetration point and within 20 NM from the centerline of the intended track over an estimated reporting/penetration point, including the Aleutian Islands.

Except when applicable under FAR § 99.7, FAR Part 99 does not apply to aircraft operations:

- within the 48 contiguous states, the District of Columbia, Alaska, and within 10 miles from the point of departure

- over any island, or within 3 NM of the coastline of any island, in the Hawaii ADIZ

- associated with any ADIZ other than the contiguous U.S. ADIZ, when the aircraft has a TAS of less than 180 knots

Authorization to deviate from the requirements of FAR Part 99 may be granted by an ARTCC, on a local basis, for some operations associated with an ADIZ. An air filed VFR flight plan makes an aircraft subject to interception for positive identification when entering an ADIZ. Pilots are urged to file the required DVFR flight plan in person or by telephone prior to departure.

k. ***Special Security Instructions.*** During air defense emergency conditions, additional special security instructions may be issued in accordance with the Security Control of Air Traffic and Air Navigation Aids (SCATANA) Plan. Under the provisions of the SCATANA Plan, the military directs the actions of aircraft in regard to landing, grounding, diversion or dispersal, and control of air navaids in the defense of the United States. Upon implementation of all or a portion of SCATANA, ATC facilities will broadcast instructions from the military over available ATC frequencies. Depending upon these instructions, VFR flights may be directed to land at the nearest available airport and IFR flights may be expected to proceed as directed by ATC. Pilots on the ground may be required to file a flight plan and obtain an approval through the FAA prior to conducting flight operation. In view of the preceding, pilots should guard an ATC or FSS frequency at all times during flight operations.

l. ***International Interception Procedures.*** There are occasions when interceptor pilots are required to transmit instructions to pilots of intercepted aircraft. When radio communications are not available, visual signals (listed below) are used. Interceptor pilots will approach the aircraft from astern, employing the interception pattern for identification of transport aircraft. A distance of at least 500 feet shall be maintained between the aircraft. Intercepted aircraft, regardless of ATC clearance, shall follow the instructions of the intercepting aircraft and shall attempt to notify the appropriate ATC. Additionally, the intercepted aircraft shall attempt radio contact with the interceptor aircraft on 121.5 MHz, giving aircraft identify, flight purpose, and position.

m. ***Intercept Pattern for Identification of Transport Aircraft.***

(1) ***Phase 1.*** Intercepting aircraft approaches target aircraft from astern. Element leader reduces the throttle and extends dive breaks. Wingman continues to the opposite side of the target aircraft from the leader and climbs to 4,000 above the target's altitude to maintain surveillance. If weather does not permit this altitude for surveillance, the wingman assumes a position on either side of the target that will permit observation of the leader and target aircraft at a distance of 3,000 feet from the target aircraft. Wingman retains position during surveillance by S-turns rather than reducing speed with dive breaks. The leader should be 1,000 feet abreast of the target aircraft at the aircraft's altitude. After speed and position are stabilized, proceed with Phase 2.

(2) ***Phase 2.*** Wingman continues surveillance. Leader begins closing on target until no closer than absolutely necessary to identify. Wingman copies identification for mission report. Leader uses every precaution to avoid startling target crew and passengers, keeping in mind that fighter aircraft maneuvers may startle nonfighter crew/passengers. Upon target identification, leader and wingman withdraw from target vicinity as described in Phase 3.

(3) ***Phase 3.*** Leader breaks away from target in shallow dive to increase speed. Wingman stays well clear of target and joins leader.

INTERNATIONAL INTERCEPTION SIGNALS

INTERCEPTING SIGNAL	MEANING	INTERCEPTED AIRCRAFT RESPONSE	MEANING
<u>Day:</u> Rocking wings from a position in front and normally to the left of the intercepted aircraft. After response, slow level turn, normally to the left, onto course.* <u>Night:</u> Same as above with flashing navigational/landing lights	You have been intercepted	<u>Day, fixed wing:</u> Rock wings, follow <u>Rotorcraft:</u> Rocking tip path plane, follow <u>Night, fixed wing:</u> Same as day plus flashing lights <u>Rotorcraft:</u> Same as day plus flashing landing/search lights	Understood, will comply

INTERNATIONAL INTERCEPTION SIGNALS - Continued

INTERCEPTING SIGNAL	MEANING	INTERCEPTED AIRCRAFT RESPONSE	MEANING
Day or night: Abrupt break away; climbing turn 90 degrees or more without crossing flight path	You may proceed	Day, fixed wing: Rock wings Rotorcraft: Rocking tip path plane Night, fixed wing: Rock wings Rotorcraft: Flash landing or search lights	Understood, will comply
Day: Circling airport, lowering landing gear, overflying runway in landing direction Night: Same as above with steady landing lights	Land at the airport	Day, fixed wing: Lower landing gear, follow, land Rotorcraft: Rock tip path plane, follow, land Night, fixed wing: Same as day plus steady landing lights Rotorcraft: Same as day plus flash landing lights	Understood, will comply
Day: Raising landing gear while overflying runway at 1,000-2,000 ft altitude; circling airport Night: Same as day with flashing lights	Designated airport inadequate	Day or night: If intercepted aircraft is to follow, intercepting aircraft raises landing gear and gives interception signals. If intercepted aircraft may land, intercepting aircraft signals "You may proceed."	Understood, will comply You may proceed

* Meteorological conditions or terrain may require the intercepting aircraft to take a position in front and to the right of the target aircraft, and to make the turn to the right.

7. OCEANIC COMMUNICATIONS.

a. *Guard Station.* The oceanic radio station guarding for flight operations is normally the station associated with the ATC center responsible for the FIR (e.g., Honolulu ARINC for the Anchorage FIR and Tokyo Radio for the Tokyo FIR). At the FIR boundary the responsibility for the guard changes, under normal signal conditions, to the station associated with each new FIR. The flight must ensure that it has established communications with the new guard facility. Normally, each oceanic radio station continuously listens on all assigned frequencies. If en route HF communications fail, every effort should be made by the flightcrew to relay progress reports through other aircraft. The VHF frequency 128.95 MHz is used exclusively as an air-to-air communications channel in Pacific operations, and 131.8 MHz is used for Atlantic operations. In emergencies, however, initial contact for such relays may be established on 121.5 MHz and transferred as necessary to 128.95 MHz or 131.8 MHz. In normal HF propagation conditions, appropriate overdue action procedures are taken by ATC in the absence of position reports or relays. In all cases of communication failure, the pilot should follow the oceanic clearance last received and not revert to the original flight plan (see Section 10 of this Chapter for emergency operations).

b. *Use of VHF and HF for Communications.* Due to the inherent line-of-sight limitations of VHF radio equipment when used for communications in international oceanic airspace, those aircraft operating on an IFR or controlled VFR flight plan beyond the communications capability of VHF are required, as per ICAO Annex 2, to maintain a continuous listening watch and communication capability on the assigned HF frequencies. Although these frequencies are designated by ATC, actual communications will be with general purpose communication facilities such as international FSS's or ARINC. These facilities are responsible for the relay of position reports and other pertinent information between the aircraft and ATC. When using these frequencies in fringe cover areas, however, care should be taken to maintain a selective calling (selcal) watch (see below) on HF, thus ensuring that if VHF contact is lost, the radio station is still able to contact the aircraft.

c. ***Guard of VHF Emergency Frequency.*** Pilots should remember that there is a need to continuously guard the VHF emergency frequency 121.5 MHz when on long overwater flights, except when communications on other VHF channels, equipment limitations, or cockpit duties prevent simultaneous guarding of two channels. Guarding of 121.5 MHz is particularly critical when operating in proximity of FIR boundaries. Pilots should not use the emergency frequency 121.5 to relay position reports and/or other information unless an actual emergency exists.

d. ***U.S. Aeronautical Telecommunications Services.*** The aeronautical voice communications stations listed on the following page are available to, and utilized, by the FAA ARTCC for ATC purposes. The frequencies in use depend upon the time of day or night and conditions that affect radio wave propagation. Voice communications are handled on a single channel simplex basis (aircraft and ground station use the same frequency for transmission and reception) unless otherwise noted. The stations remain on continuous watch for aircraft within their communication areas, and when practical, will transfer this watch when the aircraft reaches the limit of the communications area. The stations that are designated "FAA" are operated by the U.S. Federal Aviation Administration. Those stations designated "ARINC" are operated by Aeronautical Radio, Incorporated, 2551 Riva Road, Annapolis, MD 21401, U.S.A.; telephone number (301) 266-4000; cable address ARINC Annapolis, Maryland.

TELECOMMUNICATIONS SERVICES

The following chart shows examples of frequency pairings in oceanic areas. Operators should be cautioned that these frequencies change, and should be verified before using.

STATION/ OPERATING AGENCY	RADIO CALL	TRANSMITTING FREQUENCY	REMARKS
Honolulu / ARINC	Honolulu	2998 4666 6532 8903 11384 13300 17904	Central West Pacific
		3467 5643 8867 13261 17904	South Pacific
		3413 5574 8843 13354 17904	Central East Pacific Family 1
		5547 11282 13288 17904	Central East Pacific Family 2
		2932 5628 6655 8951 10048 11330 13273 17904	North Pacific
		131.95	Extended range VHF. Covered area includes tracks to mainland extending out from HNL to approx. 400 NM. Range on other tracks approx. 300 NM

TELECOMMUNICATIONS SERVICES - Continued

STATION/ OPERATING AGENCY	RADIO CALL	TRANSMITTING FREQUENCY	REMARKS
Honolulu / FAA	Honolulu Radio	122.6 122.2 #121.5	#Emergency. Frequency 122.1 also available for receiving only
	Volmet	2863 6679 8828 13282	Broadcasts at H+00-05 and H+30-35; airport forecasts, Honolulu, Hilo, Agana, Honolulu SIGMET. Hourly report Honolulu, Hilo, Kahului, Agana, Honolulu
			Broadcasts at H+05-10 and H+30-40; hourly reports, San Francisco
Miami / FAA	Miami Radio	126.7 118.9 126.9 122.2 123.65 122.75	Local and short range
		#121.5	#Emergency
New York / FAA	New York Radio	6604 10051	Broadcasts at H+05->10: airport forecasts Detroit, Chicago, Cleveland. Hourly reports Detroit, Chicago, Cleveland, Niagara Falls, Milwaukee, Indianapolis. Broadcasts at H+05->+10 SIGMET (Oceanic-New York) airport forecasts
		*13270, *3485	* Volmet broadcasts
New York / ARINC	New York	3016 5598 8825 13306 17946	North Atlantic Family A
		2899 5616 8864 13291 17946	North Atlantic Family B
		2887 5550 6577 8846 8918 11396 13297 17907	Caribbean Family A
		129.90	Extended range
Oakland / FAA	Oakland Radio	122.5 122.2 #121.5	# Emergency
San Juan PR / FAA	San Juan Radio	122.2 126.7 123.65 255.4 114.0 113.5 108.2 108.6 109.0 110.6	Unscheduled broadcasts H+00, H+15, H+30 and H+45 for weather and military activity advisories on 110.6, 109.0, 108.6, 108.2, 113.5, 114.0. For frequencies 114.0, 113.5, 108.2, 109.0 use 122.1 to transmit to San Juan Radio. For frequency 108.6 use 123.6
		#121.5, #243.0	# Emergency
San Francisco / ARINC	San Francisco	3413 5547 8843 10057 13288 17904	Central East Pacific One
		2869 5547 6673 11282 13288 17904	Central East Pacific Two
		131.95	Extended range
		129.40	For en route communication for aircraft on Seattle/Anchorage routes

e. ***Selcal Facilities.*** Selcal equipment should be seriously considered for use in both domestic and long-range communications. It enables a ground station to contact an aircraft through a combination of audio tones and illuminated lights on the instrument panel of that aircraft, and frees the crew from continually monitoring a given HF or VHF frequency. There is one problem with selcal, however; single side band (SSB) signals are incompatible with selcal signals. Many HF SSB transceivers are designed to detect selcal transmitted in the full carrier mode even though the aircraft transceiver mode selector is in the SSB position. Transceivers not designed and built with this feature must have the selector switch in the full carrier mode to detect a selcal signal. In addition, the ground station must know the aircraft's selcal code assignment in advance.

f. ***Selcal Procedures.*** During the time that they depend on HF communications, pilots should maintain a listening watch on the assigned frequency. This is not necessary, however, if selcal is installed and used correctly. Details of correct use are as follows.

- The provisions of the selcal code are included in the ICAO flight plan

- The selcal code must be corrected if subsequently altered due to a change of aircraft or equipment

- Operation of selcal equipment must be checked with the appropriate radio station prior to selcal watch and at, or prior to, entry into oceanic airspace.

- Maintenance of a constant selcal watch.

LOCATION	OPERATOR	HF	VHF
Honolulu	ARINC	X	X
New York	ARINC	X	X
San Francisco	ARINC	X	X

g. ***Standard Air-Ground Message Types and Formats.***

(1) *REQUEST CLEARANCE.*

(a) To be used in conjunction with a routine position report or to request a change in mach number, FL, or route. Content and data sequence follow:

"Request Clearance"

- Flight identification

- Present or last reported position

- Time over last reported position (hrs. and mins.)

- Present FL

- Next position on assigned route or obstacle clearance altitude (OCA) entry point

- Estimated time for next position or OCA entry point

- Next subsequent position

- Requested mach number, FL, or route

- Further information or clarifying remarks

(b) To be used to request a change in mach number when a position report message is not appropriate. Content and data sequence follow:

"Request Clearance"

- Flight identification

- Requested mach number, FL, or route

- Further information or clarifying remarks

(2) *REVISED ESTIMATE.*

(a) To be used to upgrade time estimate for next position. Content and data sequence follow:

- Flight identification

- Next position on route

- Revised estimate for next position (hrs. and mins.)

- Further information

(3) *MISCELLANEOUS MESSAGE.*

(a) To be used to convey information or make a request in plain language that does not conform with the content of other message format. No message designator is required as this will be inserted by the ground station. Content and data sequence follow:

- Flight identification

- General information or request in plain language and format free

h. ***Methods of Obtaining Oceanic Clearances.***

- Use of VHF clearance delivery frequencies when in coverage

- Use of HF to the OCA through the appropriate radio station (if possible at least 30 minutes before boundary/entry estimate)

- Request via domestic or other ATC agencies

i. ***Summary of Communication and Reporting Procedures.*** Continuous contact with the controlling agency must be maintained. This can be through VHF, HF, or selcal. The range of VHF is approximately 200 NM; HF is required beyond that distance. A family of frequencies, if more than one family is monitored, is normally assigned based on route and/or the state where the aircraft is registered. These families of frequencies are listed on en route charts.

j. ***Transponder.***

(1) NAT - maintain last assigned squawk for 30 minutes, then squawk 2000 until advised of a discreet frequency.

(2) Pacific - Between 150 and 170 East, squawk 2000

(3) In Bermuda TCA squawk 2100

k. ***Emergency Frequencies.***

(1) VHF: 121.5

(2) FM: 156.8

(3) UHF: 243.0

(4) HF: 2182/4125

8. OPERATIONS.

a. ***Overview.*** Oceanic operating procedures differ depending upon the size of the aircraft, type and number of powerplants, range with or without long-range tanks installed, operation type (general or commercial), navigation equipment installed, state (country) of departure, body of water to be transversed, and the qualifications of the flightcrew. The following chapters discuss operational factors required for the Atlantic, Pacific, Gulf of Mexico, and the Caribbean. Various types of navigation equipment are also discussed. It is the pilot's responsibility to read the sections that pertain to the flight in addition to the general discussion in this Chapter. The most stringent conditions exist in the Northern Atlantic due to the high density of traffic between North America and Europe. The most hazardous area for light aircraft is the long route between the U.S. west coast and the Hawaiian Islands.

b. ***U.S.-Registered Aircraft.*** FAA inspectors will ensure that contingency procedures specific to the authorized area of operation are detailed in U.S.-registered air carrier operator's training and check airman programs and manuals. In the case of non air carrier operators, these same procedures must be demonstrated to inspectors prior to obtaining an LOA for operations in special airspace. It should be emphasized that the improper application of contingency procedures can result in collision with other aircraft. Further inherent in contingency procedures is the requirement to contact ATC whenever the aircraft is unable to continue flight according to its current ATC clearance. This includes situations when the aircraft is off course and/or unable to maintain its assigned altitude. A failure to comply with this requirement prevents ATC from taking measures to provide separation between adjacent aircraft and the aircraft that has deviated from its clearance. Failure to contact ATC is also contrary to ICAO Annex 2 and FAR § 91.703, the latter of which requires compliance with Annex 2 by all aircraft of U.S. registry. Contingency procedures for NAT MNPS airspace can be found in Chapter 3 of this AC. For aircraft operating in the NOPAC composite route system, contingency procedures can be found in Chapter 4 of this AC. Navigation specialists are available within the FAA to aid district offices in their initial and ongoing evaluation of operator's navigation programs. If there are questions concerning any aspect of navigation programs, contact: Federal Aviation Administration, Flight Standards National Field Office, AFS-500, P.O. Box 20034, Washington, DC 20041, (703) 661-0333.

9. EXTENDED RANGE OPERATIONS (ETOPS) WITH TWO-ENGINE AIRPLANES.

Operators desiring to obtain approval under FAR § 121.161 for two-engine airplanes to operate over a route that contains a point farther than 1 hour flying time at the normal on-engine inoperative cruise speed (in still air) from an adequate airport should refer to AC 120-42, "Extended Range Operation with Two-Engine Airplanes (ETOPS)." This AC defines the tasks that must be accomplished by an operator in preparation for the monitoring process that will be undertaken by the FAA principal maintenance inspector (PMI). This monitoring process is necessary to obtain an ETOPS authorization which requires an approval from the Director, Flight Standards Service, for a deviation to the operating rule of FAR § 121.61. To meet the requirements of this deviation, the operator must be able to substantiate that the type design reliability and the performance of the proposed airplane/engine combination have been evaluated per the guidance in AC 120-42A and have been found suitable for extended range operations, and submit an application package that includes supplemental maintenance requirements and programs that allow for safe operations under an ETOPS authorization.

10. EMERGENCY PROCEDURES.

a. ***Introduction.*** When conducting flights, especially extended flights, outside the United States and its territories, full consideration should be given to the quality and availability of air navigation services in the airspace to be used. As much information as possible should be obtained concerning the location and range of navaids and availability of SAR services. SAR international standards and recommended practices are contained in Annex 12 to the Convention. Each ICAO region has published air navigation plans that include the facilities, services, and procedures required for international air navigation within that particular region.

b. ***Pilot Procedures.*** Any pilot who experiences an emergency (alert, distress, uncertainty) during flight should take three steps to obtain assistance.

(1) If equipped with radar beacon transponder and unable to establish voice communication with ATC, switch to Mode A/3 and Code 7700. If crash is imminent and the aircraft is equipped with an emergency locator transmitter (ELT), activate the emergency signal if possible.

(2) Transmit as much of the following message as possible on the appropriate air-ground frequency, preferably in the order shown below:

(a) "Mayday, mayday, mayday" for distress, "pan, pan, pan" for other types of emergency;

(b) WHO - name of station addressed, circumstances permitting;

(c) WHAT - nature of the distress or emergency condition, intentions of the person in command; and

(d) WHERE - present position, FL, altitude, and any other useful information.

The most important parts of the message are who, what, and where. If no response is received on the air-ground frequency, repeat the message on the aeronautical stations on 121.5 MHz. Other useful frequencies for attracting the attention of a maritime station are distress frequencies 2182 or 4125 kHz. An aircraft in distress may use any available means, including any frequency, to attract attention and make known the situation.

(3) Comply with the information and clearances received. Accept the communications control offered by the ground radio station, silence any interfering radio stations, and do not shift frequency or shift to a ground station unless absolutely necessary or instructed to do so.

c. ***Two-way Radio Failure.*** Pilots of flights that experience two-way radio failure are expected to follow the applicable procedures. If the pilot is lost, or is otherwise unable to follow procedures, the pilot may attempt to alert civilian or military radar systems in the area of operation. The pilot should remember that there are two ways to declare an emergency: squawk emergency on the transponder - 7700; or send an emergency message - 121.5 MHz. Ground stations have various electronic means of assisting in these situations, including receipt of emergency procedures, direction finding (DF) bearings, and detection of transponder emergency squawk.

d. ***The Four C's.*** When confronted with an emergency, pilots should remember the four C's:

(1) Confess the situation to any ground station. Don't wait too long.

(2) Communicate with the ground link and convey as much of the distress message as possible on the first transmission.

(3) Climb if possible for better radar and DF detection. If flying at a low altitude, chances of radio contact are improved by climbing. Chances of alerting radar systems may be improved by climbing or descending. Note that unauthorized climb or descent under IFR conditions within controlled airspace is prohibited except in an emergency. Any variation in altitude is unknown to ATC unless the facility has radar with height-finding capability.

(4) Comply with advice, information, and clearances received. Assist the ground control station in controlling communications on the distress frequency in use. Instruct interfering stations to maintain radio silence until needed.

For ditching or crash landing, if there is no additional risk of fire and circumstances permit, the radio should be set for continuous transmission. If a pilot is apprehensive or doubtful about a situation, assistance should be requested. SAR facilities are ready and willing to help. There is no penalty for their use. Safety is not a luxury; the pilot must take action.

e. ***Search and Rescue.*** SAR is a life-saving service provided by many governments that are assisted by aviation and other organizations. This service provides search, survival aid, and rescue of personnel of missing or crashed aircraft. Before departure, a responsible individual at the departure point should be advised of the flight plan and itinerary. Search efforts are often wasted, and rescue is delayed, because a pilot departed without informing anyone of the flight plan. To protect all personnel on the aircraft, these steps should be followed:

(1) File a flight plan with the appropriate authority in person, by telephone, or by radio.

(2) Close the flight plan with the appropriate authority immediately upon landing.

(3) If the flight lands at other than the intended destination, report the landing immediately to the appropriate authority.

(4) If an en route landing is delayed more than 30 minutes (for turbojets), notify the appropriate authority.

(5) Failure to close a flight plan within 30 minutes of landing may initiate a search.

f. ***Crashed Aircraft.*** If a crashed aircraft is observed, determine if the crash is marked with a yellow cross. If so, the crash has been reported and identified. If the site is not marked with a yellow cross, determine, if possible, the type and number of aircraft and whether there is evidence of survivors. Fix the location of the crash as accurately as possible, and transmit the information to the nearest appropriate communication facility. If possible, orbit the scene to guide other assisting aircraft until relieved by another aircraft. Immediately after landing, make a full report to the appropriate authority.

g. ***Crash Landing Survival and Rescue.*** To enhance the chances of survival and rescue in the event of a crash landing, it is important to carry survival equipment suitable to the areas the flight passes over. If a forced landing occurs at sea, survival chances are governed by the crew's proficiency in emergency procedures and the effectiveness of water survival equipment on board the aircraft. In the event that an emergency water landing is required, the crew should contact the Coast Guard and request Automated Merchant Vessel Report (AMVER) system information. Within minutes the crew will be given the name and location of every merchant vessel within 100 miles of the aircraft's reported position. The speed of rescue on land or at sea depends upon how accurately the position is determined. If the flight plan has been followed and the position is on course, rescue is expedited. Unless there is good reason to believe that the crash site cannot be located by search aircraft, it is best to remain near the aircraft and prepare to signal when search aircraft approach.

h. ***Ditching and Evacuation.*** When a forewarned ditch is imminent, the first step is to communicate with oceanic control and the passengers. The PIC should initiate the distress call to the appropriate agency per ATC instructions or as indicated in the IFIM. When contacting oceanic control, give the following information: aircraft identification; timed position; altitude; ground speed; true course; hours of fuel remaining; a description of the emergency; pilot's intentions; and the assistance desired. Oceanic control will report the situation to the Coast Guard. The Coast Guard activates the AMVER system, sending a seagoing vessel to the area.

i. ***International Procedures.*** A Coast Guard station or a nearby ship can furnish information on the surface wind, recommended ditching heading, and sea conditions in the event of a ditching. The pilot in range of a ship should ditch in close proximity to the vessel, which will stand by to pick up passengers and assist in any other way.

The passengers and crew must be prepared prior to ditching. Lifevests must be put on, seatbelts fastened, impact position must be assumed, and loose articles must be stowed. The passengers should then be briefed on lifevest inflation and evacuation of the aircraft. Crewmembers should make an inspection to ensure that lifejackets are properly worn. Personnel should be paired off in preparation for evacuation. Older persons should be paired with able-bodied men to assist them. Children and nonswimmers should be paired with swimmers whenever possible; experienced swimmers should be paired with more dependent persons. To avoid injury, passengers must remain in their seats during the ditching, and must brace themselves to meet at least two impacts in the manner instructed by the flightcrew. The method of bracing is determined by the location and arrangement of the seats and by selection of the crash position. Regardless of the method or location, seatbelts should be strapped as tightly as possible across the hipbones. The recommended ditching position is to adjust the seat to vertical position. Just before landing, fold the arms and rest them on the knees. Bend the body as far forward as possible, and rest the head firmly on the arms. If available, a pillow, blanket, or clothing should be held in front of the head to cushion any impact. Illustrated ditching cards are helpful in showing the desired position.

It is usually best for the pilot to observe the sea surface from 2,000 feet to determine the primary swell direction. Wind condition permitting, the landing should be parallel to the swells. When the PIC advises that ditching is imminent, a crewmember or flight attendant should attach the emergency escape lifelines, position the liferafts near the emergency exits, attach the liferaft lanyards to the chair tracks, and assume a position where the passengers can be monitored during the ditching. If there is an available passenger seat, the crewmember or flight attendant should consider occupying the seat with immediate access to the emergency escape window. This position should be coordinated with the cockpit crewmembers so that one person opens the escape hatches on the opposite side, and each is responsible for securing the appropriate lifeline, inflating and launching the liferaft, and aiding the passengers in evacuating the aircraft. A public address announcement should be made immediately before impact advising the passengers that there will be at least two impacts. The passengers should be advised to "stand by for ditching" at 1,000 feet or 2 minutes before ditching. Prior to impact, the command "brace for impact" should be given. Passengers and crew should not release their shoulder harnesses or seatbelts until the aircraft is at a complete stop. The passengers should hold the crash position until the aircraft has stopped.

j. ***Evacuation.*** Once the aircraft is stopped, release seatbelts and shoulder harnesses and move quickly to the cabin door. The PIC should be in command of the evacuation, and should expedite evacuation of passengers and flight personnel. Lifevests must be inflated as soon as the passengers exit the aircraft.

k. ***Liferafts.*** Most corporate aircraft stow liferafts in the rear of the aircraft. Consequently, it is imperative for the rafts to be moved near the exits before impact. It is equally important that the rafts be secured so that they will remain near the exits during ditching. The rafts must be secured to the aircraft before being deployed to prevent the raft from being carried away. The last step is raft inflation by jerking the lanyards to release the cover and begin inflation. Once the rafts are inflated, passengers should board the rafts and ensure the load is evenly distributed. The sea anchor is then deployed and the torus section is inflated. Canopy poles are then installed and the canopy is erected or inflated. Care must be taken to ensure that the canopy is not lost in strong winds.

l. ***Signaling.*** Signaling and survival equipment are usually located in the torus section of the raft. Signaling equipment usually includes locator beacons, flares, flashlight, mirror, and possibly a transceiver radio. The locator beacon, depending on design, can be used continuously or intermittently. Other signaling devices should not be used unless an aircraft or surface vessel is heard or seen. If a transceiver radio is available, it used be used to transmit in blind to attract attention. These radios usually have a battery with a 20-30 hours life span.

m. ***Survival.*** Mental attitude cannot be overemphasized when discussing survival. The crew must demonstrate total confidence that rescue is simply a matter of time. The right attitude also reinforces a will to live even when physical condition is at its lowest point. All rafts should be equipped with water desalting kits, and rain water should be trapped on the canopy and collected. Any injuries sustained during ditching should be treated as soon as possible. Food and water are important; however, life can be sustained for up to 6 days without water and up to 3 weeks without food. The crew's proficiency is the single most important element. Once the ditching and evacuation of the aircraft is completed, chances of survival are very good.

n. ***Pyrotechnic Signaling Devices.*** FAR Parts 91, 121, 125, and 135 require the carriage of at least one signaling device for extended overwater operations. For the purpose of this AC, "Coast Guard approved" refers to the minimum standards suggested by the FAA for the acquisition and use of pyrotechnic visual distress signaling devices. Reliance on Coast Guard expertise in this area is a result of their historical involvement with the entire spectrum of SAR techniques. There is a wide variety of signaling devices available, and no single device is ideal under all circumstances. Pyrotechnics make excellent distress signals, but the drawback is that they can only be used once. Coast Guard approved visual distress signaling devices fall into three general categories: daylight signals, night signals, and devices acceptable for both day and night use.

Red hand-held flares can be used by day, but are most effective at night or in restricted visibility. Hand-held devices may expel ash and slag as they burn. The flare itself is very hot and can cause a fire if dropped. Caution should be used to ensure that the device does not drip onto persons or flammable materials. Orange smoke signals, both floating and hand-held, are good for day use, particularly on clear days. The signals are effective in light or moderate winds. However, higher winds tend to keep the smoke close to the water and disperse it. Red parachute flares, both pistol and rocket propelled, are good signals for day and night use because of their altitude, slow descent, and intensity. However, the slow descent can make them drift away from the site and lead rescuers astray. Pistol launched or self-contained rocket propelled red meteors are not effective at night. Because of their rapid descent, they are less affected by the wind. However, the burning time is shorter and therefore the signals are not as readily observed. When using one of these devices, the wind must be taken into account. In calm winds, the device should be fired away from the wind at a 60 degree arc to the horizon. As wind increases, increase the angle to no more than 80-85 degrees. No pyrotechnic device should be fired straight up in calm winds; the device can fall back on the individual. Pyrotechnic devices should be stored in a cool, dry location and must be readily accessible in event of an emergency. A watertight container clearly marked "Distress Signals" is recommended. Coast Guard approved pyrotechnic devices have a service life expiration date. At this time, the expiration date may not exceed 42 months from the date of manufacture.

NUMBER MARKED ON DEVICE	DESCRIPTION OF DEVICE	ACCEPTED FOR USE
160.021	Hand-held red flare distress signal.	Day & night
160.022	Floating orange smoke distress signal (5 minutes).	Day only
160.024 160.028	Pistol-projected parachute red flare distress signal. Must be used with a suitable approved launching device.	Day & night
160.036	Self-contained rocket propelled parachute red flare distress signal.	Day & night
160.037	Hand-held orange smoke distress signal.	Day only
160.057	Floating orange smoke distress signal (15 minutes).	Day only
160.066	Red aerial pyrotechnical flare distress signal. May be meteor or parachute type and may need an approved suitable launching device.	Day & night

11. MONITORING OF NAVIGATION SYSTEM PERFORMANCE.

a. ***The Monitoring Process.*** To ensure compliance with any minimum navigation performance specifications, states need to establish procedures for the systematic or periodic monitoring of the navigation performance actually achieved. This should be supported by formal notification of PIC's, operators, and states of registry of any gross deviations from assigned track. Close cooperation between flightcrews, operators, and aviation authorities is required to ensure that unsatisfactory performance is recognized and corrected. Incident reporting procedures that encourage cooperation by the flight crewmembers involved are essential to safe operations. In the event of a significant deterioration in navigation performance, whether the product of random excursions by operators or the result of an equipment system's low performance level, corrective action is required. In this situation, ATC must accept responsibility for advising user states and operators, either directly or through the Central Monitoring Agency (CMA), of the action being taken to correct the situation. In the absence of an agreement with the concerned state(s) to exclude offending aircraft from the system, it may be necessary to temporarily increase separation while resolving the problem.

The monitoring process includes four distinct actions:

- Monitoring the operator's navigation performance in cooperation with the flightcrew.

• Monitoring of the operator by the state having jurisdiction over that operator to ensure that adequate provisions are being applied by the operator while conducting authorized flight operations.

• Monitoring of actual navigation performance during normal flight operations by means of radar used by the ATC units of states providing service in the region.

• Monitoring can also be done on the basis of position reporting.

Because of the large variety of circumstances existing in the relationships between states and their operators engaged in oceanic operations, it is not expected that all states will make maximum effort to comply with the responsibilities resulting from the application of special airspace restrictions (such as MNPS) while keeping administrative arrangements within reasonable limits.

b. ***Monitoring by the Operators.*** While operators understandably want to avoid excessive documentation, postflight monitoring and analysis should be carried out for two important reasons: it facilitates the investigation of any reported gross navigational errors (GNE's), and assists in identifying any deterioration in equipment performance (refer to the definition of GNE in Appendix 4).

Decisions regarding monitoring of an aircraft's navigation performance are largely the prerogative of individual operators. In deciding what records should be kept, airlines should consider the stringent requirements associated with special airspaces such as MNPS. Airlines are required to investigate all errors of 20 NM or greater in MNPS airspace. Whether these deviations are observed by radar or by the flightcrew, it is imperative that the cause of the deviation be determined and eliminated. Therefore, it is necessary to keep complete in-flight records so that any analysis can be made.

Operators should review their documentation to ensure that it provides all the information required to reconstruct the flight, if necessary, some weeks later. These records also satisfy the ICAO regulation that a flight journal be kept. Specific requirements could include, but are not limited to, the following:

• details of the initial position inserted in the equipment, original planned flight track, and flight levels;

• all ATC clearances and revisions;

• all reports (times, positions, etc.) made to ATC;

• all information used in the actual navigation of the flight, including a record of waypoint numbers allocated to specific points, estimated time of arrival (ETA's) and actual times of arrival (ATA's);

• routine monitoring of Omega navigation system (ONS)/very low frequency (VLF) station signals in use/strength;

• comments on any navigation problems relating to the flight, including information on any significant discrepancies between inertial navigation system (INS) and/or Omega displays, other equipment abnormalities, and any discrepancies relating to ATC clearances or information passed to the aircraft following ground radar observations;

• sufficient information on accuracy checks to permit an overall performance assessment;

• records of terminal errors and of checks made against navigation facilities immediately prior to entering oceanic airspace and, to the extent possible, details of the Omega/VLF signals in use; and

• details of any manual updates made to INS or Omega units.

It is also important that the forms used for the trip journal make it easy to examine key factors. Therefore, documentation might include a question to the crew such as, "Did a track error of 20 NM or more occur on this flight? Yes/No."

c. ***Monitoring of the Operator by the State.*** Decisions regarding the monitoring of operators by the state may be taken unilaterally, but there should be a cooperative process concerning the specifications to be satisfied by the operator while planning and reviewing achieved performance. Much of this process involves FAA-approved procedures and monitoring to ensure compliance. Varied circumstances influence the relationships between states and their operators, and also impact monitoring functions. Certain states require operators to maintain an aircraft log in which the crew records the performance of the navigation equipment. This log is used as a basis for investigation if significant equipment deficiencies occur. Other states require operators to use a form to record the performance of INS and Omega navigation equipment. The more complex the form, the more problems are likely to be encountered in its compilation and analysis. Separate forms may be justified for Omega and INS. States can use whatever methods or forms they prefer, but should carefully consider what information is necessary. Examples of factors to consider include:

(1) warnings of deteriorating INS accuracy

(2) provision of a simple record to facilitate analysis of deviations

(3) a record of performance of flight operation in areas where there is no radar coverage

In the case of Omega, there have been reports of the metallic structure of a terminal building adversely affecting navigation readouts. It may be more appropriate to record readings shortly after landing and before taxiing, or over a landfall point after an oceanic crossing. Such readings give a less reliable picture of the overwater performance than is the case with INS. However, they are likely to indicate a large error that might result from a "lane slip." If a GNE is attributed to the use of Omega, a report should be completed by the operator and forwarded to the Omega Association, with a copy to the Central Monitoring Agency. The addresses of these organizations are contained in Appendix 1, Figure 1-4 of this AC.

d. ***Direct Action by States in the Monitoring Process.*** Apart from the monitoring functions of operators and states having jurisdiction over operators flying in the NAT region, it is vital to monitor actual navigation performance as observed by ATC radars of NAT provider states. This monitoring function covers four distinct phases:

(1) the acquisition and use of monitoring data;

(2) action by the ATC unit in the case of radar observed flight deviations, including followup action by the operator and/or state concerned;

(3) periodic issuances of a summary of radar observed deviations to all interested states and international organizations to apprise users of the general situation in the NAT region regarding navigation performance achieved by flights; and

(4) collection of specific data on navigational performance by all flights, to serve as a basis for the assessment of compliance to the special navigation area requirements by all traffic in the oceanic airspace concerned by its application and the relationship to the safety of separation standards used.

The following are checklists of items discussed in this chapter, and are provided as a convenience to the reader. The checklists do not necessarily include every item that must be checked for an international flight.

7. AGREEMENTS	
ARINC	
BERNA	
STOCKHOLM	

8. NAVIGATION EQUIPMENT	
VOR	
DME	
INERTIAL	
VLF/OMEGA	
LORAN	
GPS	

9. PUBLICATIONS	
Updated aircraft documents	
Charts	
Sectionals	
WAC's	
Plotting	
Approach	
Area	
Terminal	
ONC's	
FLIPs	
NAT message (current for North Atlantic	
Flight Plans	
ICAO completed	
Blank ICAO	
Flight Plans	
Operations manual	
International Flight Information Manual	
Maintenance manuals	
Manufacturer's equipment source list	
Customs Guide	

10. WEATHER Wind Factors en route and consideration for the calculation of ETP's (Equal Time Points of No-Return)	
Boeing Seasonal Wind Factor	
IATA Seasonal Wind Factor	
Current Route Wind Factor (What weather reporting services is intended to be used?)	

11. SURVIVAL EQUIPMENT	
Area survival kit (with text)	
Medical kit (with text)	
Emergency Locator Transmitter	
Flotation equipment	

12. FACILITATION AIDS	
U.S. Department of State	
U.S. Dept of Commerce	
U.S. Customs Service	
National Flight Data Center (FAA)	
FAA Office of International Aviation (AFS-5)	
FAA Aviation Security (ACO-100)	

13. OTHER CHECK LIST CONSIDERATIONS	
Preflight Planner	
Aircraft locks	
Spare keys	
Security devices	
Commissary supplies	
Electrical adapters (razors, etc.)	
Ground transportation	
Hotel reservations	
Catering	
Slot reservations	

CHAPTER 3. NORTH ATLANTIC (NAT) OPERATIONS

1. CHARACTERISTICS OF THE AIRSPACE.

a. ***Introduction.*** The NAT region includes the following flight information regions (FIR's): Bodo Oceanic, Gander Oceanic, New York Oceanic, Reykjavik, Santa Maria Oceanic, Shanwick Oceanic, and Sondrestrom. Most of the airspace in these FIR's is high seas airspace, wherein the International Civil Aviation Organization (ICAO) Council has determined that all rules regarding flight and operation of aircraft apply without exception. However, responsibility for enforcement of these rules rests with the state of registry of the aircraft or the state of the operator. Flight rules are contained in Annex 2 to the Convention on International Civil Aviation, and procedural aspects are covered in ICAO Doc 7030, "NAT Regional Supplementary Procedures." The majority of the airspace is controlled airspace. Instrument flight rules (IFR) apply to all flights at or above flight level (FL) 60 or 2000 feet above ground level (AGL), whichever is higher. These airspaces include:

- the New York Oceanic, Gander Oceanic, Shanwick Oceanic, Santa Maria Oceanic

- the Bodo Oceanic FIR when operating more than 100 nautical miles (NM) seaward from the shoreline above FL 195

- Sondrestrom FIR when operating outside the shoreline of Greenland

- Reykjavik FIR when operating in the oceanic sector, or in the domestic sector at or above FL 200

- the Shannon Oceanic Transition Area (SOTA)

The SOTA is a portion of the Shanwick oceanic control area (OCA) to the south of Ireland within which air traffic services (ATS) are provided by Shannon Air Traffic Control (ATC) center. Communication with aircraft is by very high frequency (VHF), and secondary surveillance radar (SSR) service is provided. The SOTA is an integral part of the Shanwick OCA, and minimum navigation performance specifications (MNPS) procedures and requirements apply. Search and rescue (SAR) vessels and aircraft are stationed at some locations in the NAT region, but SAR aircraft may not always be available.

b. ***MNPS Airspace.*** MNPS airspace is that portion of the NAT airspace between FL's 275 and 400, between latitudes 27° N and the North Pole; bounded in the east by the eastern boundaries of control areas (CTA's) Santa Maria Oceanic, Shanwick Oceanic, and Reykjavik; and bounded in the west by the western boundary of CTA's Reykjavik and Gander Oceanic, and New York Oceanic east of longitude 60°W and south of 38°30' N (see Figure 2-1, Appendix 2). All aircraft operating in MNPS airspace are required to have a specified minimum navigation performance capability that has been verified by the state of registry or by the state of the operator, as appropriate. In the United States, this verification is accomplished by issuing a Letter of Authorization (LOA) or by granting authorization in the operations specifications. Within the NAT region, a volume of airspace can be established for special use, usually military. Such airspace is known as a temporary airspace reservation. This reservation can be stationary or in motion, depending on whether its position remains fixed with relation to the surface of the earth or changes with time.

c. ***RVSM Airspace.*** Reduced vertical separation minimum (RVSM) airspace is airspace where aircraft are separated vertically by 1,000 feet (300 meters). Initial implementation of RVSM airspace will be in the NAT MNPS. However, the guidance provided in this Advisory Circular (AC) can be adapted for use in other areas where RVSM is applied.

d. ***Characteristics of the Traffic.*** Within the NAT region there are both civil and military operations. Civil operations include supersonic and subsonic commercial flights and international general aviation (IGA). Due to passenger demands, time zone differences, and airport noise restrictions, much of the NAT air traffic falls into one of two categories: westbound traffic departing Europe in the morning, and eastbound traffic departing North America in the evening. The effect is to concentrate most of the traffic unidirectionally, with peak westbound traffic operating between 1130 coordinated universal time (UTC) and 1900 UTC (Figure 3-1), and peak eastbound traffic between 0100 UTC and 0800 UTC at 30W (Figure 3-2). To optimize service to the bulk of the traffic, a system of organized tracks is constructed every 12 hours to accommodate as much traffic as possible on or close to their minimum cost paths. Traffic flow on the Europe-Alaska axis is also predominantly unidirectional. In the Reykjavik CTA the westbound peak is between 1200-1800 UTC, and the eastbound traffic is peak between 0100-0600 UTC. To facilitate the traffic flow during peak hours and prevent multiple random routes, a polar track structure (PTS) consisting of 10 fixed tracks has been established. Within MNPS airspace, it is not mandatory to route on either the organized track system (OTS) or the PTS. Traffic flying on other than fixed tracks is said to fly on random tracks. During 1991, approximately 50 percent of transatlantic aircraft operated on the structured track, with the remaining traffic operating on random tracks. Records indicate that approximately 86 percent of the flights across the NAT region are public transport, 11 percent are military, and 3 percent are IGA.

e. ***Provider States.*** ICAO states that provide ATS within the NAT region are Canada, Denmark, Iceland, Ireland, Norway, Portugal, the United Kingdom, and the United States. These states are known as the NAT Provider States.

f. ***Pilot Qualification Requirements.*** The minimum pilot qualification for any flight across the North Atlantic is a private pilot license. An instrument rating (IR) is required if operating at FL 60 or above. Some states (for example, Canada) require pilots to hold an IR for operating at any altitude in the NAT region, so it is imperative that pilots are acquainted with states' varying legislative requirements. Pilots must comply with the regulations imposed by the state of registry of the aircraft being flown and with the regulations of countries in which they land or overfly. Irrespective of the mandatory requirements, it is strongly recommended that all pilots hold a valid IR. In addition to cross-county flight time, the demanding nature of the NAT operational environment requires that the pilot-in-command (PIC) meet the recent experience requirements stipulated by the state of registry for the PIC; have adequate recent flight experience in the use of long-range navigation equipment and communications equipment; and have recent partial panel training and training in dead reckoning (DR) navigation techniques.

g. ***Regulatory Requirements for NAT Flights.*** Pilots must comply with regulations imposed by the state of registry of the aircraft being flown. Pilots must also comply with regulations of states in which they land or overfly. In particular, Aeronautical Information Publications (AIP's) for these states should be checked prior to departure.

at FL 200 and above in the Sondrestrom FIR. All flights which cross international borders must file a flight plan. While enroute, all changes to IFR flight plans shall be reported as soon as practicable to the appropriate ATS unit as prescribed. An arrival report must also be sent to the appropriate ATS unit. When the flight plan cannot be closed by means of the aircraft radio, a telephone or telegraphic message should be sent. Failure to close flight plans may result in needless search operations. ICAO member states have agreed that aircraft with their registration mark will comply with the Standards and Recommended Practices (SARP's) concerning the operation of aircraft contained in ICAO Annex 6, as well as the Procedures for Air Navigation Services - Aircraft Operations (PANS OPS), stated in ICAO Doc 8168, Volume 1, as a minimum.

The quality of navigational performance required in the operation of aircraft is based on the need for safe and economic flight. It is often necessary to define the required performance level of a navigation system in relation to a particular air traffic environment or route structure. No single statement of operational requirements, although meeting basic safety requirements, can adequately reflect the many different combinations of operating conditions. Criteria established for the most exacting regions may be unsuitable for other operations. However, it is necessary to establish stringent specifications to permit operations in an area. Failure to meet the criteria may result in exclusion of aircraft from airspace. In determining performance criteria, there must be a capability to allow operations in specific areas while applying minimum separations standards to accommodate present and forecast traffic. The criteria established should be protected for a specified period, thus assuring the cost-effectiveness to operators of the equipment necessary to ensure the required level of performance. It is not intended that there should be international standardization of equipment selected by individual operators. However, it is essential that the equipment selected and their method of operation must be capable of meeting the navigation performance specifications for a particular area.

In an air traffic environment where there is a multiplicity of tracks, the aim is that no aircraft should cross the half-standard minimum separation value established between any two tracks, thus ensuring that aircraft operating on another track are not placed at risk of collision. The need is to ensure that the large majority of traffic is concentrated close to the designated track and that any deviations, whether the result of inadequate system performance or human error, are contained before reaching the half-standard. Total safety is unlikely to be achieved, but performance requirements need to relate to a prescribed target level of safety (TLS). TLS is a generic term representing the level of risk considered acceptable in particular circumstances, and is critically dependent on an assessment of collision risk. Collision risk refers to the number of midair accidents likely to occur due to loss of separation in a prescribed volume of airspace for a specific number of flight hours.

In airspace where the bulk of the air traffic flows along fixed routes, the need is to ensure that aircraft adhere to their cleared tracks and remain within any protected airspace. The conditional requirements are related to the need to avoid risk of collision with traffic operating adjacent to the protected airspace, and to avoid disruption of other traffic flows. Such adherence is also an essential requirement to ensure the safety of any ATS action regarding crossing traffic where the minimum separation values need to be kept at the lowest possible value (Figure 3-3).

FIGURE 3-3. NAR EXAMPLE - INTERNATIONAL FLIGHT INFORMATION MANUAL (IFIM)

It is expected that current North Atlantic route (NAR) documentation will be carried on the flightdeck of each aircraft operating within the NAR system, including a description of the current NAR and the information contained in the current NAT/OTS message. The official NAR route descriptions are contained in both Canadian Ministry of Transportation (MOT) and U.S. FAA publications. The official FAA listing appears in the IFIM, issued annually and amended quarterly. Changes to the NAR routes are advertised in the biweekly publication "International Notices to Airmen." The following list divides the NAR route description into two sections according to the direction of the flight. Each section is subdivided according to route portion (common or noncommon). The common portion describes the NAR route between the costal fix and the inland navigational facility. The noncommon portion describes the route between the NAR route system airport being used and the inland navigational facility.

NAR EASTBOUND ROUTES - COMMON PORTION
(FOR TRAINING PURPOSES ONLY - NOT TO BE USED FOR NAVIGATION)

NAR Designator	Inland Nav. Facility	Route Description	Costal Fix
NA21	Nantucket	Control 1146 WHALE BLUSE Sable Island	BANCS
NA23	Nantucket	Direct	BANCS
NA25	CANAL	SABLE	BANCS
NA27	Watertown	J595 HL595 Saint John (N.B.) HL506 Sable Island	BANCS
NA29	Sherbrooke	HL500 J500 Millinocket J506 HL506 Sable Island	BANCS
NA31	Sherbrooke	Direct	BANCS
NA41	Nantucket	CANSO	COLOR
NA43	Nantucket	Direct	COLOR
NA45	Nantucket	J585 HL585 Yarmouth HL575 Halifax CANSO	COLOR
NA47	Watertown	J595 HL595 Saint John (N.B.) HL506 Halifax CANSO	COLOR
NA49	Sherbrooke	HL500 J500 Millinocket J506 HL506 Halifax CANSO	COLOR
NA51	Sherbrooke	Direct	COLOR
NA53	CANAL	J575 HL575 Halifax CANSO	COLOR
NA81	Nantucket	J585 HL585 Yarmouth HL575	St.Johns (Nfld.)

FIGURE 3-3. NAR EXAMPLE - IFIM - Continued

NON-COMMON PORTION EASTBOUND VIA NANTUCKET

FROM	NON-COMMON PORTION	INLAND NAV FACILITY
Kennedy	SARDI	Nantucket

NAR WESTBOUND ROUTES - COMMON PORTION
(FOR TRAINING PURPOSES ONLY - NOT TO BE USED FOR NAVIGATION)

NAR Designator	Costal Fix	Route Description	Inland Nav. Facility
NA120	Gander	HL577 Sydney HL575	Yarmouth
NA122	Gander	Direct	Hyannis
NA124	Gander	HL577 Sydney HL575 J575	Boston
NA126	Gander	Direct	Boston
NA128	Gander	HL500 Channel Head HL573 J573	Kennebunk
NA130	Gander	Direct	Kennebunk
NA132	Gander	HL500 Moncton HL509 J509 HL509	Beauce
NA140	Springdale	HL579 Stephenville HL581 J581	Kennebunk
NA142	Springdale	Direct	Kennebunk
NA144	Springdale	Direct	Boston
NA146	Springdale	HL579 Stephenville HL581 CHEPS HL509 J509 HL509	Beauce

j. ***Navigation Equipment and Procedures.*** To meet specific requirements regarding overall navigational performance of equipment and procedures, installation and approval must be in accordance with applicable civil airworthiness requirements, with particular reference to the following:

(1) the primary equipment information displays must be visible to, and all controls usable by, the appropriate crewmembers while seated at their duty stations;

(2) warning of failures or malfunctions must be provided by visual or aural signals;

(3) the airborne system must be protected against power interruptions and/or abnormalities; and

(4) the equipment must not be the source of objectional radio frequency interference and must not be adversely affected by interference from other systems in the aircraft.

The operations manual must contain such pertinent material as required to define all operational limitations associated with the system's performance. For example, in the case of a station-referenced system, the manual would include details of the areas where an adequate signal level may be received or, in the case of an inertial system, any limitations of the system's ground alignment and of the time period within which adequate navigational performance within specified limits can be reasonably assured. Experience has clearly demonstrated that the presence of sophisticated navigational equipment on board an aircraft does not, by itself, ensure that a high level of performance will be achieved. Two operators may have identical equipment, suggesting that they would achieve similar performance. This will not be the case unless the equipment is properly installed and maintained, and correctly used by the operating crews. Therefore, it is essential to provide adequate training for the personnel operating or maintaining the equipment, and that mandatory operating drills and procedures are included in crew training courses.

k. ***Sources of Navigation Errors.*** A significant proportion of navigation errors result from the use of incorrect data. To minimize the problem, source data must be clearly legible under the worst cockpit lighting situations and presented in a format suitable for error free use in the cockpit environment. On navigation (radio facility) charts, all position coordinates should ideally be printed in dark blue or black numerals against the white background. If coordinates would normally appear against a locally tinted background, they should be enclosed in a white box. Positively no information should be overprinted on top of position coordinates. If groups of position coordinates must appear in close proximity to each other, the position referenced by each set of coordinates should be clearly indicated by means of a leader. Navigational documents, such as track messages or flight plans, should be double spaced or boxed to minimize the possibility of line slippage when the information is read. It is advisable to provide pilots with a simple plotting chart of suitable scale (1 inch equal to 120 NM has been used successfully on NAT routes) in order to facilitate a visual presentation of an intended route that is otherwise defined only in terms of navigational coordinates. (For more details, see the NAT MNPS Airspace Operations Manual.) In parts of the North Atlantic, Omega signals from the Liberia station can be badly affected by modal interference, especially at night along any part of the signal path. Consequently, when any other transmitters are shut down for reasons such as scheduled maintenance, Omega tracking problems can occur. For operations in MNPS airspace, it is generally accepted that the very low frequency (VLF) backup is advisable.

Errors involving aircraft equipped with Omega were discovered to be disproportionately high by the NAT Special Planning Group (SPG). No positive conclusion has been reached as to why the Omega gross navigation error (GNE) record is so poor, but implementation of the following suggestions is likely to lead to improvement. States of registry should ensure that their operators understand the importance of the strength of received signals. It is essential to choose the best antenna; to ensure, by careful skin mapping, that it is well located; and to check that there is no loss of efficiency at the antenna coupling as the result of inadequate drainage. The regular monitoring and logging of station signals and signal strength by the flightcrews will assist maintenance personnel in evaluations of the system's performance. Operators using Omega for MNPS operations will appreciate the need to provide crews with the latest information on the status of Omega and VLF transmissions. Omega equipped aircraft using E-field antennae are likely to suffer prolonged loss of signal reception when operating in or near clouds. Due to the recent improvement in Omega equipment and software, old equipment without updated software should not be purchased. If old equipment is still in use, every effort should be made to incorporate software modifications to achieve the best possible performance standards.

Several high power, nondirectional radio beacons (NDB's) are located in the NAT region that are useful to automatic direction finder (ADF) equipped aircraft. Some of these stations, including commercial band transmitters, are not monitored for outages or interference by transmitters on adjacent frequencies and may be severely affected by atmospheric conditions. VHF communications coverage extends to line-of-sight distance from facilities in Canada, Iceland, Greenland, Faeroe Islands, the Azores, and coastal Europe. The Canadian VHF coverage is extended by use of a remote facility in southern Greenland. High frequency (HF) communications are available throughout the NAT region for ATC purposes, and HF is mandatory for flight within the Shanwick OCA. Use of HF by pilots of IGA flights permits proper monitoring of the flight progress. HF equipped flights should be able to receive HF VOLMET broadcasts, which contain continual updates on the meteorological situation at major terminals in Europe and North America and significant meteorological information (sigmet) warnings.

2. STATE RESPONSIBILITY.

It is implicit in the concept of MNPS that all operations within the airspace, whether by public transport or general aviation aircraft, achieve the highest standards of navigation performance accuracy. All flights within NAT MNPS airspace must have the approval of either the state of registry of the aircraft or the state of the operator. Such approvals encompass all aspects of the expected navigation performance accuracy of the aircraft, including the navigation equipment carried, installation and maintenance procedures, and crew navigation procedures and training. Due to local circumstances and varying national arrangements, procedures and methods employed for issuing approvals can vary considerably between states. As new operators apply to conduct operations in MNPS airspace, states not familiar with approvals should be able to draw on the experience of other states. It is essential to the integrity of the MNPS concept that knowledge is shared; therefore, states that have issued supplementary material are urged to make it available to ICAO.

3. PURPOSE AND CONCEPTS OF MNPS.

ICAO SARP's for aircraft operation state that, for flights in defined portions of airspace where MNPS are prescribed, an airplane shall be provided with navigation equipment which continuously indicates to the flightcrew the aircraft's adherence to or departure from track to the required degree of accuracy at any point along that track, and which has been authorized by the state of the operator or the state of registry for the MNPS operations concerned. Since its inception in 1965, the NAT SPG has been developing methods and procedures allied to the safe separation between aircraft on tracks in the NAT region. In 1975, the NAT SPG proposed establishing an MNPS for all aircraft using the NAT OTS to enable a reduction in the lateral separation minimums. The rationale and foundation for MNPS is based on a mathematical model that expresses the relationship between collision risk and separation. The integrity of MNPS airspace is maintained by a series of procedures that include approval of navigation equipment and its operation, along with continuous monitoring of the navigation accuracy by aircraft in MNPS airspace. It is essential to the application of the lateral separation minimums that all operations in MNPS airspace by public transport, IGA, and state aircraft achieve the highest standards of navigation performance accuracy. Some FAR Part 91 operators erroneously believe that, because they are not required to hold an air carrier certificate, they should not be subject to stringent separation requirements. This belief is incorrect; whenever an aircraft operating on the NAT OTS deviates from course, there will be another aircraft located 60 NM or less to either side of the assigned track. If a collision results from faulty procedures or any other reason, the results are equally catastrophic regardless of whether the offending aircraft is operated under FAR Part 91 or Part 121.

a. ***NAT MNPS.*** MNPS are applied to aircraft operating between FL 275 and 400 within the Shanwick, Gander, and Reykjavik OCA's; part of the New York OCA; and Santa Maria OCA. Continuous monitoring of the navigation accuracy of aircraft using MNPS airspace is carried out by use of radars covering the exits from the airspace in order to confirm that the required navigation standard is being achieved. On the basis of such monitoring, it has been agreed by ICAO that the lateral separation minimum for aircraft operating in MNPS airspace shall be 60 NM. It is implicit in the concept of MNPS, and essential to the application of the quoted lateral separation minimum, that all operations in MNPS airspace achieve the highest standards of navigation performance accuracy. Checks are carried out from time to time to verify the approval status of aircraft operating within MNPS airspace. Aircraft that are approved for operations within the NAT MNPS airspace shall have navigation performance capability such that:

(1) the standard deviation of lateral track errors shall be less that 6.3 NM (11.7 km)

(2) the proportion of the total flight time spent by the aircraft 30 NM (55.6 km) or more off the cleared track shall be less than 5.3×10^{-4}

(3) the proportion of the total flight time spent by aircraft between 50 and 70 NM (92.6 and 129.6 km) off the cleared track shall be less than 13×10^{-5}

The MNPS shall be applicable in that volume of airspace defined on page 3-1 of this AC.

b. ***Application of MNPS.*** It is essential that stringent minimum navigation performance requirements be applied only to those route structures and localities where compliance is essential to safe and cost-effective operation with minimum interference with the free movement of air traffic. Proposals for the adoption and enforcement of criteria in a particular region should take into account the effects of any new regulatory requirements on all operations to ensure that any exclusion of traffic from desirable tracks will be kept to a reasonable minimum, and that satisfactory alternate tracks with a lower density are available for excluded traffic. Navigation performance specifications must be formulated in a manner acceptable to both equipment manufacturers and aircraft operators. These specifications should define the maximum proportion of total flight time during which aircraft can be allowed to deviate specified distances. These specifications should apply for a period of at least 10 years after implementation. Specifications relating to the separation between routes will normally be determined by regional agreements based upon assessment of navigational performance in that area or on those routes. In most cases, route spacing is based on the known performance of the majority of existing traffic to ensure that a new navigational system can meet the specified criteria. Confirmation of compliance is likely to be a long-term process, since the number of large errors that can be accepted is very low. Once performance criteria are established, continuous monitoring is needed to ensure that the required specifications and standards are maintained, and that there is no gradual erosion of safety standards. If the monitoring process shows that overall system performance is consistently better than the required navigation performance specifications, procedures may be adjusted to benefit the majority of users.

c. ***General Route Structure.*** As previously explained, much of the NAT traffic contributes to one of two flows: a westbound flow from Europe in the morning, and an eastbound flow from North America in the evening. The constraints of the necessary horizontal separation criteria and a limited economical height band (FL 310 - FL 390) make the airspace congested at peak hours. Airspace utilization is improved by strategic use of so-called "opposite direction" FL's; i.e., FL's 310, 350, and 390 eastbound, and FL's 330 and 370 westbound during periods of peak flow. Utilization is further improved by the application of mach number technique, whereby aircraft operating successively along suitable routes maintain an appropriate mach number for a relevant portion of that flight. Experience has shown that when two or more aircraft operate on the same route at the same FL, use of the mach number technique is more likely to maintain constant longitudinal separation than other methods. When the variability of the weather is introduced, it becomes necessary to create a track structure that takes into account all known factors and offers operators a choice of economically viable routes as close as possible to the minimum time track (MTT). This variable track structure is the OTS. Figure 3-4 is an example of preferred routes for westbound NAT traffic.

d. ***Organized Track System.*** After determination of basic MTT's, with due consideration to airlines' preferred tracks and taking into account airspace restrictions such as danger areas and military airspace reservations, the OTS is constructed by the appropriate oceanic area control center (OAC). The nighttime (eastbound) OTS is constructed by the Gander OAC, and the daytime (westbound) by Shanwick OAC (Prestwick), each taking into account tracks that New York, Reykjavik and/or Santa Maria may require in their respective OAC's. In each case, OAC planners consult each other, coordinate as necessary with adjacent OAC's and domestic ATC agencies, and ensure that the proposed system is viable for lateral and vertical separation criteria. They also take into account the anticipated requirements of the opposite direction of traffic and ensure that sufficient track and FL profiles are provided to satisfy anticipated traffic demand. The impact on domestic route structures and the serviceability of transition area radars and navaids are checked before the OTS is finalized.

The agreed OTS is then promulgated as a NAT track message via the Aeronautical Fixed Telecommunications Network (AFTN). A typical time of publication of the westbound OTS is 0000 UTC, with the eastbound OTS at 1200 UTC. This message gives full details of the OTS coordinates as well as the FL's that are expected to be in use on each track. Correct interpretation of the track message by operators and pilots is essential to both economy of operation and in minimizing the possibility of misunderstanding leading to the use of incorrect track coordinates. Oceanic airspace outside the published OTS is available for random operations, subject to separation criteria and

NOTAM restrictions. Flights that do not operate on the OTS, or that join or leave an organized track at some intermediate point, are considered to be random operations.

e. ***Other Routes and Route Structures Within or Adjacent to NAT MNPS.*** When NAT MNPS airspace was introduced, it was recognized that some special procedures and routes were needed. Procedures were required for aircraft suffering partial loss of their full navigational capability, with consideration of those aircraft operating along a number of relatively short-range routes within MNPS airspace. Further experience showed that account also had to be taken to cover aircraft not equipped with HF radio. Flights operating along these special routes still need state approval to operate within MNPS airspace.

FIGURE 3-4. SAMPLE OF PREFERRED ROUTES FOR NAT TRAFFIC - WESTBOUND

1 OCA points North of 57N 2 OCA points 55N-57N 3 OCA points South of 55N

Originating Area	OCA Entry Points	NAT Structure	Domestic Routing
Copenhagen FIR	61N 10W 60N 10W	1,2,3	ADN STN UN610/UN601 or SUM UN612/UN603
	59N 10W 58N 10W	1,2,3	ADN STN UN610/UN601 or SUM UN593/UN584
	57N 10W	1,2,3	GORDO UR23 GOW UN572
	56N 10W	1,2,3	GORDO UR23 GOW UN563
	55N 10W	1,2,3	GORDO UR23 GOW MAC UN552
Manchester TMA	57N 10W	1,2,3	WAL B3/UB3 BEL UN570
	56N 10W	1,2,3	WAL B3/UB3 BEL UN561
	55N 10W	1,2,3	WAL B3/UB3 BEL UN551
London/Gatwick	56N 10W	1	SAM UR14 DUB ERNAN UN560
	55N 10W	1,2	SAM UR14 DUB ERNAN UN550
	via Ackil	1,2	SAM UR14 KARMA UG1 STU UA29 ACKIL UN541 or UN531
	via SNN	1,2,3	SAM UR14 KARMA UG1 SNN UN540 or UN530 or UN521
	via CRK	1,2,3	SAM UR37 CRK UN520 or UN512
	51N 15W	1,2,3	SAM UR37 MERLY UB40 TIVLI UN510

FIGURE 3-4. SAMPLE OF PREFERRED ROUTES FOR NAT TRAFFIC - WESTBOUND - Continued

1 OCA points North of 57N 2 OCA points 55N-57N 3 OCA points South of 55N

Originating Area	OCA Entry Points	NAT Structure	Domestic Routing
London TMA	61N 10W 60N 10W	1,2,3	POL UB4 TLA UN601 STN UN610 or UN601
	59N 10W 58N 10W	1,2,3	POL UB4 MARGO GOW UN590 BEN UN590 or UN581
	57N 10W	1	TNT/ROBIN UR3 WAL UB3 BEL UN570
		2	POL UB4 MARGO MAC UN571
		3	POL UB4 MARGO GOW UN572
	56N 10W	1	UG1 STU UR14 DUB ERNAN UN560
		2	TNT/ROBIN UR3 WAL UB3 BEL UN561
		3	POL UB4 MARGO MAC UN562
	55N 10W	1,2	UG1 STU UR14 DUB ERNAN UN550
		3	TNT/ROBIN UR3 WAL UB3 BEL UN551
	via Ackil	1,2	UG1 STU UA29 ACKIL UN541 or UN531
		3	TNT UR3 WAL UB1 DUB UB1 ACKIL UN541 or UN531
	via SNN	1,2,3	UG1 SNN UN540 or UN530 or UN521
	via CRK	1,2,3	UG1 STU UB10 CRK UN520 or UN511
	51N 15W	1,2,3	UG1 STU UB10 CRK UN511
	50N 08W	1,2,3	R8 SAM UR8 LND UN500
France FIR/UIR	61N 10W 60N 10W	1,2,3	UB4 TLA UN601 STN UN610 or UN601
	59N 10W 58N 10W	1,2,3	UB4 MARGO GOW UN590 BEN UN590 or UN581
	57N 10W	1	UB4 ROBIN UR3 WAL UB3 BEL UN570
		2	UB4 MARGO MAC UN571
		3	UB4 MARGO GOW UN572

FIGURE 3-4. SAMPLE OF PREFERRED ROUTES FOR NAT TRAFFIC - WESTBOUND - Continued

1 OCA points North of 57N **2 OCA points 55N-57N** **3 OCA points South of 55N**

Originating Area	OCA Entry Points	NAT Structure	Domestic Routing
France FIR/UIR - Continued	56N 10W	1,2	UB4 UA30 UG1 STU UR14 DUB UN560 ERNAN UN560
		3	UB4 ROBIN UR3 WAL UB3 BEL UN561
	55N 10W	1,2	UB4 UA30 UG1 STU UR14 DUB UN560 ERNAN UN550
		3	UB4 ROBIN UR3 WAL UB3 BEL UN551
	via Ackil	1,2	LIZAD UG4 SNN UG4 ACKIL UN541 or UN531
	via Ackil	3	UB4 UA30 UG1 STU UA29 ACKIL UN541 or UN531
	via SNN	1,2,3	LIZAD UG4 SNN UN540 or UN530 or UN521
	via CRK	1,2,3	LIZAD UG4 CRK UN520 or UN511
	51N 15W	1,2,3	UG4 TIVLI UN510
	50N 08W	1,2,3	LIZAD UG4 LND UN500

f. ***Routes for Aircraft With Only One Long-Range Navigation System.*** A number of special routes have been developed for aircraft equipped with only one long-range navigation system (LRNS). These routes are within MNPS airspace, and state approval is required. Aircraft that are equipped with normal short-range navigation equipment (VHF omnidirectional radio range (VOR)/distance measuring equipment (DME), ADF) and at least one fully operational set of one of the following types of navigational equipment should be considered capable of meeting the MNPS while operating along the routes listed below:

- Doppler with computer
- inertial navigation system (INS)
- Omega
- Loran-C (not applicable to all routes)
- flight management system/inertial reference system (FMS/IRS)

NOTE: Routes (a) through (g), listed below, were known as "Blue Spruce" routes and are now referred to as "special" routes. Continuous VHF coverage exists on these routes at FL 300 and above except as noted.

(a) Stornoway } - 60N10W - 61N1234W - ALDAN - Keflavik;
Benbvecula } (HF is required on this route).
- 61N10W - ALDAN - Keflavik; (VHF coverage exists and, subject to prior coordination with Scottish Airways and Shanwick, this route can be used by non-HF equipped aircraft.)

(b) McHriahanish } - 57N10W - 60N15W - 61N1630W - BREKI -
Glasgow } Keflavik; (HF is required on this route).
Shannon }
Belfast }

(c) Keflavik - GIMLI - Kulusuk - Sondre Stromfjord - Frobay (HF is required on this route);

(d) Keflavik- EMBLA - 63N30W - 61N40W- Prins Christian Sund;

(e) Prins Christian Sund -59N50W - PRAWN - NAIN;

(f) Prins Christian Sund - 59N50W - PORGY - Hopedale;

(g) Prins Christian Sund - 58N50W - LOACH - GOOSE VOR;

(h) Cork } - LOACH - GOOSE VOR;
Lands End - Gapli } (HF is required on this route).

(i) Funchal/Porto Santo - Santa Maria/Ponta Delgada/Lajes;

(j) Lisboa/Porta/Faro - Ponta Delgada/Santa Maria/Lajes.

(k) between Greenland and Canada (HF is required over the Greenland icecap below FL 195);

- Sondra Stromfjord NDB, 67N 60W, Cape Hooper NDB.
- Kook Islands NDB, 66N 60W, Cape Dyer NDB.
- Kook Islands NDB, 66N 60W, 64N 63W, Frobay VOR; and

(l) between Iceland and Greenland: Reykjanesskoli NDB, 6930N2240W, Constable Pynt NDB.

g. ***Routes for Aircraft with Short-Range Navigation Equipment.*** The following routes may be flown by aircraft with short-range navigation equipment (VOR/DME, ADF), but an LOA for operation within MNPS airspace is still necessary (see below).

(1) Flesland - Myggenes - INGO - Keflavik (G3)

(2) Sumburgh - Akeraberg - Myggenes (G11)

h. ***Procedures for Aircraft Suffering Partial Loss of Navigation Capability Before Entry into MNPS Airspace.*** ICAO Annex 6, Parts I and II, Chapter 7 state that aircraft must be sufficiently provided with navigation equipment to ensure that, in the event of the failure of one item of equipment at any stage of flight, the remaining equipment will enable the aircraft to proceed in accordance with MNPS requirements where applicable. For flight in NAT MNPS airspace, this is interpreted to mean that, while two sets of long-range navigation equipment have to be carried when operating in the major part of the MNPS airspace, there are routes on which carriage of only one set each of long-range and short-range navigation equipment is required. If an aircraft suffers partial loss of navigation capability prior to entry into oceanic airspace (e.g., only one INS or FMS/IRS serviceable), the pilot should consider using one of the special routes listed above. Use of these routes following partial loss of navigation capability is subject to the following criteria:

(1) sufficient navigation capability remains to meet the MNPS; i.e., one LRNS plus short-range navigation aid;

(2) the requirements of ICAO Annex 6, Parts I and II, Chapter 7 with regard to the provision of navigation equipment necessary to enable the aircraft to be navigated in accordance with its operational flight plan and the requirements of ATS can be met by relying on the use of short-range navigation aids in the event of failure of the remaining LRNS;

(3) a revised flight plan is filed with the appropriate ATS unit; and

(4) an appropriate ATC clearance is obtained.

NOTE: A revised oceanic ATC clearance will be issued after coordination between all OAC's concerned. If the OTS extends to the northern part of the NAT region at the time of the incident, the aircraft may be required to accept a lower than optimum FL in its revised oceanic clearance, especially during peak traffic periods.

i. ***Special Provisions for Aircraft Not Equipped for Operation in MNPS Airspace to Climb or Descend Through MNPS Airspace.*** Some aircraft, particularly the higher performance IGA aircraft, operate at FL's above the upper limit of MNPS airspace (FL 410 and above). Depending on their point of departure, such aircraft often require a comparatively brief penetration of MNPS airspace. In order that non-MNPS equipped aircraft are not unduly penalized by being excluded from operating at their most economic cruising level, provisions are made for climb and descent through MNPS. The NAT SPG agreed to the following provisions on the understanding that these would be published in the relevant AIP's by the states concerned, stating the VOR/DME's to be used and indicating those parts of the MNPS airspace which may be affected by this procedure. Aircraft not equipped for operation in MNPS airspace may be cleared by the responsible ATC unit to climb or descend through MNPS airspace provided:

(1) the climb or descent can be completed within the usable coverage of selected VOR/DME's and/or within the radar coverage of the ATC unit issuing such clearance;

(2) the aircraft is able to maintain direct pilot-controller communications on VHF; and

(3) MNPS aircraft operating in that part of the MNPS airspace affected by such climb or descent are not penalized by the application of this procedure.

4. OPERATIONAL APPROVAL TO FLY IN MNPS AND/OR RVSM AIRSPACE.

a. *Methods of Approval.* In the United States, operational approval to fly in MNPS and/or RVSM airspace is obtained by the issuance of operations specifications for certificated operators or by issuance of an LOA to noncertificated operators. Previously, LOA's (called certificates by ATC and foreign governments) have been nonstandard, have not had an expiration date, and were not crew specific in spite of ICAO regulations requiring that crews be trained to operate in MNPS airspace. Upon publication of this AC and guidance to FAA inspectors, the following changes will be enacted:

(1) LOA's will be standardized as per the format shown in Figure 3-5.

(2) LOA's will have a 24 calendar months validity period.

(3) Current holders of an LOA will be required to obtain a new LOA within 24 calendar months of the publication of this AC. A new LOA can be obtained in person or by mail by surrendering the old LOA and submitting a letter in the format shown in Figure 3-6 and a completed LOA form in the format shown in Figure 3-5. Figure 3-5 may be photocopied for this purpose, and the applicable sections completed.

(4) Operators applying for an initial LOA can expect the following from the FAA inspector handling their request:

(a) inspection of navigation equipment installation;

(b) verification that the aircraft has the required communication and navigation equipment for operations in MNPS airspace; and

(c) verification that crews that will fly the aircraft and/or flight departments responsible for MNPS crews have the qualifications to use the navigation and communication equipment installed in the aircraft. Operators will be required to develop a comprehensive procedures manual that contains detailed instructions on the use of all software and navigation devices. If the inspector determines that a flight department and/or crew do not have adequate qualifications, a proving run will be required. Qualifications may be acquired by various methods. It is recommended that crews receive training from either a commercially-conducted oceanic procedures course or a course conducted by their flight training department, and not depend solely on self-study of oceanic procedures.

(d) The inspector will verify that the aircraft is a U.S.-registered aircraft, properly registered under the provisions of FAR Part 47. Inspectors will need assurance that aircraft registered to corporations have the name and address (not Post Office box) of an **individual** U.S. citizen responsible for crew(s) performance in MNPS airspace.

(5) All LOA's will be assigned a unique tracking number by the issuing office, and will be valid for 24 months. (ATC and/or foreign ATS may request the number and date of the LOA). Renewal of the LOA's will follow the same procedure as outlined in paragraph 3, above, if the aircraft's equipment has not changed since the issuance of the previous LOA. If new equipment has been installed, a new application for an LOA must be made in the same manner as that required for

the initial LOA. The LOA must be carried in the aircraft at all times when operating in MNPS airspace.

b. ***Installation Approvals.*** In most cases, operators will be able to select navigation equipment with established performance capability. When a new system is proposed or major changes have been made in an existing system, an evaluation will be required to establish the quality of performance before authorization for use as a primary system. (Detailed information on proving and validation flights is contained in Chapter 8 of this AC.) Before an installation can be approved and authorized as a primary navigation system, an FAA avionics inspector must ascertain the approval status of the installed LRNS equipment by review of the aircraft records to determine the basis for LRNS installation.

FIGURE 3-5. FORMAT FOR AN LOA TO OPERATE IN THE NAT MNPS

This letter constitutes approval for the named aircraft to operate in the North Atlantic Minimum Performance Specification Airspace (NAT MNPS) and/or Reduced Vertical Separation Minimum (RVSM) airspace or to conduct oceanic flight by the authorized operator or crew listed under the conditions and limitations below.

Aircraft make and model ____________________ N-Number ________________________

Aircraft serial number ______________________ Aircraft color ______________________

NAVIGATION EQUIPMENT

TYPE	SERIAL NUMBER	DATE INSTALLED

COMMUNICATION EQUIPMENT

TYPE	SERIAL NUMBER	DATE INSTALLED

Use back of page for additional equipment

Aircraft base of operations (city, state, zip) ________________________________
Name of aircraft owner/operator ________________________________
Crew training conducted by ________________________________
Print name of person responsible for crew operations (must be a U.S. citizen) ________________
Signature of person responsible for crew operations ________________________________
Street address (cannot be a Post Office box) ________________________________
City, State, Zip code ________________________________

FOR FAA USE ONLY (To be completed by issuing office)

This approval is for: MNPS only ________________ MNPS and RVSM ________________
Aircraft limitations (if applicable) ________________________________
Program Tracking and Reporting Subsystem (PTRS) tracking number ______________

This authorization is subject to the conditions that all operations conducted within NAT MNPS airspace are in accordance with FAR § 91.705 and the flight rules contained in International Civil Aviation Organization (ICAO) Annex 2, and that all operations outside of the United States comply with FAR § 91.703 and Annex 2, and that the person responsible for the aircraft and crew(s) operating the aircraft is the person named herein. If the person named herein relinquishes responsibility and/or changes address, he/she should immediately notify the issuing office of the change. This change will automatically rescind the Letter of Authorization (LOA) - a new LOA can be issued via a letter or fax request changing the "Aircraft owner/operator (name)" and/ or the address, whichever is appropriate.

FIGURE 3-6. FORMAT FOR LETTER TO RENEW LOA

TO: Federal Aviation Administration (FAA)
Flight Standards District Office (FSDO)
[street address]
[city, state, zip]

The letter should be sent to the office that issued expired Letter of Authorization (LOA)

FROM: Person or department requesting LOA
Company name (if applicable)
[street address] [P.O. Box not acceptable]
[city, state, zip code]

Dear Inspector:

Enclosed is an expired Letter of Authorization (LOA) and a completed form requesting a new LOA for operations in MNPS and/or RVSM airspace.

I/we certify than any changes that have taken place since the expired LOA was issued are reflected on the attached LOA form. I/we further certify that I/we have obtained a copy of FAA AC 91-XX, and are familiar with its contents.

Sincerely,

[Signature of person responsible for crew operations]

[Typed name of person responsible for crew operations]

[Title]

[Date]

FIGURE 3-7. INVESTIGATIVE REPORT FOR SPECIAL USE AIRSPACE LOA

It is an FAA responsibility to reply to the North Atlantic Central Monitoring Agency (NAT CMA) whenever an operator is suspected of not having authorization or of having improper authorization to fly in special use airspace. Routine (random) monitoring may also be the reason for initiation of a request to verify special use airspace authorization. It is imperative, therefore, that inspectors complete the following investigation worksheet questions in as much detail as possible.

PART 1. GENERAL INFORMATION
1. Operator's name and address
2. Aircraft identification number/type
3. Aircraft home base
4. PIC's name
5. PIC's address
6. PIC's certificate #   Type of certificate
7. Date and time (UTC) ATC observed aircraft in special use airspace. (If aircraft did not enter special use airspace, disregard the following question.)
8. Radar unit observing aircraft in special use airspace

Investigator	Date	Routing Symbol

FIGURE 3-7. INVESTIGATIVE REPORT FOR SPECIAL USE AIRSPACE LOA - Continued

PART 2. OPERATOR INFORMATION
9. Was a Letter of Authorization issued to this operator? If so, list LOA number (if applicable) or the date of issue and issuing office.
10. For which special use airspace was the Letter of Authorization issued?
11. Has any navigation equipment been removed since issuance of the LOA? (List if applicable)
12. Has any navigation equipment been installed since issuance of the LOA? (List if applicable)
13. Have any altimeters been removed since issuance of the LOA? (List if applicable)
14. Have any altimeters been installed since issuance of the LOA? (List if applicable)
15. Did crew experience any navigation or altimeter equipment malfunctions?
16. Did PIC attend any international training courses? If so, list source(s) of training.
17. List latest date of PIC initial or recurrent training.
18. Did the PIC have a clear understanding of the special use airspace restrictions and PIC operational responsibilities?
19. What followup action is planned to prevent recurrence?

Investigator	Date	Routing Symbol

(2) The operator must furnish proper aircraft documentation showing the approval basis of the installation. The original equipment list, which may be the basis for compliance with the aircraft type certificate (TC), and FAA Form 337, "Major Repairs and Major Alterations," showing compliance with an appropriate aircraft supplemental type certificate (STC) or FAA field approval.

(3) If the LRNS equipment has met the accuracy requirements of FAR Part 91, Appendix C as determined by the manufacturer during certification flight tests in MNPS in conjunction with the appropriate aircraft certification office (ACO), the limitations section of the flight manual supplement will state that the particular LRNS equipment is authorized for use in NAT MNPS. If that authorization is not found in the limitations section, the request for approval to operate in MNPS airspace will be denied.

c. ***Acceptable Means of Compliance.*** In developing the MNPS concept, it was recognized that an indication of an "adequate means of compliance" would be needed, with specifications in terms of aircraft equipment. However, equipment specifications are only one part of the total quality of performance required. Flightcrews must be qualified for oceanic operations and be specifically qualified to operate under the rigid demands of the NAT MNPS airspace rules. The operator may prepare an international operations procedures manual, or may incorporate those procedures as a separate chapter of the Aircraft Operations Manual. In either case, the information must be accessible to the flightcrew. The manual should include specific preflight, in-flight, and postflight procedures. It should specify the crewmembers responsible for waypoint insertion and verification, the waypoint coordinates source, and procedures for waypoint insertion and verification. Much of this information will depend upon the type of LRNS equipment in use. Procedures for recording equipment accuracy should be included. An actual log should be depicted in the manual, and a sample log page submitted with the application for the LOA. Additionally, plotting chart procedures should be included in the manual and a completed sample chart should be submitted. An LRNS checklist that includes LRNS equipment failure procedures should be incorporated with the regular aircraft checklists.

d. ***Navigational Requirements.*** There are two navigational requirements for aircraft planning to operate in NAT MNPS airspace. One refers to track-keeping accuracy, and the second refers to stand-by equipment with comparable performance characteristics (refer to ICAO Annex 6 Parts I and II, Chapter 7). To justify consideration for state approval for unrestricted operation in NAT MNPS airspace, an aircraft needs to be equipped with two fully serviceable LRNS's. It is not satisfactory for NAT MNPS operations to rely on intermittent updates of aircraft position. The standards require navigation equipment that continuously indicates to the flightcrew the aircraft's adherence to or departure from track, to the required degree of accuracy, at any point along that track. Thus, it is highly desirable, and probably essential, that the navigation system in use is coupled to the autopilot so that continuous steering guidance is provided.

e. ***INS, inertial sensor system (ISS), IRS, and flight management control system (FMCS) Equipment.*** Extensive experience has been gained, both in the NAT region and on a world-wide basis, in the use of INS's, ISS, IRS's, and FMCS's. INS and ISS/IRS, when coupled with a FMCS for automatic flight guidance, have clearly demonstrated a capability to meet the MNPS. Some smaller aircraft may carry two IRS's (or ISS's), but only one FMCS. Such an arrangement may meet trackkeeping parameters, but does not provide the required redundancy (in terms of continuous indication of position relative to track or of automatic steering guidance) should the FMCS fail. If failure occurs, dual FMCS's are required to obtain MNPS certification. INS is considered to be an LRNS. An FMCS with inputs from one or more IRS/ISS is considered an LRNS.

f. ***Omega Navigation System (ONS).*** Omega/VLF navigation systems are capable of satisfying the MNPS and have demonstrated levels of accuracy comparable to INS. However, monitoring of navigation performance in the NAT region has shown that the number of GNE's attributable to Omega equipped aircraft is disproportionately high when compared to INS equipped aircraft. Advice from the Omega Association suggests that many GNE's result from faulty positioning and installation of antennae, inadequate maintenance, and the use of old, unmodified equipment. States need to pay particular attention to these issues before granting MNPS approval to aircraft equipped with Omega. An ONS is considered to be a LRNS. An FMCS with inputs from one or more Omega sensor systems (OSS) is considered to be a LRNS. (Further information on Omega is contained in Chapter 8.)

g. ***Loran-C Equipment.*** Loran-C equipment with an integral navigation computer has an acceptable performance accuracy, but use of this equipment entails limited MNPS approval. Aircraft operations are restricted to routes where unambiguous ground wave cover is available (see Loran-C coverage diagram, Figure 2-3 in Appendix 2).

h. ***Doppler Equipment.*** The use of Doppler equipment capable of displaying drift, groundspeed, and cross-track error has been approved, on occasions, in conjunction with single INS, Omega, or Omega/VLF for operations in NAT MNPS airspace. However, such approvals are considered to be at the lowest acceptable level of navigation suitable for MNPS airspace. Doppler requires that continuous attention be paid to in-flight rating of, and compensation for, systematic errors to guard against failure of the other single aid. Thus, installation of Doppler radar plus one other LRNS cannot be recommended for unrestricted MNPS operations.

i. ***GPS.*** GPS technology is changing rapidly; therefore, FAA GPS policies and procedures are also changing. Chapter 8 of this AC, at the time of publication, contains the latest GPS guidance; however, operators should be advised that the most recent GPS information will be distributed through other FAA documentation that is published more frequently.

j. ***Summary.*** For state approval of unrestricted operations in MNPS airspace, an aircraft is required to be equipped with two fully serviceable LRNS's. An LRNS may be an INS, an ONS, or an FMCS with inputs from one or more IRS or ONS. Each LRNS must be capable of providing a continuous indication to the flightcrew of the aircraft's position relative to track. It is highly desirable, and probably essential, that the navigation system employed for the provisions of steering guidance is capable of being coupled to the autopilot.

5. RVSM - ADDITIONAL CONSIDERATIONS FOR APPROVAL.

a. ***General.*** Airspace where RVSM is applied should be considered special use airspace. Both the individual operator and the specific aircraft type or types which the operator intends to use should be approved by the appropriate FSDO before the operator conducts flights in RVSM airspace. Draft AC 91-RVSM, "Approval of Aircraft and Operators for Light in Airspace Above FL 290 Where a 1,000 Foot Vertical Separation is Applied," is scheduled for publication in late 1993. This document will provide specific guidance for the approval of aircraft types for flight in airspace where RVSM is applied.

b. ***Approval of Aircraft.*** Each aircraft type that an operator intends to use in RVSM airspace should have received FAA approval in accordance with AC 91-RVSM. The specific airworthiness approval process and the continued airworthiness maintenance requirements will be detailed in AC 91-RVSM. Operational approval is described in the following paragraph.

c. ***Operational Approval.*** Section 4 of this Chapter describes in general the administrative process which an operator should follow to receive approval or to renew a LOA to operate an aircraft in RVSM airspace. The FSDO to which an application for approval has been submitted must be satisfied that operational programs are adequate. Flightcrew qualifications as well as operation manuals will be evaluated. Approvals will be granted through the issuance of operation specifications or the issuance of an LOA. Further approval will be granted for each individual aircraft group utilized by an operator. The FSDO will ensure that each operator can maintain high levels of height-keeping performance. Details of these standards can be found in AC 91-RVSM.

d. ***Preapplication Meeting.*** A preapplication meeting should be scheduled between the operator and the certificate management office (CMO) or FSDO. The intent of this meeting is to inform the operator of FAA expectations in regard to approval to operate in a RVSM environment. The content of the operator RVSM application, FAA review and evaluation, validation flight requirements, and conditions for removal of RVSM authority should be basic items of discussion.

e. ***Content of Operator RVSM Application.*** The following paragraphs describes the material which an operator applying for RVSM authority should provide to the FAA for review and evaluation at least 60 days prior to the intended start of RVSM operations.

f. ***Application Form.*** Figure 3-5 is an acceptable format for a LOA. This figure may be copied and the top section down to the "For FAA Use Only" section filled out by the operator.

g. ***Airworthiness Documents.*** Sufficient documentation must be available to show that the aircraft has been approved by appropriate airworthiness authorities.

h. ***Description of Aircraft Equipment.*** A description of the aircraft equipment appropriate to operations in an RVSM environment should be included on the application form.

i. ***Training Programs and Operating Practice and Procedures.*** FAR Part 121 and FAR Part 135 operators should submit training syllabuses and other appropriate material to the certificate holding district office (CHDO) or FSDO to show that the operating practices, procedures, and training items related to RVSM operations are appropriately incorporated in initial and recurrent training programs. FAR Part 91 operators must demonstrate to the FSDO that their knowledge of RVSM operating practices, procedures and qualifications is equivalent to FAR Part 121 and FAR Part 135 operators and is sufficient to warrant the granting of an LOA to conduct RVSM operations. Practice and procedural training in the areas listed in Chapter 10 of this AC should be standardized along with the specific guidelines that follow.

(1) During flight planning, the flightcrew should pay particular attention to conditions which may affect operation in RVSM airspace. These include, but may not be limited to:

(a) reported and forecast weather conditions on the route of flight

(b) minimum equipment requirements pertaining to height-keeping systems

(2) The following specific actions should be accomplished during preflight:

(a) Review maintenance logs and forms to ascertain the condition of equipment required for flight in the RVSM airspace. Ensure that maintenance action has been taken to correct defects to required equipment.

(b) During the external inspection of aircraft, particular attention should be paid to the condition of static sources and the fuselage skin in the vicinity of each static source, and of any other component that affects altimeter system accuracy. This check may be accomplished by a qualified and authorized person other than the pilot; e.g., a flight engineer or maintenance personnel.

(c) Before takeoff, the aircraft altimeters should be set to the local altimeter (QNH) setting and should display a known elevation (e.g. field elevation) within the limits specified in the aircraft's operating manuals. The two primary altimeters should also agree within limits specified by the aircraft's operating manual. An alternate procedure using airport altitude (QFE) may also be used. In either case, the maximum deviation value for the checks cited in operating manuals should not exceed 75 feet.

(d) Before takeoff, equipment required for flight in RVSM airspace should be operative, and indications of malfunctions should be resolved.

(3) Before entering RVSM airspace, the pilot should review the status of required equipment. Should any of the required equipment fail prior to entering RVSM airspace, the pilot should request a new clearance so as to avoid flight in this airspace. The following equipment should be operating normally:

(a) two primary altitude measurement systems

(b) one automatic altitude-control system

(c) one altitude-alerting device

NOTE: Redundancy requirements for altitude control systems should be established by regional agreement after an evaluation of criteria such as mean time between failures, length of flight segments, and availability of direct pilot-controller communications and radar surveillance. An operating transponder may not be required for entry into all designated RVSM airspaces. The operator should determine the requirements for an operational transponder in each RVSM area where operations are intended. The operator should also determine the transponder requirements for transition areas adjacent to RVSM airspace.

(4) The following actions should be accomplished while in-flight:

(a) Emphasis should be placed on promptly setting the subscale on all primary and standby altimeters to 29.92 Hg"/1013.2 hPa when passing the transition altitude and rechecking for proper altimeter setting when reaching the initial cleared flight level (CFL).

(b) In level cruise, it is essential that the aircraft is flown at the CFL. This requires that particular care is taken to ensure that ATC clearances are fully understood and followed. Except in contingency or emergency situations, the aircraft should not intentionally depart from CFL without a positive clearance from ATC.

(c) During cleared transition between levels, the aircraft should not be allowed to overshoot or undershoot the old or new FL by more than 150 feet (45 meters).

NOTE: It is recommended that the level off be accomplished using the altitude capture feature of the automatic altitude-control system, if installed.

(d) An automatic altitude-control system should be operative and engaged during level cruise, except when circumstances such as the need to retrim the aircraft or turbulence require disengagement. In any event, adherence to cruise altitude should be done by reference to one of the two primary altimeters.

(e) The altitude-alerting system should be operative.

(f) At intervals of approximately 1 hour, cross-checks between the primary altimeter should be made. A minimum of two must agree within ± 200 feet (± 60 meters). Failure to meet this condition will require that the altimetry system be reported and that ATC be notified.

(g) For flights conducted in oceanic/remote areas, the hourly altimeter cross-check should include comparing the primary altimeters to the standby altimeter. This information can be useful in contingency situations, such as when a spread/split between primary altimeters or altimeter system malfunctions occurs.

(h) The operating altitude reporting transponder should be connected to the altimetry system being used to control the aircraft.

(i) If the pilot is advised in real time that the aircraft has been identified by a height monitoring system as exhibiting a total vertical error (TVE) greater than ± 300 feet (± 90 meters) and/or altitude system error (ASE) greater than ± 245 feet (± 75 meters), then the pilot should follow established regional procedures to protect the safe operation of the aircraft. (This assumes that the monitoring system will identify TVE or ASE within agreed levels of accuracy and confidence.)

(j) If the pilot is notified by ATC of an assigned altitude deviation (AAD) error which exceeds ± 300 feet (± 90 meters), the pilot should take action to return to the CFL as quickly as possible.

j. ***Contingency Procedures After Entering RVSM Airspace.*** The pilot should notify ATC of contingencies which affect the ability to maintain the CFL and coordinate a plan of action. Section 6 of this Chapter contains detailed guidance for contingency procedures for NAT airspace. Examples of equipment failure that should be reported to ATC are:

(1) failure of all automatic altitude control systems aboard the aircraft;

(2) loss of redundancy of altimetry systems, or any part of these, aboard the aircraft;

(3) loss of thrust on an engine necessitating descent; and

(4) any other equipment failure affecting the ability to maintain CFL.

The pilot should notify ATC when encountering greater than moderate turbulence. If unable to notify ATC and obtain an ATC clearance prior to deviating from the assigned CFL, the pilot should follow established contingency procedures to leave the assigned route or track and obtain ATC clearance as soon as possible.

k. ***Flightcrew Training.*** Chapter 10 of this AC details crew training for oceanic operations.

6. SPECIFIC CONTINGENCY PROCEDURES FOR THE NAT AIRSPACE.

a. ***Background.*** If a pilot is unsure of the vertical or lateral position of the aircraft, or if the aircraft deviates from its assigned altitude or track for cause without prior ATC clearance, the pilot must take action to mitigate the potential for collision with aircraft on adjacent routes or FL's. In this situation, the pilot should alert adjacent aircraft by making maximum use of aircraft lighting and by broadcasting position, FL, and intentions on 121.5 megahertz (MHz). Unless the nature of the contingency dictates otherwise, the pilot should advise ATC as soon as possible of a contingency situation and request an ATC clearance before deviating from the assigned route or FL if possible. If a revised ATC clearance cannot be obtained in a timely manner and action is required to avoid potential conflict with other aircraft, then the aircraft should be flown at an altitude and/or track where other aircraft are <u>least</u> likely to be encountered. This can be accomplished by offsetting from routes or altitudes normally flown in the airspace. In order of preference, these are the following actions:

- The pilot may offset half the lateral distance between routes or tracks.
- The pilot may offset half the vertical distance between altitude normally flown.
- The pilot may also consider descending below FL 285 or climbing above FL 410 (these altitudes are sparsely occupied).

When executing a contingency maneuver, the pilot should:

- watch for conflicting traffic;
- continue to alert other aircraft using 121.5 MHz and aircraft lights;
- continue to fly tracks or altitudes which are likely to be occupied; and
- obtain an ATC clearance as soon as possible.

7. THE MONITORING PROCESS IN THE NAT REGION.

a. ***Introduction.*** Radar stations that monitor NAT oceanic airspace boundaries collect data that includes information on MNPS airspace flights derived from agreed radar stations and data from other radars concerning non-MNPS airspace flights. The MNPS data gives direct input into the risk modelling of the MNPS airspace, while the non-MNPS data provides a wider understanding of navigation in the NAT region and allows followup action to be taken on a larger number of flights that are believed to have had a navigation error. The data collection process includes continuous collection of all deviations of 20 Nm or more, and collection of data on deviations of less than 20 NM as required.

b. ***Central Monitoring Agency (CMA).*** In March 1980, the NAT SPG realized that implementation of the 60 NM lateral separation minimum would place special importance on the monitoring and assessment of navigation performance. Therefore, the SPG agreed to collect, collate and circulate data regarding navigation performance in the NAT region to states participating in the monitoring. The United Kingdom acts as CMA on behalf of the NAT SPG and has accepted responsibility for the collection, analysis, and dissemination of data relevant to navigation specifications. Information received includes:

(1) monthly routine reports (from Canada and the United Kingdom) on the number of MNPS flight operations, both OTS and random;

(2) reports of GNE's observed by radar supplemented by information on causes, responses by operators and/or states, and the corrective action taken; and

(3) information on errors not observed by radar that became known by other means or from other sources.

The reports of errors not observed by radar are recorded because their inclusion and investigation can provide useful information, particularly in respect to errors and/or omissions resulting from non-compliance with the prescribed position reporting procedures, errors resulting from misunderstandings of clearances, and/or differences in interpretations between pilots and ATC regarding instructions passed. The CMA provides participating states with a monthly summary so that they may be kept current on overall developments. The CMA also provides special reports as necessary to enable states to decide on a common course of action.

c. ***Deviations from Track.*** If a deviation of 20 NM or more from assigned track is observed by radar, it is important that the pilot is immediately advised and that any comment is recorded. Followup action includes notification of the operator, the operator's state of registry, and the CMA. The appropriate authority of the state that collected the data will investigate the causes of each deviation, either directly or through the CMA, in cooperation with the operator. That agency also notifies the operator's state of registry. Such a procedure is used by Canada, France, Iceland, Ireland and the United Kingdom. All information about detected deviations and their causes, as well as any other information relating to navigation performance within the NAT region, is made available to the NAT SPG by the CMA. The data is provided on a monthly basis in a format permitting ready determination of whether MNPS criteria are being met. Such analysis is made of all available data to determine overall safety. Analysis is also made of data concerning specific navigation systems or operators, if it is suspected that they may no longer meet the specification.

If one or more of the MNPS criteria have been exceeded, the NAT SPG reviews the data and, if necessary, proposes appropriate action. There are at least two general classes of errors that can result in large lateral deviations. One of these concerns a progressive deviation from track because of navigation inaccuracy, and the other covers cases when an aircraft flies to or along a track adjacent to its intended track as the result of an operational error. The second type, though extremely dangerous, cannot be prevented by increasing the lateral separation but must be eliminated by improvements to the operating procedures.

If summary statistics indicate that the MNPS criteria are greatly exceeded, rapid response to the causes of the problems may be necessary. In such a case, the states responsible for ATC in the NAT region will take prompt action after consultation with at least the major affected users. An example of when such prompt action may be necessary is a serious disturbance of the coverage of station-referenced systems due to unserviceability of ground stations or severe ionospheric disturbances. Such action must be possible even when the number of large deviations in the limited area where the navigation performance is monitored is not excessive, if there is a reason to believe that large errors might occur elsewhere.

When the summary statistics show that the criteria have not been greatly exceeded, or if the observed performance merely shows a trend towards degradation, it will be more useful to conduct a detailed investigation, for instance by the NAT SPG. Although this may take several months, it must be remembered that the TLS is equivalent to expecting about one collision every 150 years, and that a small increase in the statistical probability of collision during a 6 or 12 months period is considered acceptable. An investigation may show that the cause of a large deviation can be eliminated by improved procedures, which will then he brought to the attention of the operators and/or ATC through the appropriate channels. Results of the actions will then be closely observed. If the causes cannot he eliminated quickly, the aircraft's state(s) of registry should temporarily exclude offending operators from MNPS airspace. In order to restore the situation, an increase in lateral separation should be made only in extreme cases and only when other actions have failed to produce the desired results. It is important that all agencies react promptly to reports of radar-based deviations. Investigation should begin at once so that consideration can be given to the need for remedial action (equipment improvements, crew training, etc.), especially if a specific trend becomes evident. In order for the deviation reports to receive prompt study, it would be prudent for each airline/operator to designate an individual to be responsible for receiving reports and initiating investigations. This individual's name and address should be made available to the appropriate ATC authorities.

Experience with the monitoring process shows that a number of the observed GNE's are attributable to aircraft operating in MNPS airspace without the required approval. For this reason, ATC units have been requested to notify the CMA of any flights, identified as a result of random checks, that operated in MNPS airspace but are considered unauthorized for that operation. In 1990, to reinforce the random checks, the NAT SPG introduced a program of tactical monitoring to help identify aircraft operating within MNPS airspace without the required approval. Currently Canada, Iceland and the United Kingdom participate in the program by selectively asking pilots requesting clearance to enter NAT MNPS airspace to confirm that they have been approved for that operation. Pilots unable to confirm, or uncertain of their approval status, are issued a clearance to operate outside MNPS airspace and a report is forwarded to the CMA for followup.

d. ***Followup of Observed and Reported Deviations.*** Different arrangements exist within those states participating in monitoring, but followup action on observed deviations of 20 NM or more generally includes the following steps for aircraft operating within MNPS airspace:

(1) the observing ATC unit should, if at all possible, inform the pilot of the observed error, that an error report will be processed, and record any comment made by the pilot at the time of notification; and

(2) all operators and relevant ATC units should be notified of the deviation, either directly by the observing ATC unit or by an agency designated by the state, by the speediest means available (telephone, AFTN, telex) and with the least possible delay.

When a U.S. registered aircraft that is not clearly identified as an air carrier or military operator is involved in a deviation, a copy of the initial error signal should be sent to the company/agency that submitted the ICAO flight plan. The full flight plan details and the name of the PIC should then be forwarded to the Federal Aviation Administration, Flight Standards National Field Office, AFS-550, P.O. Box 20034, Washington, DC, 20041.

For aircraft operating outside MNPS airspace:

(1) the observing ATC unit should, if at all possible, inform the pilot of the observed error, that an error report will be processed, and record any comment made by the pilot at the time of notification; and

(2) if the observed deviation from track is 50 NM or more, all operators and relevant ATC units should be notified of the deviation, either directly by the observing ATC unit or by an agency designated by the state, by the speediest means available (telephone, AFTN, telex) and with the least possible delay. This should be followed as soon as possible by a written confirmation. All notifications should be copied to the CMA and the operator's state of registry.

(3) If the observed deviation from track is 20 NM or more but less than 50 NM, the observing ATC unit, or other agency designated by the state, should notify the CMA of the deviation with the least possible delay (telephone, AFTN, telex). This should be followed as soon as possible by a written confirmation if necessary. The CMA will advise the state of registry.

e. ***Additional Reports to CMA.*** Whenever possible, details of the following occurrences should be reported to the CMA. Any erosion of the longitudinal separation between aircraft in MNPS airspace in excess of 3 minutes, altitude deviations of 300 ft or more, as observed on radar (Mode 'C' SSR) or by scrutiny of pilot reports (see Figure 1-4, Appendix 1), or any occasion when ATC takes action to prevent a GNE should be reported.

f. ***Further Followup by Operator and/or State.*** Subsequent followup on observed deviations of 20 NM or more, reported in accordance with the above provisions, should initially be conducted between the operator and a designated state agency responsible for the ATC unit that observed the deviation, on the understanding that:

(1) deviations of 20 NM or more but less than 50 NM, occurring outside MNPS airspace, will not normally require further action. If an investigation is deemed necessary it will be conducted by the state of registry;

(2) monitoring states may request the assistance of other states in monitoring activities;

(3) the operator's state of registry should be requested to conduct a further investigation if deemed necessary;

(4) all correspondence should be copied and forwarded to the CMA; and

(5) the European office of ICAO will assist in those cases when no response is obtained from either the operator or the state of registry.

When a GNE in MNPS airspace is observed by ATC, crews shall provide the controlling authority with detailed information on the cause of the error, including LOA number and expiration date, upon request. This information is not necessarily for the purpose of enforcement. In many cases, equipment errors and/or procedural errors caused the error, and investigators are able to work with crews to eliminate future occurrences. The type of data needed for an Oceanic Navigation Error Report (ONER) is listed in Figure 3-8. Pilots will be required to provide ATC with most of this information, and should be prepared to do so when operating in MNPS airspace. Most of the information should be contained in the flight journal for each flight in MNPS airspace, and will always be available. Altitude deviations, erosion of longitudinal separation, and requests for verification of LOA's may also require investigations. All of these investigations are similar to an investigation of a GNE. Therefore, crews must provide the controlling authority with detailed information on these deviations in a similar manner.

FIGURE 3-8. OCEANIC NAVIGATION ERROR REPORT

INFORMATION PROVIDED BY AIR TRAFFIC - (ONER OR OADR)
1. Gross navigation error report message or altitude deviation of 300 feet or more
2. Reporting agency and report number
3. Date of occurrence
4. Time of occurrence (UTC)
5. Aircraft identification and operator
6. Aircraft type
7. ATC cleared route or track
8. Radar observed position (in latitude and longitude) and distance left or right of assigned route or track or observed* or reported** flight level or altitude (* Use observed if Mode C; ** reported if pilot reported)
9. Assigned flight level or altitude
10. Crew comments when notified
11. Location where flight plan filed (For general aviation aircraft insert the 4-letter ICAO location identifier. For air carrier aircraft insert the company or agency which filed the flight plan.)
12. Type of long-range navigation equipment in use
13. Did ATC advise operator of occurrence?
14. Remarks (anything which may assist in the investigation or analysis)
15. Flight plan data. (Forward flight plan if available. If the flight plan is not available, enter any available information to help locate the operator, such as identification of departure and arrival points.)
16. Please acknowledge receipt.

FIGURE 3-8. OCEANIC NAVIGATION ERROR REPORT - Continued

TO BE COMPLETED BY FLIGHT STANDARDS
17. Operator/crew identification and remarks
18. Was the use of special use airspace authorized?
19. Cause of deviation
20. Investigator's comments
21. Corrective action recommended or initiated
22. Flight Standards National Field Office assigned report number
23. Attachments - Please indicate what additional information is attached to this report by circling "yes" or "no" as appropriate • OADR supplemental information record Yes No • Flight log Yes No • Waypoint notebook Yes No • ATC flight plan Yes No • Other (please identify) ________________

FIGURE 3-9. OCEANIC ALTITUDE DEVIATION REPORT

INFORMATION PROVIDED BY AIR TRAFFIC - (ONER OR OADR)
1. Gross navigation error report message or altitude deviation of 300 feet or more
2. Reporting agency and report number
3. Date of occurrence
4. Time of occurrence (UTC)
5. Aircraft identification and operator
6. Aircraft type
7. ATC cleared route or track
8. Radar observed position (in latitude and longitude) and distance left or right of assigned route or track or observed* or reported** flight level or altitude (* Use observed if Mode C; ** reported if pilot reported)
9. Assigned flight level or altitude
10. Crew comments when notified
11. Location where flight plan filed (For general aviation aircraft insert the 4-letter ICAO location identifier. For air carrier aircraft insert the company or agency which filed the flight plan.)
12. Type of long-range navigation equipment in use
13. Did ATC advise operator of occurrence?
14. Remarks (anything which may assist in the investigation or analysis)
15. Flight plan data. (Forward flight plan if available. If the flight plan is not available, enter any available information to help locate the operator, such as identification of departure and arrival points.)
16. Please acknowledge receipt.

FIGURE 3-9. OCEANIC ALTITUDE DEVIATION REPORT - Continued

TO BE COMPLETED BY FLIGHT STANDARDS
17. Operator/crew identification and remarks
18. Was the use of special use airspace authorized?
19. Cause of deviation
20. Investigator's comments
21. Corrective action recommended or initiated
22. Flight Standards National Field Office assigned report number
23. Attachments - Please indicate what additional information is attached to this report by circling "yes" or "no" as appropriate • OADR supplemental information record Yes No • Flight log Yes No • Waypoint notebook Yes No • ATC flight plan Yes No • Other (please identify) ________________

8. AIRCRAFT EQUIPMENT AND IN-FLIGHT OPERATING PROCEDURES IN MNPS AIRSPACE.

a. ***Introduction.*** Good operating practices in navigation are essential to application of the MNPS concept. Fundamental differences exist between navigation systems, but the basic procedures for their application have much in common. Most Omega flightdeck displays have intentionally been designed so that controls and information displays resemble INS as much as possible. In this AC, "Omega" refers to automatic equipment that meets the ARINC 580-599 specifications. Equipment that requires manual correction or plotting to determine position increases flightcrew workload and the possibility of error, and is not recommended for use in normal operations.

b. ***Cockpit Layout and Equipment Installation.*** Efficient operation and monitoring of the aircraft navigation system is enhanced if careful consideration is given to the location of the system components in the cockpit and to the various features provided. Control display units (CDU's) should be within the primary visual scan of, and conveniently accessible to, either pilot. This places them forward and inboard of each pilot. CDU's should not be mounted on the overhead panel or on the aft portion of the central pedestal (i.e., to the side or rear of the pilot), nor should they be located outboard of each pilot. Retrofit costs and considerations should not override optimum location of the CDU's.

During navigation of the aircraft, it has become customary to display certain critical navigation system outputs continuously, such as cross-track error (XTK) and miles-to-go to next waypoint. These outputs are displayed on the panel mounted radio navigation indicators, with a switch to permit selection of ADF/VOR or INS/ONS. Some operators recommend that present position be displayed on the steering CDU (either INS or ONS) and XTK miles on the other.

Flight progress alert lights should also be provided on the instrument panel. The waypoint alert light, to indicate that the waypoint is being approached, is standard. However, consideration should also be given to the installation of a XTK alert light, triggered to indicate a deviation such as 6-10 NM of XTK deviation. If the navigation system is inadvertently decoupled from the autopilot, such a light provides an early warning of XTK error. Also, some form of autopilot status light could be considered (e.g., green when coupled to the navigation system, red when uncoupled). The monitoring process has shown that errors occur because of the INS/ONS being inadvertently disconnected from the autopilot. There are problems in modifying existing equipment, but a cross-track warning system would be useful. Operators placing orders for new equipment should discuss this possibility with the manufacturer.

Navigation equipment should be protected from damage. Fluids can very easily cause damage; CDU's in particular should be protected from spilled beverages, and all component parts should be protected from moisture. A good standard of INS maintenance is important; a poor standard, or the approval of a regime which permits many in-flight failures, may not be cost effective because of the expensive difficulties which can result. It is preferable not to locate equipment in baggage holds, but if this cannot be avoided it requires protection against jarring and crushing. Care should be taken to prevent freight or baggage obstructing the ventilation of navigation units. Ventilation is an essential part of the cooling required for INS, Omega and Doppler equipment. The greatest problem is to provide adequate cooling of the equipment after the aircraft has been heat soaked while parked at a tropical airport. Adequate cooling is likely to be needed most of the time, so cooling facilities and warning of their failure are necessary.

c. ***Training.*** Whether using INS or ONS, crews need proper training. In the case of Omega, experience suggests more extensive training is necessary to ensure that crews have a general understanding of problems that may be encountered in-flight. INS and Omega, because of their precision and reliability, can induce a sense of complacency that tends to obscure the value of standard procedures, especially cross-checks. Under these circumstances, errors occur more easily. Special training programs for flightcrews using Omega should include efficient use of the equipment and indoctrination in the necessity and methods of avoiding errors. Crewmembers should be trained to develop a meticulous method of using CDU's, with careful cross-checking at all operational stages, in line with the procedures described in the NAT MNPS Operations Manual. The operator should seek to retain the interest and cooperation of flightcrews in ensuring that a good standard of navigation performance is continuously maintained. This may be achieved during ground refresher courses, periodic routine checks, or by issuing periodic newsletters. Such newsletters might include statistics on fleet navigation performance, and could include analyses of errors and reports volunteered by crews on instances of equipment being mishandled. However, reminders should not be so frequent as to be self-defeating. Crew training should stress the need for accurate trackkeeping and emphasize the need for good navigation along track (i.e., careful application of the mach number technique, accurate position reporting, and the use of accurate time in reporting positions).

d. ***Great Circle Routes.*** The navigation systems discussed in this AC, with their computers and related displays, provide the ability to fly direct Great Circle routes. This feature can be attractive and useful to crews, and they need not be discouraged from taking advantage of it. However, during initial and refresher training, operators should ensure that crews are aware that it is necessary to obtain an ATC clearance for such routes; that the wind effect may be such that the Great Circle path is not the minimum time path of greatest value for fuel economy; and that, if not properly cleared by ATC, there may be the risk of the aircraft inadvertently entering restricted airspace or crossing political boundaries without authority. Finally, crew training should also include instruction on what action should be considered in the event of navigation systems failure.

9. OPERATIONS OUTSIDE MNPS AIRSPACE.

a. ***Introduction.*** Aircraft may operate in the NAT region either within or outside of MNPS airspace. For operations within MNPS airspace, a specific approval from the state of registry or the state of the operator is required, regardless of the category of the operator; i.e., state, IGA or public transport. This section provides information to pilots for flight planning and operations, in particular of light aircraft, wishing to cross the NAT region below FL 275. Pilots wishing to cross at FL 410 or above should make particular note of the climb/descent provisions below. A number of incidents have occurred with NAT IGA flights that were caused by noncompliance with basic requirements for navigation and communications equipment needed for oceanic flights or flights over remote areas. Most of these incidents were potentially hazardous to the occupants of the aircraft and to SAR personnel. Some have resulted in needless and expensive alert activities on the part of ATC and in search activities on the part of rescue facilities. Reduction or elimination of the incidents, which have generally involved flights that were considerably off-course or had not reported their position as required, is needed so that the unnecessary expenditure of resources is eliminated. In support of this, the NAT SPG published (in October 1990) the "North Atlantic International General Aviation Operations Manual." This manual simplifies many of the technical aspects contained in this AC, and is an excellent supplement.

b. ***The NAT Operational Environment.*** The climate affecting NAT flight operations is demanding throughout the year, with storms or other adverse weather likely to be encountered during any season. It is probable that at least a portion of the route will be affected by adverse weather conditions. The scarcity of alternate airports available to transatlantic flights requires that all significant weather systems along the route be considered during flight planning.

c. ***Flight Preparation.*** Refer to Chapter 2 of this AC.

d. ***Equipment Requirements.*** Refer to Chapter 2 of this AC.

e. ***Communication Requirements.*** The VHF emergency frequency 121.5 MHz is not authorized for routine use. The frequency 131.800 MHz has been designated for use as the air-to-air communication channel in the NAT region. Additional communication requirements are detailed in Chapter 2 of this AC.

f. ***Special Requirements for Flights Transiting Greenland.*** The elevation of the highest point in Greenland is 13,120 feet mean sea level (MSL), and the general elevation of the icecap is 9,000 feet MSL. Due to low temperatures and high wind speeds, the lowest usable FL under certain conditions may be FL 235 near the highest point, and FL 190 over the icecap. Information on the lowest usable FL on published ATS routes can be obtained from the Sondrestrom Flight Information Center. High capacity cabin heating systems are needed due to the very low in-flight temperatures usually encountered, even during the summer. Rapidly changing weather situations involving severe icing, turbulence, and heavy precipitation are common and require extra vigilance by pilots. The changes may be so rapid that they are difficult to forecast. An emergency locator transmitter (ELT) is required transiting Greenland due to the very difficult terrain that hampers searches. Compliance with the regulations is monitored, and states of registry will be informed of any infractions.

Airport flight information is available at Narssarssuaq, Nuuk/Godthab, Kulusuk, Ilulissat/Jakobshavn, and Constable Point airports. Approach and tower control services are provided within the Thule and Sondrestrom TMA/CTR. Only flight information and alerting service are provided within the Sondrestrom FIR below FL 195. IFR flights operating within the Sondrestrom FIR below FL 195 must have functional radio equipment capable of operating on the published HF frequencies for Sondrestrom. Flights operating within the Sondrestrom FIR below FL 195 (i.e., Reykjavik or Gander CTA's) and outside of VHF coverage of Iceland or Gander must have functional radio equipment capable of operating on the published HF frequencies for Iceland/Gander.

g. ***Special Requirements for Flights Transiting Iceland.*** The general elevation of the mountainous areas in Iceland is approximately 8000 feet MSL. Due to the great difference in pressure and high wind speeds, the lowest usable FL may, under certain conditions, be FL 120. An ELT with an energy supply independent of the aircraft must be carried, and must be capable of functioning continuously outside the aircraft for at least 48 hours, and transmitting simultaneously on the frequencies 121.5 and 243 MHz. Aircraft should be equipped with sufficient and appropriate arctic survival equipment, including as a minimum the following:

(1) a signalling sheet (1 x 1 meter) in a reflecting color

(2) a compass

(3) a winter sleeping bag for each person on the aircraft

(4) matches in waterproof covers

(5) a ball of string

(6) a stove and fuel supply or other self-contained means of providing heat for cooking, with the accompanying mess-tins

(7) a snow saw

(8) candles or other self-contained means of providing heat, with a burning time of about 2 hours/person, with the total carried to be no less that 40 hours of burning time

(9) personal clothing suitable for the climatic conditions along the route to be overflown

(10) an arctic survival manual

(11) mosquito netting and insect repellent

Aircraft operating in the oceanic sector of the Reykjavik FIR must maintain a continuous watch on the appropriate frequency of Iceland Radio. When operations take place outside of VHF coverage, carriage of an HF transceiver operational on appropriate frequencies is mandatory. However, prior approval may be obtained for flight outside VHF coverage and without HF equipment. Flights operating under this special approval are responsible for obtaining similar approval for operating in the airspace of adjacent ATC units. Flights between FL 80 and FL 195 on the route between Sondrestrom and Keflavik, passing through 65N 30W and Kulusuk, are exempted from the HF requirements. Flights between the United Kingdom and Iceland, which are routed at or north of 61N 10W, are exempted from the HF equipment requirement. However, if the VHF transmitter/receiver at Faeroe Islands is unserviceable, prior approval is required from Reykjavik area control center (ACC).

Navigation equipment adequate for operation in accordance with the flight plan and with ATC clearances shall be carried. SSR transponders with Mode 3/A and C are required in Iceland. Pilots shall operate SSR transponders continuously on Mode A, Code 2000. Departing aircraft shall retain the last assigned code for 30 minutes after entry into NAT oceanic airspace unless otherwise instructed by ATC. This procedure does not affect the use of special purpose codes 7500, 7600 or 7700 when required.

10. TEMPORARY AIRSPACE RESERVATIONS.

a. ***Introduction.*** The NAT SPG members have agreed to applicable definitions regarding airspace reservations, principles governing the establishment and management of airspace reservations, and specific values to be used in the NAT region in order to keep controlled flights separated from airspace reservations.

b. ***Management of Temporary Airspace Reservations.*** Prior to requesting the establishment of a temporary airspace reservation, the requesting agency shall obtain full information on the likely effect of such a reservation on air traffic. Such information shall include areas of high traffic density that may exist in the vicinity or at the planned location of the airspace reservation, as well as information on peak periods of traffic operating through such areas. In light of that information, the requesting agency should, to the extent possible, select the site of the airspace reservation and the time and duration so as to have the least effect on normal flight operations in that area. In specifying the extent and duration of a requested temporary airspace reservation, the requesting agency shall limit the size of the area to the absolute minimum required to contain the intended activities within that area, taking due account of:

(1) the navigation capability of aircraft or other vehicles within the reservation;

(2) the means available to monitor those activities so as to guarantee that they will be confined within the airspace reservation; and

(3) the ability to interrupt or terminate activities.

The protection required for aircraft operating in the vicinity will be ensured by the ATC unit responsible for the airspace where the temporary airspace reservation is located. For this reason, the requesting agency should not add any protective value to the size of the area requested. The duration of the airspace reservation shall be limited, taking a realistic account of activity preparation and the time required to vacate the reservation after the completion of the activities. The actual use of the temporary airspace reservation shall be based on appropriate arrangements made between the requesting agency and the ATS unit responsible for the airspace, or special agents acting on its behalf. Such arrangements should cover the start of the use of the temporary airspace reservation; the termination of its use; and emergency provisions in case of unforeseen events affecting the activities to be conducted within the temporary airspace reservation. When a temporary airspace reservation extends into the area of responsibility of more than one ATS unit, the requesting agency shall negotiate this airspace reservation simultaneously with all ATS units concerned or the special agents acting on their behalf. The arrangements concluded shall be covered by common arrangements applicable to all parties concerned. If a temporary airspace reservation is likely to affect the provision of ATS by adjacent ATS units, the ATS unit directly affected by that airspace reservation shall ensure that the necessary coordination with those affected ATS units takes place in advance. The ATS unit normally responsible for ATS in the area of a temporary airspace reservation shall ensure that all traffic operating under its responsibility will not approach within the limits (horizontal and vertical) of the temporary airspace. Where necessary, such values shall be uniform and shall be established in accordance with agreements reached between the ATC authorities concerned for temporary airspace reservations in a given area.

11. FORMATION FLYING BY STATE AIRCRAFT IN THE NAT REGION.

a. ***Definition of Formation Flight.*** Formation flight is defined as more than one state aircraft which, by prior arrangement between the pilots, operate as a single aircraft with regard to navigation and position reporting. Separation between the aircraft within the formation is the responsibility of the flight leader and the pilots of the other aircraft in the flight. This includes transition periods when aircraft within the formation are manoeuvering to attain separation from each other to effect individual control and during joinup and breakaway.

b. *Provisions.* The formation shall file an appropriate ICAO flight plan for the operation. An ATC clearance is issued only to the formation leader. All aircraft within the formation shall operate so that the wing aircraft maintain a distance of not more than 1 NM laterally or longitudinally and a vertical displacement no greater than 100 feet from the flight leader. The formation flight is considered as one aircraft by ATC for separation purposes. If at least one of the aircraft participating in the formation flight is MNPS approved, the entire formation flight is considered to be approved for operation in NAT MNPS airspace.

APPENDIX 4. GLOSSARY OF TERMS

Accuracy - In navigation, the accuracy of an estimated or measured position of a craft (vehicle, aircraft, or vessel) at a given time is the degree of conformance of the measured position with the true position of the craft at that time. Since accuracy is a statistical measure of performance, a statement of the accuracy of a navigation system is meaningless unless it includes a statement of the applicable uncertainty in position.

AFM - Means Federal Aviation Administration (FAA) approved airplane flight manual. This entire document is FAA approved and must be carried on all aircraft certificated under Federal Aviation Regulation (FAR) Part 25. The AFM contains operating procedures and limitations for the airplane and engine combination, as well as for all installed appliances, and must be readily accessible to the flightcrew during all operations.

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

Anywhere fix - The ability of a receiver to start position calculations without being given an approximate location and approximate time.

Area navigation (RNAV) - Application of the navigation process providing the capability to establish and maintain a flight path on any chosen course that remains within the coverage area of the type of navigation sources being used. RNAV utilizing capabilities in the horizontal plane only is called 2D RNAV, while RNAV which also incorporates vertical guidance is called 3D VNAV. Time navigation (TNAV) may be added to either 2D or 3D systems. TNAV added to a 3D system is called 4D.

ARINC - An acronym for Aeronautical Radio Inc., a corporation largely owned by a group of airlines. ARINC is licensed by the Federal Communication Commission (FCC) as an aeronautical station, and contracted by the FAA to provide communication support for air traffic control (ATC) and meteorological services in portions of international airspace.

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

Bandwidth - The range of frequencies in a signal.

C/A code - The standard (course/acquisition) global positioning system (GPS) code - a sequence of 1023 pseudo-random, binary, biphase modulation on the GPS carrier at a chip rate of 1.023 megahertz (MHz). Also known as the "civilian code."

Cabotage - The Standard Dictionary of the English language defines cabotage (for flight purposes) as "air transport of passengers and goods within the same national territory." The definition adopted by

GLOSSARY - Continued

International Civil Aviation Organization [ICAO] at the Chicago Convention is, "Each state shall have the right to refuse permission to the aircraft of other contracting states to take on its territory passengers, mail, and cargo destined for another point within its territory."

Capacity - The number of system users that can be accommodated simultaneously.

Carrier - A signal that can be varied from a known reference by modulation

Carrier aided tracking - A signal processing strategy that uses the GPS carrier signal to achieve an exact lock on the pseudo random code. This is more accurate than the standard approach.

Carrier frequency - The frequency of the unmodulated fundamental output of a radio transmitter.

Channel - A channel of a GPS receiver consists of the circuitry necessary to tune the signal from a single GPS satellite.

Chip - The transition time for individual bits in the pseudo-random sequence. Also, an integrated circuit.

Class I airspace - Short-range navigation within the limits of the operational service volume of ground-based navigational aids (navaids).

Class II airspace - Long-range navigation beyond the limits of the operational service volume of ground-based navaids.

Clock bias - The difference between the clock's indicated time and true universal time.

Coast-out fix - A navaid (or intersection "fix"), sometimes called a coastal fix or gateway fix, whereby an aircraft transitions between the domestic route structure and the oceanic route structure, such as an organized track system (OTS) or air traffic service (ATS) volume of ICAO standard navaids.

Control segment - A world-wide network of GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks.

Convergence - A term used by controllers relative to the lateral separation of aircraft. Aircraft are determined to be converging if their lateral separation is becoming narrower in width.

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 user to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions, surface conductivity, and other factors affecting signal availability.

Crosstrack error - The perpendicular deviation that the airplane is to the left or right of the desired track.

GLOSSARY - Continued

Cycle slip - A discontinuity in the measured carrier beat phase resulting from a temporary loss-of-lock in the carrier tracking loop of a GPS receiver.

Data message - A message included in the GPS signal which reports the satellite's location, clock corrections, and health. Included is rough information on the other satellites in the constellation.

db - An abbreviation for decibels. It is a unit of relative power, voltage, or current, plotted on a logarithmic scale. An increase (or decrease) of 10 db means that something is either double (or half) of the original value. Db are used to compare one relative value to another.

Dead reckoning (DR) - Is a method of estimating the position of an aircraft without astronomical observations, based upon a previous known position and an estimate of the course and distance travelled within a given time increment. An estimation of the winds aloft is an integral part of the DR process.

Differential positioning - Precise measurement of the relative positions of two receivers tracking the same GPS signals.

Dilution of precision (DOP) - The multiplicative factor that modifies ranging error. It is caused solely by the geometry between the user and his/her set of satellites. Known as DOP or geometric dilution of precision (GDOP).

Domestic airspace - Airspace overlying the continental land mass of the United States, Alaska, Hawaii, and U.S. possessions. Domestic airspace extends to 12 nautical miles (NM) offshore.

Doppler aiding - A signal processing strategy that uses a measured Doppler shift to help the receiver smoothly track the GPS signal. Allows more precise velocity and position measurement.

Doppler shift - The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver.

Drms - Refers to the "distance root mean square error." This fundamental parameter is the building block to the most common measure of navigation fix accuracy, "two (2) Drms."

En route - A phase of navigation covering operations between departure and arrival terminal phases.

Ephemeris - The predictions of current satellite position that are transmitted to the user in the data message.

Extended overwater - FAR Part 1 defines "extended overwater operation" for airplanes as an operation overwater at a horizontal distance of more than 50 NM from the nearest shoreline; and for helicopters, as an operation overwater at a horizontal distance of more than 50 NM from the nearest shoreline or more than 50 NM from an offshore heliport structure.

GLOSSARY - Continued

Fast-multiplexing channel (FMC) - A single channel which rapidly samples a number of satellite ranges. "Fast" means that the switching time is sufficiently fast (2 to 5 milliseconds) to recover the data message.

Frequency band - A particular range of frequencies.

Frequency spectrum - The distribution of signal amplitudes as a function of frequency.

Fix dimensions - This characteristic defines whether the navigation system provides a linear, one-dimensional line of position, two-dimensional, or three-dimensional position fix. The ability of the system to derive a fourth dimension (e.g., time) from the navigational signals is also included.

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

Gateway fix - See "Coast-out fix."

GDOP - Refers to geometric dilution of precision. The degree of uncertainty of a position fix with respect to the crossing angles of the lines of position (LOP's).

Gross navigational error (GNE) - Pilots are expected to fly their aircraft along the centerline of their assigned route and to stay within the accuracy limits of their installed navigation systems. (For example, the accuracy tolerance limits for Loran-C equipment used in instrument flight rules (IFR) oceanic navigation is 5.8 NM). If an aircraft becomes off-course, it is usually for one of the following reasons; a "loop" (or communications) error between the pilot and the controller, a pilot intentionally entering a waypoint which is not along the assigned route of flight (e.g., a pilot deviation due to weather without prior ATC approval or without declaring an emergency), an unintentionally entered waypoint not along the assigned route, and a navigational equipment error or failure. Navigational errors that are greater than 20 NM are investigated by the various countries that provide ATC service.

Handlers - Individuals within specific countries who may be hired to accompany a flight and take care of the unique regulatory and cultural requirements associated with a flight into a foreign country. These individuals are locals who know the procedures and can assist in clearing customs, immigration, and airport security. These individuals also have varying degrees of expertise on other matters such as lodging, rental cars, flight restrictions, passenger ground travel, local prohibitions, health problems, etc.

High seas - Any body of water outside the 12 NM limit.

Handover word - The word in the GPS message that contains synchronization information for the transfer of tracking from the C/A to P-code.

IFR navigation - Navigation by electronic means or by use of a flight navigator. Navigation techniques may include use of ICAO standard navaids supplemented by accurate DR, pilot-operated

GLOSSARY - Continued

electronic long-range navigation equipment, or use of a flight navigator. IFR oceanic (en route) navigation requires that the aircraft adhere to a particular level of navigational accuracy.

Independent fix - An independent fix means that a position does not depend on a previous or following measurement.

Independent receiver function - "Independent" means that the function of any part of a receiver does not depend upon the functioning of any part of another unit. Today's receivers can be single-sensor, multisensor, or "embedded" as part of a multifunction flight management (and navigation) system (FMS). A combined communication-navigation (com/nav) system meets the requirements for an independent navigation receiver.

Inertial navigation system (INS) - An RNAV system which is a form of self-contained navigation. See "Area navigation (RNAV)."

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

Ionosphere - The band of charged particles 80 to 120 miles above the earth's surface.

Ionospheric refraction - The change in the propagation speed of a signal as it passes through the ionosphere.

L-band - The group of radio frequencies extending from 390 MHz to 1550 MHz. The GPS carrier frequencies (1227.6 MHz and 1575.42 MHz) are in the L-band.

Minimum navigation performance specifications (MNPS) - A set of standards which require aircraft to have a minimum navigation performance capability in order to operate in MNPS designated airspace. In addition, aircraft must be certified by their state of registry for MNPS operation.

MNPS airspace - Designated airspace where MNPS procedures are applied between MNPS certified and equipped aircraft. MNPS airspace is located over certain areas of the North Atlantic (NAT) and over Northern Canada. An example is NAT MNPS airspace. This airspace is defined as the volume of airspace between flight level (FL) 275 and FL 400 bounded by certain geographical coordinates. To obtain MNPS approval, each operator must show compliance with the following conditions:

a. each aircraft is suitably equipped and capable of meeting MNPS standards;

b. operating procedures are established which ensure that MNPS standards are met; and

c. flightcrews are capable of operating with sufficient precision to consistently meet MNPS requirements and are aware of the emergency procedure specific to MNPS airspace.

Minimum navigation performance specifications airspace (MNPSA) - Designated airspace in which MNPS procedures are applied between MNPS certified and equipped aircraft. Under certain

GLOSSARY - Continued

conditions, non-MNPS aircraft can operate in MNPSA. However, standard oceanic separation minimums are provided between the non-MNPS aircraft and other traffic. Currently, the only designated MNPSA is described as follows:

a. between FL 275 and FL 400;

b. between latitudes 27° N and the North Pole;

c. in the East, the eastern boundaries of the control areas (CTA's) Santa Maria Oceanic, Shanwick Oceanic, and Reykjavik; and

(d) in the West, the western boundaries of CTA's Reykjavik and Gander Oceanic, and New York Oceanic excluding the area west of 60° W and south of 38° 30' N.

Multichannel receiver - A GPS receiver that can simultaneously track more than one satellite signal.

Multipath error - Errors caused by the interference of a signal that has reached the receiver antenna by two or more different paths. Usually caused by one path being bounced or reflected.

Multiplexing channel - A channel of a GPS receiver that can be sequenced through a number of satellite signals.

Navigation - The means by which an aircraft is given guidance to travel from one known position to another known position.

Navigation guidance - The calculation of steering commands to maintain the desired track from the present aircraft position to a new position.

Navigation information - Aircraft parameters such as position, velocity vector and related data such as track angle, ground speed, and drift angle used for navigation guidance.

Navaids - Are visual or electrical devices which may be used while airborne or on the surface, which provides point-to-point guidance information or position data to an aircraft in flight. Examples of standard ICAO navaids include very high frequency (VHF) omni-directional range (VOR), with or without distance measuring equipment (DME), and nondirectional ground-based beacons (NDB).

NM or nm - means distance measured in nautical miles. One nautical mile is equivalent to 6,080.27 feet and is the fundamental measurement unit used in both sea and air navigation. It is based on the length of a minute of arc along an arc of a great circle around the Earth.

Oceanic airspace - Airspace over the oceans of the world, considered international airspace, where ICAO oceanic separation and procedures are applied. Responsibility for the provisions of ATC service in this airspace is delegated to various countries based generally upon geographic proximity and the availability of the required resources.

GLOSSARY - Continued

Oceanic airspace - Airspace over the oceans of the world is considered international airspace where aircraft separation and air traffic procedures are standardized by ICAO. The responsibility for ATS in oceanic airspace is delegated to the various ICAO member States according to geographic proximity and availability of the required resources. Specific procedures are defined by ICAO Document 7030.

Oceanic navigational error report (ONER) - A report filed when an aircraft exiting oceanic airspace has been observed by radar to be off course. ONER reporting parameters and procedures are contained in FAA Order 7110.82, "Monitoring of Navigational Performance in Oceanic Areas."

Offshore airspace - The airspace between the United States' 12 NM limit and the oceanic flight information region (FIR) boundary. An alternate definition is "within the limits of conventional land-based navaids."

Omega - An RNAV system designed for long-range navigation based upon ground-based electronic navaid signals.

Operational service volume - Defines the reception limits of VOR/DME and NDB navaids which are usable for random/unpublished route navigation and which are flight checked periodically to reconfirm these limits of coverage. The operational service volume of NDB's used in oceanic navigation; i.e., beyond the 75 NM standard service volume, must be individually flight checked and identified as such on the appropriate charts before they can be used for navigation.

Overwater - Section 91.511 of the FAR defines "overwater" as more than 30 minutes flying time or 100 NM from the nearest shore. This definition differs from the "extended overwater" definition found in FAR Part 1.

P-code - The precise or protected code. A very long sequence of pseudo-random binary biphase modulations on the GPS carrier at a chip rate of 10.23 MHz which repeats approximately every 267 days. Each 1 week segment of this code is unique to one GPS satellite and is reset each week.

Parallel offset path - A desired track parallel to, and left or right of, the "parent" track specified in nautical miles of offset distance.

Parent track - The planned track between two waypoints.

Parent waypoint - A waypoint used for route definition or progress reporting. The geographical position of a parent waypoint is not altered when RNAV equipment is operating in a parallel offset mode.

Pilotage - Aerial navigation by means of visual identification of landmarks.

POH - Is the Pilot's Operating Handbook. The POH is the result of a 1976 industry-developed specification for the operation of FAR Part 23 certificated aircraft. Only Sections I and II of the POH are FAA-approved. These sections contain operating limitations for the airframe and engine

GLOSSARY - Continued

combination. Section IX of the POH also contains additional operating instructions and FAA approved limitations for all supplemental installed equipment, including Loran-C. Some type certificates issued for airplanes manufactured after 1977-1978 require that the POH be carried on the airplane (and therefore accessible to the pilot during flight) as a condition to meeting its type design.

Precise positioning service (PPS) - The most accurate dynamic positioning possible with GPS, based on the dual frequency P-code.

Primary navigation - See "Sole means of navigation." A "primary means" system is not required to reference a magnetic compass as it is totally independent of all other reference systems.

Pseudolite - A ground-based differential GPS receiver which transmits a signal like that of an actual GPS satellite and can be used for ranging. The data portion of the signal contains the differential corrections that can be used by other receivers to correct for GPS errors.

Pseudorandom code - A signal with random-noise like properties. It is a very complicated but repeated pattern of 1's and 0's.

Pseudorange - A distance measurement based on the correlation of a satellite transmitted code and the local receiver's reference code, that has not been corrected for errors in synchronization between the transmitter's clock and the receiver's clock.

P-static - Is precipitation static, a form of background noise caused by rain, hail, snow, or dust storms in the vicinity of a receiving antenna, and measured at frequencies less than 10 MHz.

Reliability - The reliability of a navigation system is a function of the frequency that 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 operating conditions. Formally, reliability is one minus the probability of system failure.

Route - A defined path, consisting of a course in the horizontal plane, which aircraft transverse over the surface of the earth.

Satellite constellation - The arrangement in space of a set of satellites.

Selcal - Selective calling, a term used by the chart services on high/low altitude charts and others to indicate specific frequencies available for aircraft with selcal installed to be contacted on demand.

Self-contained navigation - Systems which are not dependent on external navigation sources on a continuous basis to determine position or navigation track. Self-contained navigation systems must be updated periodically with station-referenced or earth-referenced navigation systems to maintain their accuracy.

SNR - Signal-to-noise ratio. SNR is the ratio of the radio field intensity of a received radio wave to the radio noise field intensity received along with that signal.

GLOSSARY - Continued

Sole means air navigation systems - An approved navigation system that can be used for specific phases of air navigation without the need for any other navigation source.

Space segment - The part of the whole GPS system that includes the satellites and the launch vehicles.

Spread spectrum - A system in which the transmitted signal is spread over a frequency band much wider than the minimum band-width needed to transmit the information being sent. For GPS, this is done by modulating the carrier with a pseudo-random code.

Standard positioning service (SPS) - The normal civilian positioning accuracy obtained by using the single frequency C/A code.

State aircraft - Aircraft used exclusively in the service of any government or of any political subdivision thereof, including the government of any state, territory, or possession of the United States or the District of Columbia, but not including any government-owned aircraft engaged in carrying persons or property for commercial purposes.

Static positioning - Location determination when the receiver's antenna is presumed to be stationary in the earth. This allows the use of various averaging techniques that improve accuracy by factors of over 100.

Station referenced navigation - Position determination which is referenced to a stationary source.

Strap-down navigation equipment - Navigation equipment that is temporarily installed in an aircraft, usually for the purpose of ferry flights. The installation is FAA approved for "form, function and fit" and placed on FAA Form 337.

Supplemental air navigation system - An approved navigation system that can be used in conjunction with a sole-means navigation system.

Standard service volume - Defines the reception limits of VOR/DME and NDB ground-based navaids which are usable for random/unpublished route navigation. Standard service volume is a calculated value that has not been flight checked. Coverage limits for VOR/DME systems are published in the "Federal Radio-navigation Plan," published biennially by the FAA and available to the pilot community.

Statistical measure of accuracy - Navigation system errors generally follow a known error distribution. Therefore, the uncertainty in position can be expressed as the probability that the error will not exceed a certain amount. A thorough treatment of errors is complicated by the fact that the total error is comprised of errors caused by instability of the transmitted signal, effects of weather and other physical changes in the propagation medium, errors in the receiving equipment, and errors introduced by the human navigator. In specifying or describing the accuracy of a system, human errors usually are excluded. Further complications arise because some navigation systems are linear (one-dimensional) while others provide two or three dimensions of position. When specifying linear

GLOSSARY - Continued

accuracy, or when it is necessary to specify requirements in terms of orthogonal axes (e.g., along-track or crosstrack), the 95 percent (or two σ) confidence level is used. Vertical or bearing accuracies is specified in one-dimensional terms at the two σ, or 95 percent, confidence level. When two-dimensional accuracies are used, the 2 Drms (distance root mean square) uncertainty estimate is employed. Two Drms is twice the radial error or 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. It is often found by first defining an arbitrarily-oriented set of perpendicular axes, with the origin at the true location point. The variances around each axis are then found, summed, and the square root computed. When the distribution of errors is elliptical, as it often is for stationary ground-based systems, these axes can be taken for convenience as the major and minor ellipse. Then the confidence level depends on the elongation of the error ellipse. The range of confidence levels is from 95 to 99 percent. As the error ellipse collapses to a line, the confidence level of the 2 Drms measurement approaches 95 percent.

Circular error probable (CEP) - A U.S. Department of Defense (DOD) specification in terms of accuracy. CEP is defined as the radius of a circle containing 50 percent of all possible fixes. Specification of radio navigation system accuracy generally refer to one or more of the following definitions.

a. *Predictable accuracy*: the accuracy (in NM or feet) of a position with respect to geographic or geodetic coordinates of the Earth. Predictable accuracy is also known as geodetic or absolute accuracy.

b. *Repeatable accuracy*: the accuracy (in feet) with which a user can return to a position whose coordinates have been measured at a previous time with the same navigation system.

c. *Relative accuracy*: the accuracy (in feet) with which a user can measure position relative to that of another user of the same navigation system at the same time. This may be expressed also as a function of the distance between two users. Relative accuracy may also refer to the accuracy with which a user can measure position relative to his own position in the recent past. For example, the present position of a craft whose desired track forms a specific geometric pattern on search operations will be measured generally with respect to a previously determined datum.

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

User interface - The way a receiver conveys information to the person using it. The controls and displays.

User segment - The part of the whole GPS system that includes the receivers of GPS signals.

VFR navigation - Navigation by pilotage (i.e., DR) or electronic means. There are no published accuracy standards for visual flight rules (VFR) oceanic (en route) navigation.

GLOSSARY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Aircraft - Device(s) that are used or intended to be used for flight in the air, and when used in ATC terminology, may include the flightcrew.

[ICAO] Aircraft - Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

Airport elevation - The highest point of an airport's usable runways measured in feet from mean sea level (MSL). See "Touchdown Zone."

[ICAO] Aerodrome elevation - The elevation of the highest point of the landing area.

Airport rotating beacon - A visual navaid operated at many airports. At civil airports, alternating white and green flashes indicate the location of the airport. At military airports, the beacons flash alternately white and green, but are differentiated from civil beacons by dual-peaked (two quick) white flashes between the green flashes. See "Special VFR operations" and/or "Instrument flight rules." (Refer to Airman's Information Manual (AIM), "Rotating Beacons")

[ICAO] Aerodrome beacon - Aeronautical beacon used to indicate the location of an aerodrome from the air.

Airport traffic control service - A service provided by a control tower for aircraft operating on the movement area and in the vicinity of an airport. See "Movement Area" and/or "Tower."

[ICAO] Aerodrome control service - ATC service for aerodrome traffic.

Air traffic - Aircraft operating in the air or on an airport surface, exclusive of loading ramps and parking areas.

[ICAO] Air traffic - All aircraft in flight or operating on the maneuvering area of an aerodrome.

Air traffic clearance - An authorization by ATC, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace. See "ATC instructions."

[ICAO] Air traffic control (ATC) clearance - Authorization for an aircraft to proceed under conditions specified by an ATC unit.

> NOTE 1: For convenience, the term "ATC clearance" is frequently abbreviated to "clearance" when used in appropriate contexts.
>
> NOTE 2: The abbreviated term clearance may be prefixed by the words taxi, takeoff, departure, en route, approach, or landing to indicate the particular portion of flight to which the ATC clearance relates.

GLOSSARY - Continued

Air traffic control (ATC) - A service operated by an appropriate authority to promote the safe, orderly and expeditious flow of air traffic.

[ICAO] Air traffic control (ATC) service - A service provided for the purpose of:

a. preventing collisions

- between aircraft; and

- on the maneuvering area between aircraft and obstructions; and

b. expediting and maintaining an orderly flow of air traffic.

Air traffic control (ATC) specialist - A person authorized to provide ATC service. See "Air traffic control" and/or "Flight service station."

[ICAO] Controller - A person authorized to provide ATC services.

Airway - A CTA or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids. See "Federal airways." (Refer to FAR Part 71, AIM)

[ICAO] Airway - A CTA or portion thereof established in the form of corridor equipped with radio navigational aids.

Alternate airport - An airport at which an aircraft may land if a landing at the intended airport becomes inadvisable.

[ICAO] Alternate aerodrome - An aerodrome specified in the flight plan to which a flight may proceed when it becomes inadvisable to land at the aerodrome of intended landing.

NOTE: An alternate aerodrome may be the aerodrome of departure.

Altitude - The height of a level, point, or object measured in feet above ground level (AGL) or from MSL. See "Flight level."

a. MSL altitude is altitude expressed in feet measured from MSL.

b. AGL altitude is altitude expressed in feet measured AGL.

c. Indicated altitude is the altitude as shown by an altimeter. On a pressure or barometric altimeter it is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions.

[ICAO] Altitude - The vertical distance of a level, a point or an object considered as a point, measured from MSL.

GLOSSARY - Continued

Approach control service - ATC service provided by an approach control facility for arriving and departing VFR/IFR aircraft and, on occasion, en route aircraft. At some airports not served by an approach control facility, the air route traffic control center (ARTCC) provides limited approach control service. (Refer to AIM)

[ICAO] Approach control service - ATC service for arriving or departing controlled flights.

Approach sequence - The order in which aircraft are positioned while on approach or awaiting approach clearance.

[ICAO] Approach sequence - The order in which two or more aircraft are cleared to approach to land at the aerodrome.

Apron - A defined area on an airport or heliport intended to accommodate aircraft for purposes of loading and unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron form the water.

[ICAO] Apron - A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, refuelling, parking or maintenance.

Area navigation (RNAV) - A method of navigation that permits aircraft operation on any desired course within the coverage of station-reference navigation signals or within the limits of a self-contained system capability. Random area navigation routes are direct routes, based on area navigation capability, between waypoints defined in terms of latitude/longitude coordinates, degree/distance fixes, or offsets from published or established routes/airways at a specified distance and direction. The major types of equipment are described below.

a. VORTAC referenced or course line computer (CLC) systems, which account for the greatest number of RNAV units in use. To function, the CLC must be within the service range of a VORTAC.

b. Omega/VLF, although two separate systems, can be considered as one operationally. A long-range navigation system based upon very low frequency radio signals transmitted from a total of 17 stations worldwide.

c. INS are systems that are totally self-contained and require no information in response to signals resulting from internal effects on components within the system.

d. MLS area navigation (MLS/RNAV) provides area navigation with reference to an MLS ground facility.

e. Loran-C is a long-range radio navigation system that uses ground waves transmitted at low frequency to provide user position information at ranges of up to 600 to 1,200 NM at both en route and approach altitudes. The usable signal coverage areas are determined by the signal-to-noise ratio, the envelope-to-cycle difference, and the geometric relationship between the positions of the user and the transmitting stations.

GLOSSARY - Continued

[ICAO] 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.

Automatic terminal information service (ATIS) - The continuous broadcast of recorded non-control information in selected terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of essential but routine information; e.g., "Los Angles information alpha. One three zero zero coordinated universal time. Weather, measured ceiling two thousand overcast, visibility three, haze, smoke, temperature seven one, dew point five seven, wind two five zero at five, altimeter two niner niner six. I-L-S runway two five left approach in use, runway two five right closed, advise you have alpha." (Refer to AIM)

[ICAO] Automatic terminal information service - The provision of current, routine information to arriving and departing aircraft by means of continuous and repetitive broadcasts throughout the day or a specified portion of the day.

Blind speed - The rate of departure or closing of a target relative to the radar antenna at which cancellation of the primary radar target by moving target indicator (MTI) circuits in the radar equipment causes a reduction or complete loss of signal.

[ICAO] Blind velocity - The radial velocity of moving target such that the target is not seen on primary radars fitted with certain forms of fixed echo suppression.

Broadcast - Transmission of information for which an acknowledgement is not expected.

[ICAO] Broadcast - A transmission of information relating to air navigation that is not addressed to a specific station or stations.

Ceiling - The height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as "broken," "overcast," or "obscuration," and not classified as "thin" or "partial."

[ICAO] Ceiling - The height above the ground or water of the base of the lowest layer of cloud below 6,000 meters (20,000 feet) covering more than half the sky.

Clearance limit - The fix, point, or location to which an aircraft is cleared when issued an air traffic clearance.

[ICAO] Clearance limit - The point of which an aircraft is granted an ATC clearance.

Clearance void if not off by (time) - Used by ATC to advise an aircraft that the departure clearance is automatically canceled if takeoff is not made prior to a specified time. The pilot must obtain a new clearance or cancel his IFR plan if not off by the specified time.

[ICAO] Clearance void time - A time specified by an ATC unit at which a clearance ceases to be valid unless the aircraft concerned has already taken action to comply therewith.

GLOSSARY - Continued

Clutter - In radar operations, clutter refers to the reception and visual display of radar returns caused by precipitation, chaff, terrain, numerous aircraft targets, or other phenomena. Such returns may limit or preclude ATC from providing services based on radar. See "Target."

[ICAO] Radar clutter - The visual indication on a radar display of unwanted signals.

Compass locator - A low power, low or medium frequency (L/MF) radio beacon installed at the site of the outer or middle marker of an instrument landing system (ILS). It can be used for navigation at distances of approximately 15 miles or as authorized in the approach procedure.

a. Outer compass locator (LOM) is a compass locator installed at the site of the outer marker of an instrument landing system.

b. Middle compass locator (LMM) is a compass locator installed at the site of the middle marker of an instrument landing system.

[ICAO] Locator - an LM/MF NDB used as an aid to final approach.

NOTE: A locator usually has an average radius of rated coverage of between 18.5 and 46.3 km (10 and 25 NM).

Controlled airspace - Airspace designated as a control zone, airport radar service area, terminal CTA, transition area, CTA, continental CTA and positive CTA within which some or all aircraft may be subject to ATC. (Refer to AIM, FAR Part 71) Types of U.S. controlled airspace include the following.

a. *Airport radar service area (ARSA)* - Regulatory airspace surrounding designated airports wherein ATC provides radar vectoring and sequencing on a full-time basis for all IFR and VFR aircraft. The service provided radar in an ARSA is called ARSA service, which includes: IFR/IFR-standard IFR separation; IFR/VFR-traffic advisories and conflict resolution; and VFR/VFR-traffic advisories and, as appropriate, safety alerts. The AIM contains an explanation of ARSA. The ARSA's are depicted on VFR aeronautical charts. (Refer to AIM, Airport/Facility Directory, and/or FAR Part 91)

b. *Continental control area (CTA)* - The airspace of the 48 contiguous United States, the District of Columbia and Alaska, excluding the Alaska peninsula west of longitude 160° 00' 00''W, at and above 14,500 feet MSL, but does not include:

(1) the airspace less than 1,500 feet above the surface of the earth; or

(2) prohibited and restricted areas, other than the restricted areas listed in FAR Part 71.

c. *Control area (CTA)* - Airspace designated as Colored Federal Airways, VOR Federal

GLOSSARY - Continued

airways, CTA's associated with jet routes outside the continental CTA (FAR § 71.161), additional CTA's (FAR § 71.163), CTA extensions (FAR § 71.165), and area low routes. CTA's do not include the continental CTA, but unless otherwise designated, they do include the airspace between a segment of a main VOR Federal airway and its associated alternate segments with the vertical extent of the area corresponding to the vertical extent of the related segment of the main airway. The vertical extent of the various categories of airspace contained in CTA's is defined in FAR Part 71.

d. *Control zone*. Controlled airspace which extends upward form the surface of the earth and terminates at the base of the continental CTA. Control zones that do not underlie the continental CTA have no upper limit. A control zone may include one or more airports and is normally a circular area with a radius of 5 statute miles and any extension necessary to include instrument approach and departure paths.

e. *Positive control area (PCA)* - Airspace designated in FAR Part 71 within which there is positive control of aircraft. Flight in PCA is normally conducted under IFR. PCA is designated throughout most of the conterminous United States and its vertical extent is from 18,000 feet MSL to and including FL 600. In Alaska PCA does not include the airspace less than 1,500 feet above the surface of the earth nor the airspace over the Alaska Peninsula west of longitude 160 degrees west. Rules for operating in PCA are found in FAR § 91.135 and FAR § 91.215.

f. *Terminal control area (TCA)* - Controlled airspace extending upward from the surface or higher to specified altitudes, within which all aircraft are subject to operating rules and pilot and equipment requirements specified in FAR Part 91. TCA's are depicted on Sectional, World Aeronautical, En Route Low Altitude, DOD flight information publication (FLIP), and TCA charts. (Refer to FAR Part 91, AIM)

g. *Transition area* - Controlled airspace extending upward from 700 feet or more above the surface of the earth when designated in conjunction with an airport for which and approved instrument approach procedure has been proscribed; or from 1,200 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless otherwise specified, transitions areas terminate at the base of the overlying controlled airspace. Transition areas are designed to contain IFR operations in controlled airspace during portions of the terminal operation and while transiting between the terminal and en route environment.

[ICAO] Controlled airspace - Airspace of defined dimensions within air traffic service is provided to controlled flights.

[ICAO] Control zone - A controlled airspace extending upwards from the surface of the earth to a specified upper limit.

[ICAO] Terminal control area (CTA) - A CTA normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes.

[ICAO] Control area (CTA) - A controlled airspace extending upward from a specified limit above the earth.

GLOSSARY - Continued

Cruising altitude - An altitude or FL maintained during en route level flight. This is a constant altitude and should not be confused with a cruise clearance. See "Altitude."

[ICAO] Cruising level - A level maintained during a significant portion of a flight.

[ICAO] Danger area - An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at a specified times.

NOTE: The term "Danger Area" is not used in reference to areas within the United States or any of its possessions or territories.

Decision height (DH) - With respect to the operation of aircraft, means the height at which a decision must be made during an ILS, MLS, or precision approach radar (PAR) instrument approach to either continue the approach or to execute a missed approach.

[ICAO] Decision altitude (DA)/Decision height (DH) - A specified altitude or height (A/H) in the precision approach at which a missed approach must be initiated of the required visual reference to continue the approach has not been established.

NOTE 1: DA is referenced to MSL, and DH is referenced to the threshold elevation.

NOTE 2: The required visual reference means that section of the visual aids or of the approach area whicb should have been in view for sufficient time for the pilot to have an assessment of the aircraft position and rate of change of position, in relation to the flight path.

[ICAO] Estimated elapsed time - The estimated time required to proceed form one significant point to another. See "Total estimated elapsed time."

[ICAO] Estimated off-block time - The estimated time at which the aircraft will commence movement associated with departure.

Final approach - IFR - The flight path of an aircraft which is inbound to an airport on a final instrument approach course, beginning at the final approach fix or point and extending to the airport or the point where a circle-to-land maneuver or missed approach is executed. See "Segments of an instrument approach procedure."

[ICAO] Final approach - That part of an instrument approach procedure which commences at the specified final approach fix or point, or where such a fix or point is not specified,

a. at the end of the last procedure turn, base turn, or inbound turn of a racetrack procedure, if specified; or

b. at the point of interception of the last track specified in the approach procedure; and ends at a point in the vicinity of an aerodrome from which:

GLOSSARY - Continued

(1) a landing can be made; or

(2) a missed approach procedure is initiated.

Flight level (FL) - A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, FL 250 represents a barometric altimeter indication of 25,000 feet; FL 255, an indication of 25,500 feet.

[ICAO] Flight level (FL) - A surface of constant atmospheric pressure which is related to a specific pressure datum, 1013.2 Hg"(1013.2mb), and is separated from other such surfaces by specific pressure intervals.

NOTE 1: A pressure type altimeter calibrated in accordance with the standard atmosphere:
a. When set to a en route FL (QNH) altimeter setting, will indicate altitude;
b. When set to a airport altitude (QFE) altimeter setting, will indicate height above QFE reference datum; and
c. When set to a pressure of 1013.2 Hg" (1013.2 mb), may be used to indicate FL's.

NOTE 2: The terms 'height' and 'altitude,' used in Note 1 above, indicate altimetric rather than geometric heights and altitudes.

Flight recorder - A general term applied to any instrument or device that records information about the performance of an aircraft in-flight or about conditions encountered in-flight. Flight recorders may make records of airspeed, outside air temperature, vertical acceleration, engine rotation per minute (RPM), manifold pressure, and other pertinent variables for a given flight.

[ICAO] Flight recorder - Any type of recorder installed in the aircraft for the purpose of complementing accident/incident investigation. See ICAO Annex 6, Part I, for specifications relating to flight recorders.

General aviation - That portion of civil aviation which encompasses all facets of aviation except air carriers holding certificate of public convenience and necessity from the Civil Aeronautics Board and large aircraft commercial operators.

[ICAO] General aviation - All civil aviation operations other than scheduled air services and nonscheduled air transport operations for remuneration or hire.

Glideslope - Provides vertical guidance for aircraft during approach and landing. The glideslope/glidepath is based on the following:

a. Electronic components emitting signals which provide vertical guidance by reference to airborne instruments during instrument approaches such as ILS/MLS, or

GLOSSARY - Continued

b. Visual ground aids, such as visual approach slope indicator (VASI), which provide vertical guidance for a VFR approach or for the visual portion of an instrument approach and landing.

c. PAR. Used by ATC to inform an aircraft making a PAR approach of its vertical position (elevation) relative to the descent profile.

[ICAO] Glidepath - A descent profile determined for vertical guidance during a final approach.

Holding fix - A specified fix identifiable to a pilot by navaids or visual reference to the ground used as a reference point in establishing and maintaining the position of an aircraft while holding. (Refer to AIM)

[ICAO] Holding point - A specified location, identified by visual or other means, in the vicinity of which the position of an aircraft in flight is maintained in accordance with ATC clearances.

Homing - Flight toward a navaid, without correcting for wind, by adjusting the aircraft heading to maintain a relative bearing of zero degrees.

[ICAO] Homing - The procedure of using the direction-finding equipment of one radio station with the emission of another radio station, where at least one of the stations is mobile, and whereby the mobile station proceeds continuously towards the other station.

Instrument approach procedure (IAP) - A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority. See "Segments of an instrument approach procedure." (Refer to FAR Part 91, AIM)

a. U.S. civil standard instrument approach procedures are approved by the FAA as prescribed under FAR Part 97 and are available for public use.

b. U.S. military standard instrument approach procedures are approved and published by the DOD.

c. Special instrument approach procedure are approved by the FAA for individual operators but are not published in FAR Part 97 for public use.

[ICAO] Instrument approach procedure - A series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en route obstacle clearance criteria apply.

Instrument flight rules (IFR) - Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan. (Refer to AIM)

GLOSSARY - Continued

[ICAO] Instrument flight rules (IFR) - A set of rules governing the conduct of flight under instrument meteorological conditions.

Instrument runway - A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved.

[ICAO] Instrument runway - One of the following types of runways intended for the operation of aircraft using instrument approach procedures:

a. *Nonprecision approach runway* - An instrument runway served by visual aids and nonvisual aid providing at least directional guidance adequate for a straight-in approach.

b. *Precision approach runway, Category I* - An Instrument runway served by ILS and visual aids intended for operations down to 60 m (200 feet) decision height and down to an runway visual range (RVR) of the other of 800 m.

c. *Precision approach runway, Category II* - An instrument runway served by ILS and visual aids intended for operations down to 30 m (100 feet) decision heigbt and down to an RVR of the other of 400 m.

d. *Precision approach runway, Category III* - An instrument runway served by ILS to and along the surface of the runway and:

(1) Intended for operations down to an RVR of the order of 200 miles (no decision height being applicable) using visual aids during the final phase of landing;

(2) Intended for operations down to an RVR of the order of 50 miles (no decision height being applicable) using visual aids for taxing; and

(3) Intended for operations without reliance on visual reference for landing or taxiing.

NOTE 1: See Annex 10 Volume I, Part I Chapter 3, for related ILS specifications.

NOTE 2: Visual aids need not necessarily be matched to the scale of nonvisual aids provided. The criterion for the selection of visual aids is the conditions in which operations are intended to be conducted.

International airport - Relating to international flight, it means:

a. an airport of entry which has been designated by the Secretary of Treasury or Commissioner of Customs as an international airport for customs service.

GLOSSARY - Continued

b. A landing rights airport at which specific permission to land must be obtained from customs authorities in advance of contemplated use.

c. Airports designated under the Convention on International Civil Aviation as an airport for use by international commercial air transport and/or international general aviation. (Refer to Airport/Facility Directory and/or International Flight Information Manual (IFIM))

[ICAO] International airport - Any airport designated by the contracting state in whose territory it is situated as an airport of entry and departure for international air traffic, where the formalities incident to customs, immigration, public health, animal and plant quarantine and similar procedures are carried out.

Landing area - Any locality either on land, water, or structures, including airports/heliports and intermediate landing fields, which is used, or intended to be used, for the landing and takeoff of aircraft whether or not facilities are provided for the shelter, servicing, or for receiving or discharging passengers or cargo.

[ICAO] Landing area - That part of a movement area intended for the landing or takeoff of aircraft.

Minimum safe altitudes (MSA) -

a. The minimum altitude specified in FAR Part 91 for various aircraft operations.

b. Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance for emergency use within a specified distance from the navigation facility upon which a procedure is predicated. These altitudes will be identified as minimum sector altitudes or emergency safe altitudes and are established as follows:

(1) *Minimum sector altitudes* - Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance within a 25-mile radius of the navigation facility upon which the procedure is predicated. Sectors depicted on approach charts must be at least 90 degrees in scope. These altitudes are for emergency use only and do not necessarily assure acceptable navigational signal coverage.

(2) *Emergency safe altitudes* - Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance in non-mountainous area and 2,000 feet of obstacles clearance in designated mountainous areas with in 100-mile radius of the navigation facility upon which the procedure is predicated and normally used only in military procedures. These altitudes are identified on published procedures as "Emergency Safe Altitudes."

[ICAO] Minimum sector altitude - The lowest altitude which may be used under emergency conditions which will provide a minimum clearance of 300 miles (1,000 feet) above all obstacles located in an area contained within a sector of a circle of 46 km (25 NM) radius centered on a radio aid to navigation.

GLOSSARY - Continued

Mode - The letter or number assigned to a specific pulse of radio signals transmitted or received by ground interrogator or airborne transponder components of the Air Traffic Control Radar Beacon System (ATCRBS). Mode A (military Mode 3) and Mode C (altitude reporting) are used in ATC. See "Transponder" and/or "Radar." (Refer to AIM)

[ICAO] Mode (Secondary Surveillance Radar (SSR) Mode) - The letter or number assigned to a specific pulse spacing of the interrogation signals transmitted by an interrogator. There are 4 modes, A, B, C and D specified in Annex 10, corresponding to four different interrogation pulse spacings.

Movement area - The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At those airports/heliports with a tower, specified approval for entry onto the movement area must be obtained from ATC.

[ICAO] Movement area - That part of an aerodrome to be used for the takeoff, landing and taxiing of aircraft, consisting of the manoeuvreing area and the apron(s).

Night - The time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

[ICAO] Night - The hours between the end of evening civil twilight and the beginning of morning civil twilight or such other period between sunset and sunrise as may be specified by the appropriate authority.

> NOTE: Civil twilight ends in the evening when the center of the sun's disk is 6 degrees below the horizon and begins in the morning when the center of the sun's disk is 6 degrees below the horizon.

Notice to Airmen (NOTAM) - A notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations.

a. *NOTAM(D)* - A NOTAM given (in addition to local dissemination) distant dissemination beyond the area of responsibility of the Flight Service Station. These NOTAM's will be stored and available until canceled.

b. *NOTAM(L)* - A NOTAM given local dissemination by voice and other means, such as telegraph and telephone, to satisfy local user requirements.

c. *FDC NOTAM* - A NOTAM regulatory in nature, transmitted by United States NOTAM office (USNOF) and given system wide dissemination.

[ICAO] NOTAM - A notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

GLOSSARY - Continued

a. *Class I Distribution* - Distribution by means of telecommunication.

b. *Class II Distribution* - Distribution by means other than telecommunications.

Precision approach radar (PAR) - Radar equipment in some ATC facilities operated by FAA and/ or the military services at joint-use civil/military locations and separate military installations to detect and display azimuth, elevation, and range of aircraft on the final approach course to a runway. This equipment may be used to monitor certain nonradar approaches, but is primarily used to conduct a PAR wherein the controller issues guidance instructions to the pilot based on the aircraft's position in relation to the final approach course (azimuth), the glidepath (elevation), and the distance (range) from the touchdown point on the runway as displayed on the radar scope. (Refer to AIM)--The abbreviation "PAR" is also used to denote preferential arrival routes in ARTCC computers.

[ICAO] Precision approach radar (PAR) - Primary radar equipment used to determine the position of an aircraft during final approach, in terms of lateral and vertical deviations relative to a nominal approach path, and in range relative to touchdown.

NOTE: Precision approach radars are designed to enable pilots of aircraft to be given guidance by radio communications during the final stages of the approach to land.

Prohibited area - See "Special Use Airspace."

[ICAO] Prohibited area - An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited.

Radar - A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulses.

a. *Primary radar* - A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at that site for processing and display at an ATC facility.

b. *Secondary radar/Radar beacon (ATCRBS)* - A radar system in which the object to be tested is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display at an ATC facility. See "Transponder." (Refer to AIM)

[ICAO] Radar - A radio detection device which provides information on range, azimuth and/or elevation of objects.

a. *[ICAO] primary radar*. Radar System which uses reflected radio signals.

GLOSSARY - Continued

b. *[ICAO] secondary radar*. Radar system wherein a radio signal transmitted form a radar station initiates the transmission of a radio signal from another station.

Radar approach - An instrument approach procedure which utilizes PAR or Airport Surveillance Radar (ASR). See "Precision approach radar" and/or "Instrument approach procedure." (Refer to AIM)

[ICAO] Radar approach - An approach, executed by an aircraft, under the direction of a radar controller.

Radar contact -

a. Used by ATC to inform an aircraft that it is identified on the radar display and radar flight following will be provided until radar identification is terminated. Radar service may also be provided within the limits of necessity and capability. When a pilot is informed of "radar contact," he automatically discontinues reporting over compulsory reporting points. (Refer to AIM)

b. The term used to inform the controller that the aircraft is identified and approval is granted for the aircraft to enter the receiving controllers airspace.

(ICAO Radar contact - The situation which exists when the radar blip or radar position symbol of a particular aircraft is seen and identified on a radar display.

Radar identification - The process of ascertaining that an observed radar target is the radar return from a particular aircraft. See "Radar contact" and/or "Radar service."

[ICAO] Radar identification - The process of correlating a particular radar blip or radar position symbol with a specific aircraft.

Radar service - A term which encompasses one or more of the following services based on the use of radar which can be provided by a controller to a pilot of a radar identified aircraft.

a. *Radar monitoring* - The radar flight-following of aircraft, whose primary navigation is being performed by the pilot, to observe and note deviations from its authorized flight path, airway, or route. When being applied specifically to radar monitoring of instrument approaches; i.e., with PAR or radar monitoring of simultaneous ILS/MLS approaches, it includes advice and instructions whenever an aircraft nears or exceeds the prescribed PAR safety limit or simultaneous ILS/MLS no transgression zone.

b. *Radar navigational guidance* - Vectoring aircraft to provide course guidance.

c. *Radar separation* - Radar spacing of aircraft in accordance with established minima.

[ICAO] Radar service - Term used to indicate a service provided directly by means of radar.

GLOSSARY - Continued

[ICAO] **Radar monitoring** - The use of radar for the purpose of providing aircraft with information and advice relative to significant deviations from nominal flight path.

[ICAO] **Radar separation** - The separation used when aircraft position information is derived from radar sources.

Released time - A departure time restriction issued to a pilot by ATC (either directly or through an authorized relay) when necessary to separate a departing aircraft from other traffic.

[ICAO] **Release time** - Time prior to which an aircraft should be given further clearance or prior to which it should not proceed in case of radio failure.

Reporting point - A geographical location in relation to which the position of an aircraft is reported. (Refer to AIM)

[ICAO] **Reporting point** - A specified geographical location in relation to which the position of an aircraft can be reported.

Rescue coordination center (RCC) - A search and rescue (SAR) facility equipped and manned to coordinate and control SAR operations in an area designated by the SAR plan. The U.S. Coast Guard and the U.S. Air Force have responsibility for the operation of RCC's.

[ICAO] **Rescue co-ordination center** - A unit responsible for promoting efficient organization of SAR service and for coordinating the conduct of SAR operations within a SAR region.

[ICAO] **Restricted area** - An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions.

Route segment - As used in ATC, a part of a route that can be defined by two navigational fixes, two navaids, or a fix and a navaid. See "Route."

[ICAO] **Route segment** - A portion of a route to be flown, as defined by two consecutive significant points specified in a flight plan.

Runway - A defined rectangular area on a land airport prepared for the landing and takeoff run of aircraft along its length. Runways are normally numbered in relation to their magnetic direction rounded off to the nearest 10 degrees; e.g., Runway 01, Runway 25.

[ICAO] **Runway** - A defined rectangular area on a land aerodrome prepared for the landing and takeoff of aircraft.

Segments of an instrument approach procedure - An instrument approach procedure may have many as four separate segments depending on how the approach procedure is structured.

a. *Initial approach* - The segment between the initial approach fix and the intermediate fix or

GLOSSARY - Continued

the point where the aircraft is established on the intermediate course or final approach course.

b. *Intermediate approach* - The segment between the intermediate fix or point and the final approach fix.

c. *Final approach* - The segment between the final approach fix or point and the runway, airport, or missed approach point.

d. *Missed approach* - The segment between the missed approach point or the point of arrival at decision height and the missed approach fix at the prescribed altitude. (Refer to FAR Part 97)

[ICAO] Initial approach segment - That segment of an instrument approach procedure between the initial approach fix and the intermediate approach fix or, where applicable, the final approach fix or point.

[ICAO] Intermediate approach segment - That segment of an instrument approach procedure between either the intermediate approach fix and the final approach fix or point, or between the end of a reversal, race track, or DR track procedure and the final approach fix point or point, as appropriate.

[ICAO] Final approach segment - That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

[ICAO] Missed approach procedure - The procedure to be followed if the approach cannot be continued.

Separation - In ATC, the spacing of aircraft to achieve their safe and orderly movement in flight and while landing and taking off.

[ICAO] Separation - Spacing between aircraft, levels or tracks.

Sigmet (WS) - A weather advisory issued concerning weather significant to the safety of all aircraft. Sigmet advisories cover severe and extreme turbulence, severe icing, and widespread dust or sandstorms that reduce visibility to less than 3 miles. (Refer to AIM)

[ICAO] Sigmet information - Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena which may affect the safety of aircraft operations.

Special VFR operations - Aircraft operating in accordance with clearances within control zones in weather conditions less than the basic VFR weather minima. Such operations must be requested by the pilot and approved by ATC.

GLOSSARY - Continued

[ICAO] Special VFR flight - A controlled VFR flight authorized by ATC to operate within a control zone under meteorological conditions below the visual meteorological conditions.

Target - The indication shown on a radar display resulting from a primary radar return or a radar beacon reply.

[ICAO] Target - In radar:

a. Generally, any discrete object which reflects or retransmits energy back to the radar equipment.

b. Specifically, an object of a radar search or surveillance.

[ICAO] Total estimated elapsed time - For IFR flights, the estimated time required from take off to arrive over that designated point, defined by reference to navigation aids, from which it is intended that an instrument approach procedure will be commenced, or, if no navigation aid is associated with the destination aerodrome, to arrive over the destination aerodrome. For VFR flights, the estimated time required from takeoff to arrive over the destination aerodrome.

Touchdown -

a. The point at which an aircraft first makes contact with the landing surface.

b. Concerning a PAR, it is the point where the glide path intercept the landing surface.

[ICAO] Touchdown - The point where the nominal glide path intercepts the runway.

NOTE: Touchdown as defined above is only a datum and is not necessarily the actual point at which the aircraft will touch the runway.

Touchdown zone - The first 3,000 feet of the runway beginning at the threshold. The area is used for determination of touchdown zone elevation in the development of straight-in landing minimums for instrument approaches.

[ICAO] Touchdown zone - The portion of a runway, beyond the threshold, where it is intended landing aircraft first contact the runway.

Tower (ATCT) - A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or takeoff at the takeoff at the airport controlled by the tower or to transit the airport traffic area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar). (Refer to AIM)

[ICAO] Aerodrome control tower - A unit established to provide ATC service to aerodrome traffic.

GLOSSARY - Continued

Track - The actual flight path of an aircraft over the surface of the earth. See "Route."

[ICAO] Track - The projection on the earth's surface of the path of an aircraft, the direction of which path any point is usually expressed in degrees from north (true, magnetic, or grid).

Traffic pattern - The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, and final approach.

a. *Upwind leg* - A flight path parallel to the landing runway in the direction of landing.

b. *Crosswind leg* - A flight path at right angles to the landing runway off its upwind end.

c. *Downwind leg* - A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.

d. *Base leg* - A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.

e. *Final approach* - A flight path in the direction of landing along the extended runway centerline. The final approach normally extends from the base leg to the runway. An aircraft making a straight-in approach VFR is also considered to be on final approach. (Refer to AIM and/or FAR Part 91)

[ICAO] Aerodrome traffic circuit - The specified path to be flown by aircraft operating in the vicinity of an aerodrome.

Transfer of control - That action whereby the responsibility for the separation of an aircraft is transferred from one controller to another.

[ICAO] Transfer of control - Transfer of responsibility for providing ATC service.

Transferring controller - A controller/facility transferring control of an aircraft to another controller/facility.

[ICAO] Transferring unit/controller - ATC unit/air traffic controller in the process of transferring the responsibility for providing ATC service to an aircraft to the next ATC unit/air traffic controller along the route of flight.

Transponder - The airborne radar beacon receiver/transmitter portion of the ATCRBS which automatically receives radio signal from interrogators on the ground, and selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond. (Refer to AIM)

GLOSSARY - Continued

[ICAO] Transponder - A receiver/transmitter which will generate a reply signal upon proper interrogation; the interrogation and reply being on different frequencies.

Urgency - A condition of being concerned about safety and of requiring timely but not immediate assistance; a potential distress condition.

[ICAO] Urgency - A condition concerning the safety of an aircraft or other vehicle, or of person on board or in sight, but which does not require immediate assistance.

Vector - A heading issued to an aircraft to provide navigational guidance by radar.

[ICAO] Radar vectoring - Provisions of navigational guidance to aircraft in the form of specific headings, based on the use of radar.

Vertical separation - Separation established by assignment of different altitudes or FL's.

[ICAO] Vertical separation - Separation between aircraft expressed in units of vertical distance.

[ICAO] Visibility - The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent objects by night.

a. *[ICAO] Flight visibility* - The visibility forward from the cockpit of an aircraft in flight.

b. *[ICAO] Ground visibility* - The visibility at an aerodrome as reported by an accredited observer.

c. *[ICAO] Runway visual range (RVR)* - The range over which the pilot of an aircraft on the center line of a runway can see the runway surface markings or the lights delineating the runway or identifying its center line.

Visual approach - An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of an ATC facility and having an ATC authorization, may proceed to the airport of destination in VFR conditions.

[ICAO] Visual approach - An approach by an IFR flight when either part or all of an instrument approach procedure is not completed and the approach is executed in visual reference to terrain.

CHAPTER 4. NORTHERN PACIFIC OCEANIC OPERATIONS

1. THE NORTHERN PACIFIC (NOPAC) SYSTEM.

a. *General.* Due to increases in passenger demand, time zone differences, airport noise restrictions, and other factors, most NOPAC air traffic is concentrated in predictable flow patterns. The effect of these flows is that eastbound traffic peaks between 0800 coordinated universal time (UTC) and 2000 UTC, and westbound traffic peaks between 2200 UTC and 0800 UTC. During peak periods, airspace becomes congested due to the limitations of the lateral and longitudinal separation required. This is compounded by winds aloft and route distances. The long route distances add to the critical aspects of the airspace, because climb approval and altitude availability may necessitate in-flight decisions concerning destination. The most critical altitudes are flight levels (FL's) 310 to 410.

b. *Composite Route System.* To more adequately meet present and future demands, the NOPAC Composite Route System was implemented in March 1982 to maximize use of available airspace while providing a safe and orderly traffic flow. The composite route system is comprised of five air traffic service (ATS) routes that travel the NOPAC between Alaska and Japan. The two northern routes are used for westbound traffic except for R580, which is used for eastbound traffic transiting the Tokyo\Anchorage flight information region (FIR) between 1000 UTC and 1700 UTC. The three southern routes are used for eastbound traffic, except that A590 is used for westbound aircraft crossing the Tokyo\Anchorage FIR between 2300 UTC and 0500 UTC when R220 and R580 traffic is saturated. The system allows a combination of 50 nautical miles (NM) lateral separation and 1,000 feet vertical separation on immediately adjacent routes. By management of route and altitude assignments, any aircraft at the same altitude and not longitudinally separated are laterally separated by at least 100 NM. Any aircraft on the same route are separated by 2,000 feet vertically or 20 minutes longitudinally. The longitudinal separation can be reduced to 10 minutes or less when mach techniques are applied. Standard oceanic (noncomposite) separation is used elsewhere unless radar services are provided or aircraft are within domestic control areas where domestic nonradar control procedures are used. A sample of a composite route, with latitude/longitude coordinates of reporting points and magnetic bearings and distances between them, follows:

Route R220

- BETHEL VORTAC - 239° 312 NM 057° -
- NABIE (N59 18.0 W171 45.4) - 237° 3296 NM 056° -
- NUKKS (N57 15.1 E179 44.3) - 237° 3297 NM 054° -
- NEEVA (N54 40.7 E172 11.8) - 241° 3281 NM 060° -
- NINNO (N52 21.5 E165 22.8) - 240° 3280 NM 058° -
- NIPPO (FIR boundary) (N49 41.9 E159 19.3) - 238° 3330 NM 053° -
- NYTIM (N46 11.9 E153 00.5) - 233° 3330 NM 051° -
- NOKKA (N42 23.3 E147 28.8) - 231° 3163 NM 049° -
- NOHO (N40 25.0 E145 00.0) - 231° 3122 NM 049° -
- NANAC (N38 54.2 E143 13.9)

FIGURE 4-1 LOCATION IDENTIFIERS

AKN	King Salmon, Alaska	KET	Keta, Japan
ANC	Anchorage, Alaska	MX	Matsushima, Japan
BET	Bethel, Alaska	NOH	Noho, Japan
CDB	Cold Bay, Alaska	NUD	Navy Adak, Alaska
CVC	Choshi, Japan	PDN	Port Heiden, Alaska
DLG	Dillingham, Alaska	RCTP	Taipei, China
EDF	Elmendorf AFB	RJAA	Narita, Japan
EHM	Cape Newenham, Alaska	RJSM	Misawa, Japan
EIL	Eielson AFB	RJTT	Tokyo, Japan
FAI	Fairbanks, Alaska	RJTY	Yokota, Japan
GOC	Daigo, Japan	RODN	Kadina, Japan
GTC	Niigata, Japan	SCR	Schooner
INF	Inkfish	SNL	Snail
VHHH	Hong Kong	SPY	St. Paul Island, Alaska
KCC	Nagoya, Japan	SYA	Shemya, Alaska

Samples of cross-checks that are available are shown below. Current navigation charts should be consulted for current cross-check information.

- for NEEVA on R220: SYA 328R/135 DME
- for ONADE on R580: SYA 328R/068 DME
- for AMMOE on R591: SYA 148R/050 DME
- for CHIPT on G344: SYA 148R/100 DME

c. ***Oceanic Transition Routes.*** Within the Tokyo FIR, oceanic transition routes (OTR) and, in one case, a Victor route, have been established for aircraft transitioning to and from the NOPAC. Within the Oakland/Anchorage FIR, certain ATS routes are used for the same purpose. Examples of some of those routes follow, in some cases including the magnetic bearings and distances between significant points:

(1) Within the Tokyo FIR, Route V51 primarily serves eastbound and westbound traffic overflying Japan. V51 routing is:
GTC (Niigata) - SDE (SENDAI) - ASTER 056° 100NM - NOGAR 065° 134NM

OTR-3 serves as a departure route from RJTY (Yokota) to A590, an arrival route to RJTY (Yokota) and RJTT (Tokyo) from R580, and for westbound traffic overflying Japan.

OTR-3 routing is:
GOC (Daigo) - SNL (Snail) - Sabes - A590
R580 OATIS 250° 79NM 069° Snail - GOC (Daigo)

OTR-4 serves as a departure route from RJTY (Yokota) to A590. OTR-4 routing is:
GOC (Daigo) TOPOS - PABBA

OTR-11 serves as a departure route from RJAA (Narita) and RJTT (Tokyo) into the eastbound NOPAC routes, and for eastbound traffic overflying Japan. OTR-11 routing is:
CVC (Choshi) - KAGIS - A590
CVC (Choshi) - KAGIS - 085° 91NM 266° - ABETS - A591
CVC (Choshi) - KAGIS - SCR (Score) - COMFE - G344

(2) Within the Anchorage/Oakland control area (CTA)/FIR's, OTR-14 serves traffic departing North America and transiting the Gulf of Alaska for the NOPAC route system. OTR-14 routing is:
N54 20 W014 00 - 277° 402NM 090 ° - MARLO (N57 27.9 W150 31.7) - J123 - AKN (King Salmon) - EHM (Cape Newenham) - 250 ° 281NM 069° - OYSTA (N58 12.9 W170 57.4) - 251° 305NM 069° - NUKKS (N57 15.1 E179 44.3) - R220

OTR-15 serves traffic departing North America and transiting the Gulf of Alaska for the NOPAC composite route system. OTR-15 routing is:
N52 30 W140 00 - 274° 388NM 087° - N55 05 W150 00 - 273° 312NM 089° - PDN (Port Heiden NDB) - 258° 379NM 074° - SPY (St. Paul Island NDB/DME) - 250 ° 308NM 069° - ORDON (N56 12.8 W179 23.3) - R580

OTR-16 serves traffic departing the United States and transiting the North Pole for the NOPAC route system. OTR-16 routing is:
N48 00 W150 00 - 273° 416NM 088° - N50 15 W160 00 - 265° 385NM 081° - N51 10 W170 00 - 270° 250NM 089° - NUD (Adak) - J115 - SYA (Shemya) - 255° 296NM - 073° - OMPPA (N51 26.3 E166 20.2) - R580

2. GENERAL PROCEDURES.

a. ***Climb Times.*** All aircraft entering the Anchorage FIR and planning a higher altitude en route should forward the time that the climb to higher altitude is desired. This information should be included with the first mandatory position report. Although most carriers include climb times in their flight plans, actual loads, weather conditions, outside air temperature, and other factors are almost always different from the forecast situation. Pilots should notify air traffic control (ATC) if the climb time differs significantly. Climb times are used by controllers to determine action that may be necessary to preclude merging air traffic conditions. Advance planning usually means better airspace use, more altitude change approvals, and better service to more users. Without accurate climb times, an altitude change for one aircraft may cause other flights to be trapped at low FL's. Traffic permitting, cruise climbs to higher en route altitudes will be approved when requested.

b. ***Visual Flight Rules (VFR) Climbs.*** Requests for VFR climbs can only be approved when the aircraft is within the confines of Control 1234/Anchorage Continental FIR or Woody Island Control Area (formerly known as Control 1235).

c. ***Peak Traffic Constraints.*** Eastbound peak traffic periods are 1000 UTC to 1800 UTC. Westbound peak traffic period is 0000 UTC to 0700 UTC. Due to traffic volume, flights desiring to operate opposite the peak traffic flow can expect to be rerouted or restricted to a low altitude. If feasible, users planning to operate in the NOPAC composite area at airspeeds below mach 0.78 should use other than the peak hours for their flights. This avoids congestion and expedites traffic.

3. FLIGHT PLANS AND PREFERRED ROUTES.

a. ***Flight Plans.*** Flightcrews operating in the composite route system are expected to carry a flight plan for each of the composite routes for the direction to be flown, plus a plan for Route A590 since that route is used for eastbound or westbound traffic at different times. This prevents unnecessary delays, since pilots may be assigned routes other than those filed in the flight plan. Flight plans should be filed according to International Civil Aviation Organization (ICAO) procedures and format. This permits automatic flight data processing at oceanic control centers and oceanic radio stations en route. Flights originating outside of Anchorage or Tokyo regions that enter oceanic airspace without intermediate stops should submit flight plans as early as possible. In addition to the normal requirements of addressing the flight plan to all oceanic control centers en route, associated oceanic radio stations should be addressed. This provides those stations with information such as flight identification, selective calling (selcal), aircraft registration, destination, and estimated time of arrival (ETA). This information is necessary to control traffic. A properly addressed flight plan that is formatted according to ICAO standards is automatically handled by oceanic centers. When planning a flight via composite routes, list the point of entry followed by the route designator and the point of exit.

b. ***Preferred Routes.*** Prior to 1300 UTC daily, users may inform Anchorage Air Route Traffic Control Center (ARTCC) by teletype of their proposed routes. Preferred ATS routes are announced daily for aircraft entering the Anchorage FIR en route to the composite route system between 2200 UTC and 0500 UTC daily. Between 1300 UTC and 1330 UTC, Anchorage ARTCC issues an international Notice to Airmen (NOTAM) that specifies the transition route that must be filed for flights planned for R220, R580, and A590.

NOTAM example: "West coast operators...the following routes are in use today between 2200 UTC and 0500 UTC for westbound aircraft entering the Anchorage FIR and transitioning to the NOPAC: for R220, B327 over MARLO; for R580, G469 over NESSY; for A590, A342 over BLOWS."

Aircraft entering the composite route system between 0400 UTC and 2000 UTC daily must file via R220. Aircraft departing Anchorage for the NOPAC route system between 2200 UTC and 0300 UTC may anticipate a restriction of 10 minutes between successive departures. Due to a route crossing in a nonradar environment, westbound arrivals destined for RJCC, RJCH, RJSM and other westbound aircraft leaving the NOPAC system by way of V51 must file via R220. R580 is an eastbound track for aircraft entering the Anchorage FIR between 1000 UTC and 1700 UTC daily.

The preferred route to Alaska, Europe, midwestern United States, and U.S. east coast airports is by way of R580 - OZZIE - flight planned route.

To Alaska, Canada, U.S. west coast, midwest United States, and U.S. east coast airports:

- A590 - SPY - G469 - NESSY - flight planned route
- A590 - EMH - B327 - MARLO - flight planned route
- A590 - EHM - J996R - ANC - flight planned route

To Canada, U.S. west coast, and southwestern United States airports:

- R591 - ARGOS - G215 - DUVAL - flight planned route
- R591 - ASHER - A342 - BLOWS - flight planned route

To U.S. west coast and southwestern airports: G344-CHIPT-R451-SAVRY-flight planned route.

4. COMMUNICATIONS AND POSITION REPORTING.

a. ***High Frequency (HF) Communications.*** Most NOPAC area communications are conducted on HF single sideband. Pilots communicate with control centers through oceanic radio stations. Aircraft reports, messages and requests are relayed by the station to the appropriate ATC center by interphone, computer, or teletype. The relay function, coupled with the need for intercenter coordination, may cause delays in handling routine requests. Priority message handling procedures for urgent communications reduce time lag; however, flightcrews should consider the possibility of delays when requesting step climbs, reroutes, or other routine requests requiring action by ATC. Delays can be reduced by advance planning. Aircraft entering a FIR should establish communication with the appropriate oceanic radio station. The station will advise the aircraft of the primary and secondary HF channels in use. If possible, the aircraft should monitor both channels. If only one frequency can be monitored, the primary should be guarded and the secondary should be the first frequency checked if communication is lost on the primary. If the selcal unit is working when initial contact is made, the aircraft may maintain a selcal watch on the appropriate frequencies. If the selcal unit is inoperative or the radio station's selcal transmitter is malfunctioning, the aircraft shall maintain a listening watch on the appropriate NOPAC frequency. The NOPAC HF net operates on the following assigned frequencies: 2932 kilohertz (KHz), 5628 KHz, 6655 KHz, 8951 KHz, 10048 KHz, 11330 KHz, 13273 KHz, and 17904 KHz.

b. ***Guard Station.*** The oceanic radio station guarding for flight operations is normally the station associated with the ATC center responsible for the FIR. At the FIR boundary, the responsibility for the guard normally changes to the station associated with the new FIR. The flight must ensure that it establishes communication with each successive guard facility. Each oceanic radio station normally listens continuously on all assigned frequencies. If en route HF communications fail, every effort should be made by the flightcrew to relay progress reports through other aircraft. The VHF frequency 128.95 megahertz (MHz) is for exclusive use as an air-to-air communication channel. In emergencies, however, initial contact for such relays may be established on 121.5 MHz. In normal HF propagation conditions, appropriate overdue action procedures are taken by ATC in the absence of position reports or relays. In all cases of communication failure, the pilot should follow the oceanic clearance last received and acknowledged.

c. ***Air-to-Ground Very High Frequency (VHF) Communication.*** Oceanic radio stations normally have VHF capability within 200 NM of their geographic location. The frequency is listed in the appropriate publications. This frequency may be used prior to departure from the adjacent international airport to establish communication with the radio station, or for aircraft operating within range to relay progress reports or other messages to their company's operations. All international flights departing from Anchorage or Fairbanks should relay their departure time to the FAA Flight Service Station (FSS) on VHF for use in transmitting departure messages.

d. ***Air-to-Air VHF Communication.*** Frequency 128.95 MHz has been designated for use in air-to-air communications between aircraft operating in the Pacific area out of range of VHF ground stations to exchange operational information and facilitate resolution of operational problems.

e. ***Time and Position Reports.*** When operating on a fixed route with designated reporting points, aircraft should report over such points. Unless otherwise required by ATC, position reports for flights on routes not defined by designated reporting points should be made at the significant points listed in the flight plan. By requiring aircraft to report at intermediate points, ATC is guided by the requirement for positional information at ICAO established intervals and by the need to accommodate varying types of aircraft, traffic load, and weather conditions. When reporting to oceanic radio stations, the prefix "position" should be used on initial contact or prior to the text of the message. Keep in mind that the operator is typing the report into a teletype or computer terminal; it is imperative that the person transmitting the report speak slowly and distinctly so that the message can be correctly copied on the first attempt. To minimize radio frequency congestion, routine weather information and fuel remaining information should not be included in position reports made directly to Anchorage ARTCC. Position reports must include information on the present position, estimated next position, and ensuing position(s) in the sequence indicated below:

(1) Present position

(a) The word "position"

(b) Aircraft identification

(c) Reporting point name or, if not named:

(i) for east-west flights, latitude in degrees and minutes, and longitude in degrees only (in Tokyo FIR, degrees and minutes)

(ii) for north-south flights, latitude in degrees only (in Tokyo FIR, degrees and minutes) and longitude in degrees only (in Tokyo FIR, degrees and minutes)

(d) time over reporting point in four digits UTC

(e) altitude - FL at which the aircraft is currently operating, plus the assigned altitude if the aircraft is climbing or descending to an assigned altitude

(2) Estimated next position information shall include

(a) name of the next required position information point or, if not named, as in (1) above; and

(b) estimated time over next position. If the estimated time is in error by more than 5 minutes (3 minutes in Tokyo FIR), a revised estimate shall be forwarded to Tokyo or Anchorage FIR, as appropriate, as soon as possible.

(3) Ensuing position information shall include the name of the next successive reporting point, whether compulsory or not. If the point is not named, use the procedure in (1)(c) above.

f. ***Special Reporting Procedures.*** All aircraft operating on ATS routes R220, R580, R591, and G344 must cross-check their position over reporting points abeam Shemya VORTAC (109.0 MHz, DME-27, identification SYA). In addition to normal reporting procedures, pilots shall provide the cross-check in terms of the DME distance when crossing the specified radial. The radial/DME distances are as follows:

- for NEEVA on R220, SYA 328R/135 DME
- for ONADE on R580, SYA 328R/068 DME
- for AMMOE on R591, SYA 148R/050 DME
- for CHIPT on G344, SYA 148R/100 DME

A July 1985 memorandum of understanding between the United States, USSR, and Japan provides for direct voice communication between Anchorage ARTCC, Tokyo ACC, and Khabarovsk ACC to allow coordination between these facilities in assisting civil aircraft in certain emergency situations. These situations are mechanical problems requiring immediate landing, unlawful seizure of an aircraft, loss of communication, unidentified aircraft in USSR FIR, and possible entry of aircraft into USSR FIR. This communication link is checked daily at 0000 UTC.

g. ***Transponder Codes.*** When operating west of 164E, transponders should be set to Mode A Code 2000. When east of 164E, a discrete code may be assigned. This code should be maintained unless otherwise advised by ATC. If no discrete code is assigned, transponders should be set to Code 2000.

5. MACH NUMBER TECHNIQUE.

a. ***Background.*** The term "mach number technique" is used to describe the technique of clearing turbojet aircraft operating along the same route to maintain specified mach numbers in order to maintain adequate longitudinal separation between successive aircraft at, climbing to, or descending to the same altitude. The principal objective of the use of this technique is to improve use of the airspace on long routes where ATC has no means other than position reports to ensure the longitudinal separation of aircraft is not reduced below the established minimum. Experience has demonstrated that two or more turbojet aircraft on the same route and FL are more likely to maintain a constant time interval when this technique is used. This is because the aircraft are normally subject to the same wind and air temperature, and minor variations in speed tend to be neutralized over long periods of flight.

b. ***Application Procedures.*** Information on the planned mach number must be included in the flight plan for turbojet aircraft operating in oceanic airspace. For all flight plans, the true mach number must be included in Item 15 of the ICAO flight plan. The true airspeed (TAS) in knots equivalent to the planned mach number shall be specified in the remarks section of Item 18 on the same form, along with the abbreviation "TAS" and the four-figure group. When the mach number technique is applied, the normal requirement for ATC to calculate estimated times for the aircraft to pass significant points still applies. This is necessary to ensure longitudinal separation and coordination between ATC units. Intervention by ATC should not be necessary unless position reports indicate that longitudinal separation may be deteriorating to unacceptable levels. In applying this technique, it is imperative that pilots adhere strictly to their assigned cruise mach number at all times, including during climbs and descents, unless a specific reclearance is obtained from ATC. If an immediate temporary change in the mach number is essential before a revised clearance can be obtained, ATC must be notified as soon as possible that a change has been made.

6. IN-FLIGHT CONTINGENCIES.

a. ***General.*** Not all contingencies can be covered in this Advisory Circular (AC), but the following procedures provide for cases such as inability to maintain FL due to weather, aircraft performance, and pressurization failure. They are useful when rapid descent, turn back, or both are required. The pilot's judgment determines the sequence of actions taken.

b. ***Basic Procedures.*** If an aircraft experiences navigational difficulties, it is essential that the pilot inform ATC as soon as possible so that the appropriate action can be taken to prevent conflict with other aircraft. If an aircraft is unable to continue flight according to ATC clearance, a revised clearance shall be obtained whenever possible before any action is taken. If prior clearance cannot be obtained, ATC clearance shall be obtained at the earliest possible time. In the interim, the aircraft shall broadcast its position and intentions, including the ATS route designator, on 121.5 MHz at suitable intervals until ATC clearance is received. In such circumstances, communication may also be accomplished on VHF with certain stations, such as ADAK approach on 134.1 MHz; Shemya Tower on 126.2 MHz; Anchorage Center on 118.5 MHz (Cold Bay); on 124.4 MHz at Dutch Harbor; on 127.8 MHz at St. Paul Island; and on 128.2 MHz at Shemya.

If unable to comply with these procedures, the aircraft should leave its assigned route by turning 90 degrees to the right or left whenever possible. The direction of the turn should be determined by the position of the aircraft relative to the route system. Aircraft operating on ATS Route R220 under these circumstances should, if possible, avoid turning northward to leave the route because of the route's proximity to the boundary between Anchorage/Tokyo and the USSR FIR. An aircraft that is able to maintain its assigned level should climb or descend 500 feet while acquiring and maintaining, in either direction, a track laterally separated from its assigned route by 20 NM. For subsequent level flight, a level should be selected that differs by 500 feet from those normally used.

7. NAVIGATION PROCEDURES.

a. ***Master Documents.*** Navigational procedures must include the establishment of some form of a master working document for use on the flight deck. This document may be based upon the flight plan, navigation log, or other suitable document that sequentially lists the waypoints that define the routes, distances between the waypoints, and any other navigation information pertinent to the cleared route. This document is known as the master document. Misuse of the master document can result in serious navigational errors. For this reason, strict procedures should be in place for use of the document. These procedures should include the following:

• Only one copy of the master document should be used in the cockpit. If more than one copy is provided, one copy may be altered to reflect reclearance and other amendments to the flight plan. The unaltered copy may be used to extract navigational information that results in an unintentional deviation.

• A waypoint numbering sequence should be established from the outset of the flight. This sequence should be entered on the master document and should also be used to store waypoints in the navigational computer.

• Appropriate symbology should be adopted to indicate the status of each waypoint listed on the master document. For example:

(a) the waypoint number is entered against the relevant waypoint coordinates to indicate that the waypoint has been entered in the navigation computer;

(b) the number is circled to signify that entry of the coordinates in the navigation computer has been doublechecked by another crewmember;

(c) the circled number is ticked to signify that the distance information has been doublechecked; and

(d) the circled number is crossed out to signify that the aircraft has passed the waypoint.

All navigational information contained in the master document must be verified against the best available primary data source. If an ATS route change is received or the ATC clearance is otherwise changed, the master document must be updated to reflect the change. Old waypoints should be clearly crossed out and the new information inserted. While ATC clearances are being obtained, headsets should be worn because loudspeaker distortion has been known to result in errors. Two qualified crewmembers should monitor such clearances: one should record the information, and the other should check the receipt and read back the information. All waypoint coordinates should be read back in detail unless approved local procedures make this unnecessary. In that case, each detail must be cross-checked with the master document.

b. ***Position Plotting.*** It is helpful for crews to use a plotting chart to provide themselves with a visual presentation of the intended route. Plotting the route may reveal errors or discrepancies in the navigational coordinates that can be corrected before they can cause a deviation from the ATC cleared route. As the flight progresses, plotting the position after passing each waypoint helps confirm that the flight is on course. If the position is laterally offset, the flight may be deviating unintentionally and should be investigated at once.

c. ***Relief Crewmembers.*** Flightcrews conducting very long-range operations may include a relief pilot. In such cases, it is necessary to ensure that the continuity of the operation is not interrupted, especially in regard to the handling and treatment of navigational information.

d. ***System Alignment.*** INS alignment must be completed and the equipment switched to "nav" mode prior to releasing the parking brake at the ramp. There are various ways of ensuring that there is adequate time for this operation, including the following methods:

- Have the first crewmember on the flight deck place the system in align mode as early as possible.

- At short transit stops, leave the equipment in "nav" mode provided that the system errors are not so large as to require INS realignment. The decision to realign may depend on the size of the error as well as the length and nature of the next leg.

- INS batteries usually have a limited life, and cannot be recharged onboard if allowed to run down. If the INS is left in "nav" mode during a transit stop, or if the INS has been switched on for alignment, it is imperative that an individual be responsible for monitoring ground power interruption. Some INS systems provide overheat protection in "stby" and "align," but not in other modes. During stops at tropical terminals, the mode selector should be put directly to "align" (not through "stby," which would cause realignment).

In the absence of abnormally high radio noise levels, Omega synchronization usually takes only a minute or so after being switched on. At certain ramp or gate positions, however, particularly those where metal structures interfere with Omega signals, synchronization may take longer or the inserted ramp coordinates may drift after insertion. Interference from ground vehicles may have a similar effect. Synchronization or dead reckoning (DR) warning lights usually indicate this situation. If the Omega equipment is serviceable, the problem usually disappears shortly after the equipment is switched to aircraft power or the aircraft is moved, but it is good practice to check the position ("pos") coordinates immediately before takeoff and make any necessary corrections.

e. ***Initial Insertion of Latitude and Longitude.*** Early in the course of the preflight check, the aircraft's position should be loaded into the INS and verified. This position must be checked against an authoritative reference source before insertion. Any latitude error in the initial position will introduce a systematic error that cannot be removed during flight by updating the resulting erroneous "pos" indications. Correct insertion of "pos" must be checked before the "align" mode is selected and the "pos" recorded in the flight log or master document. Subsequently, silent checks of "pos" should be made independently by both pilots during an early stage of the preflight check. In the case of some INS, insertion errors exceeding one degree of latitude will activate a malfunction light. However, very few systems provide similar protection against erroneous longitudinal insertion errors. Care should be taken at all times to ensure that previously inserted coordinates are correct.

f. ***Loading of Initial Waypoints.*** The entry of waypoint data into the navigation system must be a coordinated operation by two people working in sequence and independently. One should key in the data, and the other person should recall and confirm the data against source information. It is not sufficient for one crewmember to simply observe another crewmember entering the data. Waypoint #1 should be used for the ramp position of the aircraft. At least two additional waypoints should be loaded while the aircraft is on the ramp; all waypoints may be loaded at this time. However, it is more important to ensure that the second waypoint is inserted accurately than to attempt to load all waypoint data. The second waypoint should be associated with the first significant position along the route (approximately 100 NM from departure point). Positions associated with ATC standard instrument departures (SID's) should not normally be used for this purpose. During flight, at least two current waypoints beyond the sector being navigated should be maintained in the control display unit (CDU) until the destination ramp coordinates are loaded. The pilots should be responsible for loading, recalling, and checking the accuracy of the loaded waypoints. Each pilot should cross-check the other's work. In no case should this process engage the attention of both pilots simultaneously during flight. An acceptable procedure is for the pilots to independently load their own waypoints and then cross-check the waypoints. The pilot responsible for verification should work from the CDU display to the master document, lessening the risk of seeing what is expected rather than the actual information. After the initial waypoints have been loaded, the route between waypoints 1 and 2 and the auto track change should be selected.

g. ***Flight Plan Check.*** The purpose of the flight plan check is to ensure complete compatibility between the master document and the programming of the navigation system.

(1) "Dis/time" should be selected to verify the correct distance from the ramp position to waypoint 2. An appropriate allowance may have to be considered since the great circle distance shown on the CDU's may be less than the flight plan as a consequence of the additional mileage involved in ATC SID's. However, a significant disparity requires a recheck of "pos" and waypoint 2 coordinates.

(2) Select "remote" and track change 1-2. Check the accuracy of the indicated distance against that listed in the master document.

(3) Select "dsrtk" and check that the desired track indicated on the CDU is the same as that in the master document. This track check will reveal any errors in the latitude and longitude designators.

(4) Similar track and distance checks should be performed for subsequent pairs of waypoints and any discrepancies between the CDU information and the master document. These checks can be coordinated between the pilots against the master document.

(5) After checking each leg of the flight as described above, a note should be made on the master document using the appropriate symbols.

h. ***Leaving the Ramp.*** If the aircraft is moved before the "nav" mode is initiated, the INS must be realigned. The aircraft should be relocated so that it does not block the gate or otherwise interfere with traffic while the realignment takes place. After leaving the ramp, INS groundspeeds should be checked. A check of the malfunction codes should be made while the aircraft is stopped but after it has taxied at least part of the way to the takeoff position. Any significant groundspeed indication while stationary may indicate a faulty unit. This check does not normally apply in the case of Omega, because such equipment is usually inhibited from providing speed indicators until the aircraft is airborne. Omega position indicators should be checked before takeoff if there is a possibility of error induced by signal interference.

i. ***In-Flight.*** If the initial part of the flight is conducted along airways, the airways facilities should be used as the primary navigational aids and the aircraft navigation system should be monitored to ascertain which system is giving the most accurate performance.

j. ***Approaching the Ocean.*** Before entering oceanic airspace, the aircraft's position should be checked as accurately as possible by using external navigation aids (navaids) to ascertain the aircraft navigation system to be used. This may require distance measuring equipment (DME)/DME and/or DME/VHF omnidirectional radio range (VOR) checks to determine navigation system errors through displayed and actual positions. In the event of significant discrepancies (greater than 6 NM), updating the navigation system should be considered. Updating is normally not recommended when the discrepancy is less than 6 NM. The duration of the flight before the oceanic boundary and the accuracy of the external navigation system are factors that influence any decision to update the system. If the system is updated, the proper procedures should be followed with the aid of a prepared checklist. The navigation system that performs the most accurately should be selected for autocoupling. In view of the importance of following the correct track in oceanic airspace, some operators advise that the third pilot or equivalent crewmember should check the inserted waypoints using appropriate source information.

k. ***Oceanic Boundary Position Report.*** Just prior to the oceanic boundary and prior to any waypoint, the present position coordinates should be monitored, recorded, and verified. The coordinates for the next waypoint should be monitored and verified. When the CDU alert light comes on, the crew should note and record the present position on the master document. This information should be verified against the current clearance on the master document. The waypoint number on the master document should be annotated with the appropriate symbol to indicate that it has been verified. If the oceanic boundary position report is made over a VOR facility, the appropriate radial to the first oceanic waypoint should be selected as a further check that the navigation system is tracking according to the current clearance. If DME is available, a distance check can also be performed.

l. ***At an Oceanic Waypoint.*** Coordinates of the next two waypoints should be verified against the master document. When sending the ATC position report, the coordinates should be copied from the master document or the present position and the next two forward positions can be read from the CDU. As soon as the waypoint alert light goes on, the present position coordinates of each navigation system should be checked against the current clearance to ensure that the position report coincides with the actual position of the aircraft and the ATC clearance. Over the waypoint, the pilots should verify that the aircraft is headed in the right direction and takes up the heading appropriate to the leg to the next waypoint. The coordinates of the next waypoint should be verified against the master document. After the ATC position report is sent, the present position should be plotted to ensure that the tracking is correct. The crew should be particularly alert in maintaining selcal watch in the event of possible ATC followup to the position watch.

m. ***Routine Monitoring.*** There are a number of ways in which the autopilot may accidentally become disconnected from the command mode. Regular checks of correct engagement should be made. Although it is a common practice to display "dis/time," it is recommended that the navigation system coupled to the autopilot should display the present position coordinates throughout the flight. If the coordinates are plotted at roughly 20 minute intervals, they will confirm that the flight is on track according to the ATC clearance. Distance-to-go information should be available on the instrument panel, and the waypoint alert light provides a reminder of the proximity of the waypoint. If a position check and verification are being made at each waypoint and 10 minutes after each waypoint, additional plotting every 20 minutes may be counterproductive during routine flight. The navigation equipment not being used to steer the aircraft should display cross-track error (XTK) and track angle error (TKE). These indicators should be monitored, with XTK being displayed on the horizontal situation indicator (HSI) when feasible.

n. ***Use of Radar.*** Aircraft equipped with airborne weather radar capable of ground mapping should use the radar to observe any land masses as an aid to determining the accuracy of their navigation. Aircraft conducting NOPAC operations under U.S. civil certification are required to be equipped with functioning weather radar approved for day and night operation. The flightcrews must use the radar on a constant basis during flight to monitor navigation system accuracy.

o. ***Approaching Landfall.*** When the aircraft is approaching the first landfall navaid, it should acquire the appropriate inbound radial as soon as the flightcrew is confident that the navaid's information is accurate. The aircraft should be flown to track by means of radio navigation and fly over the facility, which becomes the primary navigational guidance after leaving the oceanic area.

p. ***Navigation System Accuracy Check.*** At the end of each flight, the accuracy of the navigational system should be determined to facilitate correction of performance. A check to determine the radial error at the ramp position may be performed as soon as the aircraft is parked. Radial errors in excess of 2 NM per hour are generally considered excessive. Records should be kept of navigation systems performance.

q. ***Monitoring During Distractions.*** Training and drills ensure that minor emergencies or interruptions of normal routine do not distract the crew to the extent that the navigation system is mishandled. If the autopilot is disconnected during flight, it must be reengaged carefully to ensure that the correct procedure is followed.

r. ***Avoiding Confusion Between Magnetic and True.*** To cover all navigation requirements, some air carriers produce flight plans that include both magnetic and true tracks. If crews are changing to a new system, there is a risk of confusion in selecting the correct values. Operators should devise drills to reduce this risk and ensure that the subject is covered during training. Crews that check or update their long-range navigation systems (LRNS's) by reference to VOR located in the Canadian Northern Control Area should remember that they are not aligned with reference to magnetic north.

s. ***Navigation in Areas of Magnetic Unreliability.*** In areas of compass unreliability, basic INS operations require no special procedures. However, many operators retain an independent heading reference in case of INS failure. There are a number of ways to accomplish this. For example, Omega requires heading input from an external source. Different manufactures offer their own solutions to special problems in magnetic unreliability. Such solutions should not involve the use of charts or manual measurement of direction.

t. ***Deliberate Deviations.*** Temporary deviations from track are sometimes necessary, but prior ATC clearance should be obtained. Such deviations can cause gross navigation errors (GNE's) if the autopilot is not re-engaged. Selection of the autopilot turbulence mode can disengage the autopilot from the navigation system. After using turbulence mode, the aircraft must be flown hack to the desired track before the autopilot is reengaged. The following steps are useful in preventing GNE's as a result of deviations around severe weather:

(1) The autopilot turn control knob is used to turn the aircraft in the desired direction

(2) The autopilot engage switch will automatically move from "command" to "manual." The altitude mode switch will either remain in "altitude hold," or if in the "altitude select" mode, will trip to "off."

(3) The steering CDU selector is set to XTK/TKE to provide a continuous display of cross-track data.

(4) If turbulence is encountered, the "turb" setting on the speed mode selector may be used. In this case, the altitude mode switch automatically positions to "off."

(5) Both radio INS switches remain in the INS position. This provides a visual display of the navigation situation on the HSI. Even if more than 8 NM off the track, the pegged needle on the HSI is a reminder of that fact and confirms whether the aircraft is tracking towards, away from, or parallel to the desired track.

(6) The turn control knob should be used to maneuver the aircraft as necessary.

(7) When clear of the severe weather, the aircraft should be steered back to the desired track, guided by the steering CDU to zero the XTK indication.

(8) When the aircraft returns to the desired track, the autopilot engage switch is set to "command" and the altitude mode switch to "altitude hold." The navigation mode selector should still be in the INS position.

(9) The captain and first officer, or the entire crew if possible, should monitor the diversion maneuver to ensure that the aircraft has returned to the desired track and the autopilot is properly reengaged for command INS operation.

(10) After return to route has been completed, check the assigned mach number and advise ATC.

u. ***ATC Reclearance.*** Experience suggests that when ATC issues a clearance involving rerouting and new waypoints, the risk of errors increases. The procedures used to copy the ATC clearance, load and check the waypoints, verify the flight plan information, and prepare a new plotting chart should be the same as the procedures for beginning a flight. One pilot should be designated to fly the aircraft while the other pilot reprograms the navigation systems and amends the cockpit documents. In the event that a reclearance involves a direct routing, data relevant to the original route should be retained in case the aircraft is required by ATC to return to its original course.

v. ***Detecting Failures.*** INS and Omega installations normally include comparator and/or warning devices, but the crew must still make frequent comparison checks. With three systems on board, identification of a defective system should be straightforward. During the acceleration phase of flight, Omega groundspeed indicators are likely to be less accurate than INS and should not be used in comparison checks. With only two systems on board, identifying system failures is more difficult before significant deviations occur. If a significant deviation occurs in oceanic airspace, nearby aircraft can be contacted on 128.9 MHz and information can be obtained to aid in identifying a system failure. A record of Omega and INS performance should be maintained and kept available for crews. The following are suggestions for recordkeeping:

(1) Before takeoff and while stationary, note the INS groundspeed and "pos" indicators. These may give an indication of system accuracy.

(2) The accuracy of each unit should be noted before reaching oceanic airspace, preferably while passing a convenient short-range facility. A further record should be made at the destination regarding terminal error after first canceling any in-flight updates that were made.

(3) Compass deviation checks (INS only) can be made to determine deviation values for the magnetic compass systems so that the accuracy of INS heading outputs can be checked in-flight.

w. ***Identifying Faulty Systems.***

(1) Check malfunction codes for indications of unservicability.

(2) Refer to records for indications of prior problems.

(3) Obtain a fix, possibly using the weather radar, to determine position and compare to information from the systems.

(4) Communicate with nearby aircraft on air-to-air VHF to compare information on spot wind, groundspeed, and drift. If no aircraft can be contacted, compare information from the prognostic chart to the system readout. This method should be a last resort, and preferably should be used with another method of verification.

(5) Use the heading method (INS only). Simultaneously read both INS and magnetic compass indicators. Obtain the mean to the nearest degree to get an acceptably accurate true heading value to compare to the INS readings and determine what reading is inaccurate.

x. *When Faulty Systems Cannot be Identified.* Situations may arise when distance or cross-track differences develop between two INS or Omega systems, but the crew cannot identify the faulty system. Most air carriers believe that the best procedure in this instance is to fly the aircraft halfway between the cross-track differences as long as uncertainty exists. ATC must be informed that the flight is experiencing navigation difficulties so that appropriate clearances may be obtained.

y. *What Constitutes a Failed System.* Crews must be able to determine when an INS or Omega system should be considered to have failed. INS failure may be indicated by the red warning light or self-diagnostic indications, or by an error over a known position exceeding the value agreed upon by the operator and the certifying authority. Generally, if there is a difference of greater than 15 NM between the two aircraft's navigation systems, it is advisable to split the difference to determine the aircraft's position. If the disparity exceeds 25 NM, one or more of the systems should be regarded as having failed and ATC should be notified. In the case of Omega, estimates of position error are easier to determine because it is likely the system using the greater number of ground stations will be the most reliable. Omega failure may be indicated by a red warning light or by built-in test equipment (BITE) indications.

z. *Loss of Navigation Capability.* There are two navigational requirements for NOPAC operations. One refers to the navigation performance that should be achieved; the second to the need to carry standby equipment with comparable performance characteristics. Some aircraft carry triplex equipment so that if one system fails the requirements are still met. The following guidance is for aircraft with two systems.

(1) If one system fails before takeoff, the pilot should consider delaying departure if repair is possible, or obtaining a clearance for below FL 280, if practical.

(2) If a system fails before an oceanic boundary is reached, the pilot should consider landing at a suitable airport before the boundary, returning to the departure airport, or obtaining a reclearance below FL 280.

(3) If a system fails while the aircraft is in oceanic airspace, the pilot should continue the flight according to the ATC clearance already obtained while keeping in mind that the reliability of the navigational information is significantly reduced. The pilot should assess the reliability of the remaining system and contact ATC with a proposed course of action. ATC clearance must be obtained before any deviation to the existing clearance.

(4) While continuing flight in oceanic airspace with a failed system, the pilot should monitor the following:

- the operation of the remaining system;
- check the main and standby compass reading against available information; and
- check the performance record for the remaining system. If there is doubt about the reliability of the remaining system, the pilot should attempt visual sighting of other aircraft contrails for a track indication, call the appropriate ATC facility to get information on the location of adjacent aircraft, and establish air-to-air communication with nearby aircraft on 128.95 MHz.

(5) If the remaining system fails or indicates degradation of performance, the pilot should notify ATC, obtain all possible information from other aircraft, keep visual watch for other aircraft, use all possible outside lights, and use any necessary contingency procedures.

CHAPTER 5. SOUTHERN PACIFIC OCEANIC OPERATIONS

1. CENTRAL EAST PACIFIC (CEPAC) COMPOSITE AIRSPACE. CEPAC composite airspace is an organized route system, at or above flight levels (FL) 290 between the west coast of the continental United States and Hawaii, within the Honolulu and Oakland Control Areas (CTA's) Flight Information Region (FIR's). The organized route system between Hawaii and Los Angeles or San Francisco is comprised of six air traffic service (ATS) routes from FL 290 to 410, as depicted in Figure 2-6, Appendix 2. The same rules used for the North Pacific (NOPAC) routes apply to these routes, including mach number technique and contingencies.

2. CENTRAL PACIFIC AREA (CENPAC). Oakland Oceanic CTA has designated the airspace south of G344 (southernmost NOPAC route) and north of Hawaii as the CENPAC area (Figure 2-6). Two air traffic routes have been constructed in this area: A227 and R339. These are standard ATS routes with no special separation requirements, and there are no special rules to file a flight plan or to fly on these routes. Just south of R339, a free flow boundary has been established. When operating north of this boundary, flight must be conducted on one of the five NOPAC routes (see Chapter 5) or on A227 or R339. Random traffic is only authorized south of the free flow boundary.

3. TOKYO-HONOLULU FLEXIBLE TRACK SYSTEM. A flexible track system (FTS) consisting of two flexible track routes (FTR's) is permanently established between Tokyo and Honolulu to achieve more efficient use of the airspace for traffic operating at FL 290 or above. The boundary of the Tokyo-Honolulu FTS is depicted in Figure 2-7, Appendix 2. The routes are effective daily between 1200 coordinated universal time (UTC) and 1700 UTC within the Tokyo fix, and between 1300 UTC and 1900 UTC within the Oakland fix. The routes are published daily in Class 1 Notices to Airmen (NOTAM's) and are designated "North FTS" and "South FTS." The FTS must be filed on the International Civil Aviation Organization (ICAO) flight plan by coordinates.

4. COMMUNICATIONS AND POSITION REPORTING.

a. ***Communications.*** Most CEPAC and CENPAC area communications are conducted on high frequency (HF), predominantly by single side band (SSB). Pilots communicate with control centers via oceanic radio stations. Aircraft reports, messages, and requests are relayed by the station to the appropriate air traffic control center (ATCC) by interphone, computer display, or teletype message. The relay function, coupled with the need for intercenter coordination, may cause delays in the handling of routine aircraft requests. There are priority message handling procedures for processing urgent messages that reduce any time lag; however, the crew should take possible delays into consideration when requesting step climbs, reroutes, or other routine requests requiring air traffic control (ATC) action. Delays can be reduced by advance planning of such requests.

b. ***Frequency monitoring.*** Aircraft should establish communications with the appropriate oceanic radio station upon entering a specific FIR. The station advises the aircraft of the primary and secondary HF frequencies in use. If possible, the flightcrew should monitor both of these frequencies. If only one frequency can be monitored, the primary should be guarded with the secondary being the first one checked in the event of lost communications on the primary frequency. If the selective calling (selcal) unit is working at the time of the initial contact, the crew should maintain a selcal watch on the appropriate frequencies. If the selcal unit is inoperative, or if the radio station has a malfunctioning selcal transmitter, the crew should maintain a listening watch. The oceanic station guarding for flight operations is normally the station associated with the ATC center responsible for the FIR (i.e., Honolulu Aeronautical Radio, Incorporated (ARINC) for the Anchorage FIR and Tokyo Radio for the Tokyo FIR). At the FIR boundary the responsibility for the guard is changed, under normal signal conditions, to the station associated with each new FIR. The flightcrew must ensure that it has established communications with the new guard facility. Normally, each oceanic radio station continuously listens on all assigned frequencies. If en route HF communications fail, every effort should be made by the flightcrew to relay progress reports through other aircraft. The very high frequency (VHF) frequency 128.95 megahertz (MHz) is for exclusive use as an air-to-air communications channel. In emergencies, however, initial contact for such relays may be established on 121.5 MHz (the frequency guarded by all aircraft operating in the oceanic airspace) and transferred as necessary to 128.95 MHz. In normal HF propagation conditions, appropriate overdue action procedures are taken by ATC in the absence of position reports or relays. In all cases of communications failure, the pilot should follow the oceanic clearance last received and not revert to the original flight plan.

5. MACH NUMBER TECHNIQUE. Mach number technique for the South Pacific is identical to that used in NOPAC (see previous Chapter).

6. IN-FLIGHT CONTINGENCIES.

a. ***General.*** The procedures for in-flight contingencies are often aircraft specific, and therefore cannot be covered in detail here for every aircraft. However, the procedures listed provide for such cases as inability to maintain assigned FL due to weather, aircraft performance, and pressurization failure. These procedures are primarily applicable when rapid descent, turning back, or both are necessary. The pilot's judgment determines the sequence of actions taken while considering the specific circumstances.

b. ***Basic Procedures.*** If an aircraft experiences navigational difficulties, it is essential that the pilot inform ATC as soon as the condition is apparent so that appropriate action can be taken to prevent conflicts with other aircraft. If any aircraft is unable to continue flight in accordance with its ATC clearance, a revised clearance shall, whenever possible, be obtained prior to initiating any action, using the radio telephone distress or urgent signals, as appropriate. If prior clearance cannot be obtained, an ATC clearance shall be obtained at the earliest possible time; in the meantime, the aircraft shall broadcast its position (including the ATS route designator) and intentions on 121.5 MHz at suitable intervals until ATC clearance is received. In such circumstances, communications with certain VHF stations may be practical. Frequencies should be verified before using. A list of these stations follows:

Adak approach - 134.1 MHz
Shemya tower - 126.2 MHz
Anchorage Center - 128.5 MHz (Cold Bay)
Anchorage Center - 127.4 MHz (Dutch Harbor)
Anchorage Center - 127.8 MHz (St. Paul Island)
Anchorage Center - 128.2 MHz (Shemya)

If unable to comply with these provisions, the aircraft should leave its assigned route by turning 90 degrees to the right or left whenever possible. The direction of the turn should be determined by the position of the aircraft within the route system. The turn should be made in a direction that will keep the aircraft within the system and prevent any possible chance of a conflict with other traffic. For instance, aircraft on NOPAC routes should always turn south due to the proximity of these routes to the Russian FIR's. Aircraft on the northern route of the CEPAC route structure should turn south; aircraft on the southern route of the CEPAC route structure should turn north. An aircraft able to maintain its assigned level should, nevertheless, climb or descend 500 feet while acquiring and maintaining, in either direction, a track laterally separated by 25 nautical miles (NM) from its assigned route or track.

CHAPTER 6. CARIBBEAN OPERATIONS EXCLUSIVE OF THE GULF OF MEXICO

1. GENERAL INFORMATION.

a. *International Flight Information Manual (IFIM).* The following information is provided to inform crews of problem areas that may be encountered when traveling in the Caribbean, Central America, and South America. The IFIM contains specific information on an individual country's requirements for the following:

- Personal entry requirements
- Embassy information
- Aircraft entry requirements
- Corporate aircraft restraints
- Special notices
- Aeronautical information sources
- International Notices to Airmen (NOTAM's) office
- Airports of entry

Detailed information regarding flights into Mexico is contained in the "Mexico Flight Manual," published by the Texas Aeronautic Commission, P.O. Box 12607, Capitol Station, Austin, Texas 78711.

b. *Disease Control.* Central and South American countries periodically experience epidemics of communicable diseases. Pilots and crews departing for destinations in the Caribbean, Central America, and South America should contact the U.S. Department of State in Washington, DC both well ahead of the proposed flight and just prior to the proposed flight. The initial contact should be made to determine if immunization is required and to determine the time period required for the immunizations to become effective. Some countries will actually isolate a crew and/or passengers if a particular immunization has not run the course of its incubation period. The final contact to the State Department is made to determine the latest health warnings in effect at the destination and/or possible intermediate stopping points. Under the International Health Regulations adopted by the World Health Organization, a country may require International Certificates of Vaccination against yellow fever and cholera from international travelers. No vaccinations are required to return to the United States from any country.

c. *Passports.* Those countries that do not require a passport to enter or depart frequently, require crews and passengers to have documentary evidence of U.S. citizenship and identity. A birth certificate, Certificate of Naturalization, or Certificate of Citizenship may suffice as evidence of citizenship, but a passport is the best form of identification. Refer to Chapter 2, Section 4 of this advisory circular (AC) for additional information on passports and entry requirements.

d. ***Altimeter Settings.*** Pilots and crews should be especially aware of the altimeter setting requirements of many of the Caribbean Islands. Various islands have different altimeter setting requirements. For example, Grand Turk requires en route flight level (QNE) at flight level (FL) 60 or above, and Punta Caucedo in the Dominican Republic requires QNE above FL 40. (See Chapter 2 of this AC for definitions of QNE, field elevation (QNH), and airport altitude (QFE).)

2. BAHAMAS.

a. ***Aircraft Entry Requirements.*** Private aircraft overflying or landing in the Bahamas for noncommercial purposes need not obtain prior permission. However, prior notification to the destination airport is required, and a flight plan must be on file. Permission must be obtained from the Ministry of Transport for overflight and landing clearances for nonscheduled commercial aircraft. In addition to having a flight plan on file, nonscheduled commercial aircraft landing for commercial purposes must obtain permission from the Secretary, Air Transport Licensing Authority, P.O. Box N975, Nassau, New Providence, Bahamas prior to departure.

b. ***Special Notices.***

(1) Flights made between sunset and sunrise must be conducted under instrument flight rules (IFR). With the exception of Freeport International and Nassau International Airports, no aircraft will be permitted to land or take off at any location in the Bahamas between sunset and sunrise without prior approval from the Director of Civil Aviation.

(2) New Providence - Nassau: Amphibious aircraft on international flights landing at the Nassau Marine Base must first land at Nassau International Airport for customs and immigration clearance.

(3) Before turning onto final approach and taxiing out for takeoff, it is recommended that pilots announce their identification, location, and intention on 122.8 megahertz (MHz) at uncontrolled airports. Arriving aircraft should fly over the airstrip at 1,000 feet above ground level (AGL) to observe other traffic and fly a left-hand pattern. Extreme caution should be exercised when flying an approach or taking off from any of the outer islands. These fields are uncontrolled, but the attractiveness of the Caribbean makes them very popular destinations for both commercial operators and pleasure pilots. A wide range in crew island-flying ability levels often exists, and aircraft using these uncontrolled fields have significant differences in performance capabilities.

3. CUBA.

a. ***Personal Entry Requirements.*** The accuracy and currency of the following information is uncertain because of the difficulty in obtaining information about this country. All aircraft arriving from or departing for Cuba must land at or depart from Miami International Airport. A passport and a visa are required.

b. ***Aircraft Entry Requirements.*** All private and nonscheduled commercial aircraft overflying or landing for commercial or noncommercial purposes must obtain prior approval from the Ministerio Del Transporte Area Aeronautica, Calle 23-No. 64 Vedado, Plaza de la Revolucion, Cuidad de La Habana 4, Cuba at least 48 hours prior to overflying, and at least 10 days prior if landing. All requests must include provisions for prepaid reply. All requests must include the following information:

- Name, nationality and address of the aircraft operator
- Aircraft type and registration marks
- Name of pilot-in-command (PIC)
- Place of origin and destination
- Air corridor and routes to be used under the flight plan
- Date of the flight
- Purpose of the flight
- Number of passengers and type and amount of cargo
- Statements of third party insurance liability coverage
- Radio frequencies available

All flights into Cuban airspace, including those in the established air corridors of Maya, Giron, and Nuevas, must be able to establish and maintain communications with Havana flight information region (FIR)/control area (CTA) 10 minutes prior to airspace entry. All flights must have a flight plan on file with Havana FIR/CTA at least 1 hour prior to airspace entry. In addition, any aircraft overflying or landing in Cuba must carry the following documents on board:

- Registration certificate
- Certificate of airworthiness
- Licenses (certificates) for all crewmembers
- Aircraft logbooks
- The onboard radio station licenses
- A list of passengers' names showing places of embarkation and destination
- A manifest and detailed declaration of all cargo carried

c. ***Special Notices.*** A NOTAM dated April 1, 1993 contained the following warning regarding Cuban airspace: "The Federal Aviation Administration has been informed that an official Cuban government publication has issued a warning that Cuban Armed Forces will shoot down any aircraft that penetrates Cuban airspace illegally and refuses to obey an order to land for inspection. All pilots should take note; use extreme caution in the area of Cuban airspace; adhere strictly to Cuban requirements for overflight of their territory." Any aircraft that flies over Cuban national territory or jurisdictional waters may be intercepted and required to land if any of the following occurs:

- Flying over national territory and jurisdictional waters without proper authorization
- Flying without proper authorization outside national routes or established international corridors
- Executing inappropriate maneuvers
- Not following the instructions from air traffic control (ATC)

d. ***Legal Considerations.*** Aircraft that have been ordered to land, or have landed without proper authorization, will be subject to whatever penalties the Cuban authorities may prescribe, **without recourse**. The pilot and/or aircraft owner will be held responsible for any damage, injuries, or resulting expense. No aircraft may make an overflight carrying photographic equipment, arms, ammunition, explosives, or other articles and substances the Cuban aeronautical authority may specify. Overflights shall not be authorized if the operation constitutes a danger to air navigation or if, in the judgment of the Cuban aeronautical authority, the operator does not offer adequate guaranties to cover any liability incurred because of the overflight. These liabilities include damage and loss caused to subjacent persons or property, and payment for any services rendered or obligations that may arise in connection with the overflight. The use of Cuban radio for flight information, ATC, or other purposes is considered a service, and operators should expect to be billed for its use. Any person or any corporation, partnership, organization, or association subject to U.S. jurisdiction and considering the operation of aircraft into Cuba must review current Department of Commerce and Department of State regulations relating to trade and other transactions involving Cuba. Within 1 hour before departure, the PIC must file an IFR flight plan and a written statement with the Immigration and Naturalization Service office at the departure airport. This statement must contain all of the information in the flight plan, the name of each occupant of the aircraft, the number of occupants in the aircraft (including the flightcrew), and a description of any cargo. The U.S. Naval airfield/facilities located at Guantanamo Bay, Cuba are closed to all civilian air traffic except for valid emergencies. All emergency landings will be thoroughly investigated by U.S. authorities to determine their validity and the nature of their business.

4. SOUTH FLORIDA DEPARTURES.

a. ***Special Airspace Considerations.*** South Florida has a complex airspace environment. Airport radar service areas (ARSA's) exist at Sarasota, Fort Meyers, Fort Lauderdale, and West Palm Beach. There are terminal control areas (TCA's) at Tampa, Orlando, and Miami with their associated 30 nautical miles (NM) Mode C veils. All pilots should be aware of these areas and be familiar with all associated regulations pertaining to equipment and communication requirements. The new airspace classification went into effect in September 1993. Therefore, it is imperative that pilots have current charts in the cockpit and that the flightcrew has a comprehensive knowledge of the new classifications.

b. ***National Parks, Wildlife Refuges, and Bird Activity.*** South Florida has a number of national parks and wildlife refuges. These areas are home to large numbers of animals and birds, some of which are very sensitive to aircraft noise. Everglades National Park in particular is very aggressive about reporting low-flying aircraft to the FAA. Because of the large expanses of seacoast and the presence of large numbers of migratory birds during certain seasons, the possibility of bird strikes is a very real hazard in south Florida. Pilots should exercise added vigilance at low altitudes and be especially aware of the guidance in the Airman's Information Manual (AIM), Chapter 7, Section 4, entitled "Bird Hazards and Flights Over National Refuges, Parks and Forests."

c. ***Special Use Airspace and Military Activity.*** The Miami Aviation International Flight Service Station (AIFSS) keeps information on file concerning the status of special use airspace and military training routes in the airspace within 100 NM of their flight plan area. This airspace covers an area south of the Tampa, Orlando, and Melbourne areas. Information on special use airspace is not distributed by a NOTAM, and military training routes are included in pilot briefings only at the pilot's request. For information on activity more than 100 NM from Miami's flight plan area, contact the appropriate facility while en route.

d. ***Key West Naval Air Station.*** There is a high volume of military, high-speed jet aircraft operating in the Key West International and Navy Key West Airports. It is recommended that all civil air traffic proceeding to the Key West area from the direction of Marathon, Florida contact Navy Key West Tower on frequency 126.2 MHz when approximately 10 miles east of the Navy Key West Airport (at approximately Sugar Loaf Key - N24 39 W081 35) for traffic information and/or clearance through or around the Navy Key West Airport traffic area. Radar service is available through Navy Key West approach control on frequency 119.25 MHz. Visual flight rules (VFR) flights departing Key West International Airport should advise the tower of the direction of their flight.

e. ***Restricted Area R-2916.*** Of special safety interest in the Lower Keys, Restricted Area 2916 is an area of 4 statute miles in diameter, protected up to 14,000 feet mean sea level (MSL). This area contains a tethered aerostat balloon flown at various altitudes and times. All VFR pilots flying south to or across the Lower Keys should treat the restricted area as being active at all times and avoid the area. R-2916 is located 17.5 NM northeast of the Key West very high frequency (VHF) omnidirectional radio range (VOR) (113.5 EYW) on the 066 degree radial. Authorization to enter this area is granted by Miami Air Route Traffic Control Center (ARTCC) on 132.2 MHz.

CHAPTER 7. GULF OF MEXICO OPERATIONS

1. CHARACTERISTICS OF THE AIRSPACE.

a. *General.* The airspace above and surrounding the Gulf of Mexico is complex, and includes heavy concentrations of military operations at all altitudes, high altitude air carrier operations, and low altitude helicopter activity. There are numerous alert, warning, noise-sensitive, and restricted areas; control zones; heavy concentrations of student pilot activity; and areas of communication and navigation unreliability. As the volume of air traffic in this area has increased, it has become more common for flights to deviate from track, fail to make position reports, or report an incorrect position. Separation of air traffic is a matter of increasing concern in this airspace because of this increased activity. Any operation that is conducted in international airspace on an instrument flight rules (IFR) flight plan, a visual flight rules (VFR) controlled flight plan, or at night and that continues beyond the published range of normal airways navigation facilities (nondirectional radio beacon (NDB), very high frequency (VHF) omnidirectional radio range (VOR)/distance measuring equipment (DME)) is considered to be a long-range navigation operation. Long-range navigation in a control area (CTA) requires that the aircraft be navigated to the degree of accuracy required for the control of air traffic; that is, the aircraft should remain within one-half of the lateral separation standard from the centerline of the assigned track. The aircraft should also remain within the established longitudinal and vertical separation standards for the area of operation. These separation standards can be found in the International Civil Aviation Organization (ICAO) Regional Supplementary Procedures Document 7030/2. For flights conducted within international airspace under U.S. jurisdiction, Federal Aviation Administration (FAA) Order 7110.83, "Oceanic Air Traffic Control Handbook" provides a simplified version of these separation standards. Federal Aviation Regulations (FAR) § 91.703(a) requires that civil aircraft must comply with ICAO Annex 2 when operating over the high seas. Annex 2 requires that "aircraft shall be equipped with suitable instruments and with navigation equipment appropriate to the route being flown." In addition, Annex 6, Part II stipulates that an airplane operated in international airspace be provided with navigation equipment that will enable it to proceed in accordance with the flight plan and the requirements of the air traffic services. Annex 2 further requires that an aircraft shall adhere to the "current flight plan unless a request for change has been made and clearance received from the appropriate air traffic control (ATC) facility."

b. *Control of Air Traffic.* ATC of the airspace over the Gulf of Mexico is assigned to the Houston Air Route Traffic Control Center (ARTCC). This center controls airspace within and outside of the U.S. Air Defense Identification Zone (ADIZ). The Houston CTA/Flight Information Region (FIR) includes the airspace in the northern part of the Gulf of Mexico. This control extends southward from Houston Center's coastal CTA to the middle of the Gulf in the vicinity of longitude N24 30. The Houston CTA/FIR borders Houston's coastal control in the west and north, and meets Miami's oceanic CTA/FIR at latitude W86 in the east. The southern border of the Houston CTA/FIR is under the control of several Mexican FIR/upper control areas (UTA's) and is controlled by Havana CTA in the southeast. Flight operations in this area must be conducted in accordance with the applicable FAR and ICAO Annex 2, "Rules of the Air." The navigation and communication equipment required for operations over the high seas must be installed and fully operational for flight in this airspace.

c. *Flight Plans.* Unless otherwise authorized by ATC, no aircraft may be operated in oceanic airspace unless a flight plan has been filed. VFR operations in oceanic airspace are permitted only between sunrise and sunset at or below flight level (FL) 180. Although VFR flights are permitted in offshore airspace (the airspace between the U.S. 12-mile limit and the oceanic control area (OCA)/FIR boundary), instrument meteorological conditions (IMC) are commonly encountered. It is recommended that pilots hold an instrument rating, the aircraft be equipped for IFR flight, and that an IFR flight plan be filed.

d. ***Alert Areas.*** Alert areas are areas wherein a large volume of pilot training flights or unusual aeronautical activity is contained. All activity within alert areas must be conducted according to the FAR, without waiver, and no activity that may be hazardous to other aircraft may be conducted. All aircraft within an alert area, both participating and nonparticipating, are equally responsible for collision avoidance.

e. ***Controlled Firing Areas.*** Controlled firing areas contain activities such as the firing of missiles and rockets, ordnance disposal, and static testing of large rocket motors. The users of these areas are responsible for immediate suspension of activities in the event that the activity might endanger nonparticipating aircraft. The controlled firing area locations in the Gulf of Mexico are published in Notices to Airmen (NOTAM's).

f. ***Key West International Airport.*** FAR Part 121 operations that land or depart from Key West International Airport must meet the special airport requirements of FAR § 121.445.

g. ***Noise-Sensitive Areas.*** Noise-sensitive areas include outdoor assemblies of persons, churches, hospitals, schools, nursing homes, designated residential areas, and national park areas. As national park areas, wildlife refuges are considered noise-sensitive areas. Numerous wildlife refuges are located along the U.S. coastline surrounding the Gulf of Mexico, and many of these refuges have large bird populations. The heaviest concentrations of these refuges are along the Texas and Florida coasts. VFR flights over noise-sensitive areas should be no lower than 2,000 feet above the surface, weather permitting, even if flight at a lower altitude is otherwise permitted under FAR § 91.119. The surface is defined as the highest terrain within 2,000 feet laterally of the route of flight, or the uppermost rim of a canyon or valley.

h. ***Warning Areas.*** Warning areas are established in international airspace and contain operations hazardous to nonparticipating aircraft. IFR clearances through this airspace can be issued when hazardous operations are not taking place. Because there is no provision in international agreements for prohibiting flights in international airspace, there is no restriction on flights in these areas. However, pilots should take note of the location of all warning areas along a planned route.

i. ***Restricted Areas.*** Restricted areas are designated under FAR Part 73 to contain activities considered hazardous to nonparticipating aircraft. Aircraft may not operate within 3 nautical miles (NM) of a restricted area unless authorized under the provisions of FAR § 73.13. There are numerous restricted areas near and along the Gulf of Mexico coastline. Pilots should be aware of these areas and plan flights accordingly.

2. NAVIGATION AND COMMUNICATIONS IN THE GULF OF MEXICO.

a. ***Background.*** ICAO Annex 6, Part II contains standards and recommended practices adopted as the minimum standards for all airplanes engaged in general aviation international air navigation. It requires those aircraft operated in accordance with IFR, at night, or on a VFR controlled flights (such as in CTA/FIR oceanic airspace) to have installed and approved radio communications equipment capable of conducting two-way communication at any time with the appropriate aeronautical stations on the prescribed frequencies.

b. ***High Frequency (HF) and VHF Communications.*** Due to the inherent "line of sight" limitations of VHF radio equipment used for international oceanic airspace communications, aircraft operating on an IFR or controlled VFR flight plan beyond VHF communications capability are required to maintain a continuous listening watch and communications capability on the assigned HF frequencies. Although these frequencies will be assigned by ATC, actual communication will be with general purpose communication facilities such as an international flight service station (FSS) or Aeronautical Radio Inc. (ARINC). These facilities will be responsible for the relay of position reports and other information between the aircraft and ATC. Except in an emergency, the use of relay on VHF through aircraft operating at higher altitudes is not an acceptable method of communication with ATC.

c. ***Communication and Position Reporting.*** The following describes an area in the Houston CTA/FIR where direct air traffic communication is not available:

N27 28 W086 00 to N27 30 W087 42 to
N25 50 W088 15 to N25 37 W091 55 to
N24 40 W093 19 to N24 28 W088 01 to
N24 00 W086 00 to beginning point.

Pilots planning flights through this area should be aware of the communications and position reporting requirements. HF communications are available for all oceanic flights, and limited VHF coverage is also available on 130.7 megahertz (MHz). The communication requirements for IFR flights within the Houston OCA are as follows:

(1) The aircraft must have functioning two-way radio communications equipment capable of communicating with at least one ground station from any point on the route.

(2) The crew must maintain a continuous listening watch on the appropriate frequency.

(3) All mandatory position reports must be made.

d. ***Position Reports.*** When flying an oceanic route in the Gulf of Mexico, position reports must be made over all designated reporting points. A position report must also be made upon crossing the FIR boundary. Unless otherwise required, reporting points should be located at intervals of 5 or 10 degrees latitude (if flying north/south) or longitude (if flying east/west) either north or south of the equator or east or west of the 180 degree meridian. Aircraft transversing 10 degrees of latitude or longitude in 1 hour, 20 minutes should normally report at 10 degree intervals. Slower aircraft should report at 5 degree intervals. In the absence of designated reporting points, position reports shall be made as instructed by ATC. Position reports are vital to air traffic safety and control. Inability to comply is a violation of the FAR and ICAO requirements.

e. ***Navigation Requirements.*** Class II navigation on routes in the Gulf of Mexico can be conducted using VOR/DME and NDB supplemented by dead reckoning (DR). These routes are located off-shore and are shown on en route charts. The areas are established by FAA

Order 7110.2C, "Procedures for Handling Airspace Matters," and serve aircraft operations between U.S. territorial limits, OCA/FIR boundaries, and/or domestic flights operating in part over the high seas. These transition CTA's permit ATC to apply domestic procedures and separation minimums. Because independent radar surveillance is maintained within these CTA's, separation minimums are not as large as for other OCA's. As long as radar surveillance is maintained, operations may be conducted on Gulf routes using VOR/DME and NDB supplemented by DR. The radar surveillance provides an equivalent level of safety even though DR may be required for extended periods. Because of the proximity of these routes to shore-based facilities, the accuracy of DR can be enhanced by the use of shore-based navigational aids (navaids). The DR techniques and procedures must be approved as part of the air carrier operator's training program, and should include contingency training for weather avoidance and emergencies. Approval for use of a single long-range navigation system on these routes, as well as the navigation techniques discussed in this paragraph, are part of the operations specifications issued to air carrier operators.

f. ***Use of NDB for Navigation.*** The use of NDB as a primary source of navigation on long-range flights presents the operator with numerous limitations and restrictions inherent in low frequency radio equipment and the low frequency signals they receive. NDB navaids of the highest power (2,000 watts or greater) that are maintained and flight checked as suitable for navigation, are limited to a usable service and/or reception range of 75 NM from the facility at any altitude. Although the operator may be able to receive standard AM broadcast stations with NDB equipment, primary dependence on these facilities for navigation is a questionable operating practice. The following are some of the inherent problems associated with reception of these stations:

(1) Infrequent station identification

(2) Foreign language station identification may be impossible without knowledge of the language

(3) Transmitter sites are not always located with the studio facilities

(4) Termination of service without notice

(5) Weather or atmospheric disturbances may cause erratic and unreliable signal reception

(6) Flight checks may not have been conducted to verify the suitability and reliability of the facility and signal for navigation

(7) The "shoreline/mountain" effect may cause signal fluctuations

(8) Standard broadcast stations are not dedicated for navigation purposes

Considering these limitations, the operator should be able to navigate so as to maintain the course specified in the ATC clearance. The inadequacies of NDB as the sole source of navigation must be carefully evaluated, as an error of 10 degrees over 2,000 miles can result in a deviation of 350 miles.

3. INTERNATIONAL OPERATIONS.

a. ***Operations to Mexico.*** Pilots should be aware of the landing restrictions in effect at Mexico City Airport. A fee of 3.77 million pesos (approximately $ 1,240) will be imposed on aircraft that land or depart from this airport during peak hours (7:00 am - 10:00 am; 5:00 - 9:00 pm). If an aircraft lands during peak hours but departs during nonpeak hours, 75 percent of the fee will be imposed. Operators planning a flight to Mexico should check the NOTAM's for updated information. FAR Part 121 operations to Guadalajara, Mexico must meet FAR § 121.445 special airport qualification requirements.

b. ***Operations to Cuba.*** FAR § 121.445 requirements for special airport qualifications apply to FAR Part 121 operations landing or departing from Guantanamo Bay Naval Air Station. Operators should be aware that the Cuban government has issued a warning that Cuban Armed Forces will shoot down any aircraft that penetrates Cuban airspace without authorization and refuses to land for inspection.

4. MILITARY AND HELICOPTER OPERATIONS.

a. ***Military Operations Areas (MOA's).*** Military operations represent approximately one third of the air traffic in the Gulf of Mexico. These operations include a high volume of nonhazardous training flights, which are contained within MOA's. MOA's and military training routes (MTR's) are shown on VFR and sectional maps. However, MTR's are subject to change every 56 days. Because the charts are only issued every 6 months, pilots are strongly advised to contact the nearest FSS for current route dimensions and status.

b. ***Helicopter Operations.*** Pilots should be aware of the nature and extent of helicopter operations within the Gulf of Mexico. The density of helicopter traffic is primarily due to the presence of numerous oil rigs and drilling platforms in the Gulf. The majority of these flights are below 2,000 feet mean sea level (MSL) at varying distances from the coastline. Additional information on helicopter operations is contained in Chapter 9 of this advisory circular (AC).

CHAPTER 8. LONG-RANGE NAVIGATION

1. GENERAL NAVIGATION CONCEPTS, FAA POLICIES AND GUIDANCE.

a. ***General Concepts.*** In the early days of aviation, few aircraft operated within any given area at the same time. The most demanding navigational requirements were to avoid obstacles and arrive at the intended destination with enough fuel remaining to safely complete a landing. As aviation evolved, the volume of air traffic grew and a corresponding need to prevent collisions increased. Today, the most significant and demanding navigational requirement in aviation is the need to safely separate aircraft. There are several factors that must be understood concerning the separation of aircraft by air traffic control (ATC).

b. ***Separation of Air Traffic.*** In many situations, ATC does not have an independent means such as radar to separate air traffic, and must depend entirely on information relayed from an aircraft to determine its actual geographic position and altitude. A flightcrew's precision in navigating the aircraft is critical to ATC's ability to provide safe separation. Even when ATC has an independent means such as radar to verify the aircraft's position, precise navigation and position reports, when required, are still the primary means of providing safe separation. In most situations, ATC does not have the capability or the responsibility for navigating the aircraft. ATC relies on precise navigation by the flightcrew. Therefore, flight safety in all instrument flight rules (IFR) operations depends directly on the operator's ability to achieve and maintain certain levels of navigational performance. ATC radar is used to monitor navigational performance, detect navigational errors, and expedite traffic flow. Any aircraft operating in accordance with ATC instructions must navigate to the level of accuracy required to comply with ATC instructions. Aircraft must be navigated with sufficient precision to avoid airspace where prior ATC clearance or ATC instructions must be obtained. For example, an aircraft flying adjacent to minimum navigation performance specifications (MNPS) airspace must fly with a degree of precision that ensures that aircraft will not inadvertently enter MNPS airspace.

c. ***VFR Flight.*** The control of air traffic requires that a certain level of navigational performance be achieved by visual flight rules (VFR) flights to ensure safe separation of aircraft and to expedite the flow of air traffic. During cruising flight, the appropriate VFR flight altitude must be maintained to ensure the required vertical separation between VFR and IFR aircraft and to assist in collision prevention. VFR aircraft must be navigated with sufficient precision to avoid weather conditions that would prevent visual contact with (and avoidance of) other aircraft, and with sufficient precision to locate a suitable airport and land safely. VFR aircraft that require navigational assistance from ATC adversely affect ATC's ability to control air traffic and expedite its flow.

d. ***The Concept of an ATC Clearance.*** Issuance of an ATC clearance by a controller, and the acceptance of this clearance by a pilot, is a negotiation process that establishes conditions for the prevention of collision hazards (in-flight and terrain). When a controller issues an IFR clearance, a three-dimensional block of airspace is reserved for that aircraft along the defined route. The controller also agrees to issue clearances to all other controlled air traffic to ensure that all assigned flight routes will be safely separated. When a pilot accepts an ATC IFR clearance, that pilot is agreeing to continuously remain within the assigned three-dimensional block of airspace and adhere to the flight rules for that operation. The pilot is obligated to comply with this agreement unless an emergency is declared or an amended clearance is received. Any deviation outside the assigned airspace creates a flight safety hazard. In such cases, the aircraft has failed to navigate to the degree of accuracy required for air traffic control and has failed to comply with Federal Aviation Regulations (FAR) and International Civil Aviation Organization (ICAO) requirements. In a nonradar environment, ATC has no independent knowledge of the aircraft's actual position or its relationship to other aircraft. Therefore, ATC's ability to detect a navigational error and resolve collision hazards is seriously degraded when a deviation from an agreed upon clearance occurs.

e. ***Concept of Navigation Performance.*** The concept of navigation performance involves the precision that must be maintained for both the assigned route and altitude by an aircraft operating within a particular area. Navigation performance is measured by the deviation (for any cause) from the exact centerline of the route and altitude specified in the ATC clearance. This includes errors due to degraded accuracy and reliability of the airborne and ground-based navigational equipment and the flightcrew's competence in using the equipment. Flightcrew competence involves both flight technical errors and navigational errors. Flight technical error is defined as the accuracy with which the pilot controls the aircraft as measured by success in causing the indicated aircraft position to match the desired position. Standards of navigational performance vary depending on traffic density and the complexity of the routes flown. Variation in traffic density is reflected in the different separation minimums applied by ATC in these two areas. For example, the minimum lateral distance permitted between coaltitude aircraft in Chicago Center's airspace is 8 nautical miles (NM) (3 NM when radar is used), while in North Atlantic (NAT) MNPS airspace it is 60 NM. The airspace assigned by ATC has lateral dimensions on both sides of the exact centerline of the route of flight specified in the ATC clearance equal to one-half of the lateral separation standard (minimum). For example, the overall level of lateral navigation performance necessary for flight safety must be within 4 NM of the airway centerline in Chicago Center's airspace, and within 30 NM in NAT MNPS airspace. FAR §§ 121.103 and 121.121 require that each aircraft must be navigated to the degree of accuracy required for air traffic control. FAR § 91.123 requirements related to compliance with ATC clearances and instructions also reflect this fundamental concept. The concept of navigational performance is also inherent in the ICAO Standards and Recommended Practices (SARP's). For example, Annex 2 states that the aircraft "shall adhere to its current flight plan" and "when on an established air traffic service (ATS) route, operate along the defined centerline of that route."

f. ***Degree of Accuracy Required.*** The fundamental concept for all IFR navigation standards, practices, and procedures is that all IFR aircraft must be navigated to the degree of accuracy required for control of air traffic. When a flight remains within the assigned three-dimensional block of airspace at all times, that aircraft is considered to be navigated to the degree of accuracy required for the control of air traffic. If an aircraft deviates outside its assigned block of airspace (except during a declared emergency), that aircraft has not been navigated to the required degree of accuracy. ATC separation minimums represent the minimum dimensions of a three-dimensional block of airspace that can be assigned by ATC to control flight. These separation minimums have been established for IFR operations in controlled airspace. These standards are usually established through international agreement and implemented through national regulations. These minimums are established for particular categories of navigational operation and specified areas. Examples include navigation on airways in the national airspace of ICAO member states and long-range navigation in oceanic or remote land areas. Separation minimums establish the minimum lateral, vertical, and longitudinal distances that can be used to safely separate aircraft operating within a specified area. Separation minimums also represent the minimum level of overall navigation performance which can be accommodated at any time without jeopardizing flight safety. Any aircraft deviating greater than one-half the separation minimums established for that operation has failed to meet the required level of navigational performance and to navigate to the degree of accuracy required for control of air traffic. For example, the vertical separation minimum for airplanes operating above flight level (FL) 290 in the United States is 2000 feet. Each aircraft's actual altitude must remain within $\pm$ 1000 feet of the assigned altitude even when factors such as atmospheric pressure variations and instrument or pilot errors are considered. Where ATS are provided by the United States, separation minimums are established by the FAR and ATC directives. Where ATS are provided by contracting ICAO member states, separation minimums are established by those states' national regulations and in ICAO documents. Operations in uncontrolled airspace are not provided ATS, and separation minimums are not normally established for uncontrolled airspace. U.S. national airspace separation minimums can be found in FAA Order 7110.65, "Air Traffic Control." FAA Order 7110.83, "Oceanic Air Traffic Control," prescribes separation minimums in international oceanic airspace delegated to the United States by ICAO. ICAO Document 7030/3, "Regional Supplementary Procedures," prescribes separation minimums in international airspace.

g. ***FAR Part 91 Communication Equipment Requirements.*** FAR § 91.511 states the equipment requirements for overwater flights operating more than 30 minutes flying time or 100 NM from the nearest shore. The PIC is required to maintain a continuous listening watch on the appropriate frequency when operating under IFR in controlled airspace.

h. ***FAR Part 121 Communication Equipment Requirements.*** Communication equipment requirements for Part 121 operations are contained in FAR §§ 121.347 and 121.349. Under FAR § 121.351(a), extended overwater operations may not be conducted unless the communication requirements of FAR §§ 121.347 and 121.349 are met. FAR § 121.99 communications facilities requirements may be waived for Part 121 operators for flights over certain oceanic areas with one high frequency (HF) radio inoperative if certain conditions and limitations are met.

i. ***FAR Part 135 Communication Equipment Requirements.*** The communication equipment required for turbojet airplanes with 10 or more passenger seats and multiengine commuter airplanes are contained in FAR § 135.165(a). All other aircraft operated under FAR Part 135 must meet the requirements of FAR § 135.165(b). Under FAR § 135.165(b)(7), aircraft are required to have an additional communication transmitter for extended overwater operations.

j. ***Communication Equipment Requirements for Ferry Flights.*** FAR § 91.511 contains the requirements for radio equipment for overwater operations for ferrying FAR Parts 121 or 135 aircraft under Part 91. Certain operable communications equipment must be carried on large and turbine powered multiengine aircraft flown overwater. If both HF and very high frequency (VHF) equipment are required under FAR § 91.511, FAR § 91.511(d) permits overwater operations with only one HF transmitter and one HF receiver provided that the aircraft is equipped with two independent VHF transmitters and receivers.

k. ***Concept of Operational Service Volume.*** The concept of operational service volume is critical to understanding and applying the principles of air navigation. Operational service volume is the volume of airspace surrounding an ICAO standard airways navigation facility that is available for operational use. Within that volume of airspace a signal of usable strength exists and that signal is not operationally limited by cochannel interference. Within this volume of airspace, a navigational aid (navaid) facility's signal-in-space conforms to flight inspection signal strength and course quality standards including frequency protection. ICAO standard navaids are VHF omnidirectional radio range (VOR), VOR/distance measuring equipment (DME), and nondirectional radio beacon (NDB). The national airspace systems of ICAO contracting member states are based on the operational service volume of these facilities. Navigational performance within the operational service volume and ATC separation minimums can be predicated on the use of these facilities. In contrast, the signal-in-space outside the operational service volume bas not been shown to meet the flight inspection signal strength, course quality, and frequency protection standards. Therefore, navigational performance and ATC separation minimums cannot be predicated on the use of these facilities alone.

l. ***Categories of Navigational Operations.*** A thorough comprehension of the categories of navigational operations is essential to understanding air navigation concepts and requirements, and in evaluating an operator's ability to navigate to the required degree of accuracy. In the broad concept of air navigation, two major categories of navigational operations are identified in the ensuing paragraphs:

m. ***Class I Navigation.*** Class I navigation is defined as any en route flight operation conducted in controlled or uncontrolled airspace that is entirely within operational service volumes of ICAO standard navaids (VOR, VOR/DME, NDB). The operational service volume describes a three-dimensional volume of airspace within which any type of en route navigation is categorized as Class I navigation. Within this volume of airspace, IFR navigational performance must be at least as precise as IFR navigation is required to be using VOR, VOR/DME (or NDB in some countries). The definition of Class I navigation is not dependent upon the equipment installed in the aircraft. For example, an aircraft equipped and approved to use Loran-C in the United States as the sole means of en route navigation (no VOR, VOR/DME installed) is conducting Class I navigation when the flight is operating entirely within the operational service volume of federal VOR's and VOR/DME's. In this example, the Loran-C's IFR navigational performance must be as precise as IFR navigation is required to be using ICAO standard navaids, if IFR operations are to be conducted. In another example, a VFR flight navigated by pilotage is conducting Class I navigation when operating entirely within the operational service volume. However, the VFR navigational performance in this example must be only as precise as VFR pilotage operations are required to be.

The lateral and vertical extent of the airspace where Class I navigation is conducted is determined solely by the operational service volumes of ICAO standard navaids. Class I navigation cannot be conducted outside of this airspace. Class I navigation also includes VFR or IFR navigation operations on the following:

- federal airways
- published IFR direct routes in the United States
- published IFR off-airway routes in the United States
- airways, advisory routes (ADR's), direct routes, and off-airway routes published or approved by a foreign government provided that these routings are continuously within the operational service volume (or foreign equivalent) of ICAO standard navaids

Class I navigation requirements are directly related to separation minimums used by ATC. IFR separation minimums applied in the U.S. national airspace system and most other countries are based on the use of ICAO standard navaids. These separation minimums, however, can only be applied by ATC within areas where the navaid's signal-in-space meets flight inspection signal strength and course quality standards. An ICAO standard navaid's signal-in-space conforms to flight inspection signal strength and course quality standards (including frequency protection) within its designated operational service volume. Therefore, air navigation and the safe separation of aircraft within that service volume can be predicated on the use of these facilities.

Within areas where the safe separation of aircraft is based on the use of ICAO standard navaids, any IFR operation must be navigated with at least the same precision as that specified by the appropriate national separation minimums. Any operation or portion of an operation (VFR or IFR) in controlled or uncontrolled airspace, with any navigation system (VOR, VOR/DME, NDB, Loran-C, inertial navigation system (INS), Omega) or any navigational technique (dead reckoning (DR), pilotage), is Class I navigation for that portion of the route that is entirely within the operational service volume of ICAO standard en route navaids.

n. ***Class II Navigation.*** Class II navigation is any en route operation that is not categorized as Class I navigation and includes any operation or portion of an operation that takes place outside the operational service volumes of ICAO standard navaids. For example, an aircraft equipped with only VOR conducts Class II navigation when the flight operates in an area outside the operational service volumes of federal VOR's/DME's.

Class II navigation involves operations conducted in areas where the signals-in-space from ICAO standard navaids have not been shown to meet flight inspection signal strength, course quality, and frequency protection standards. Therefore, ATC cannot predicate aircraft separation on the use of these facilities alone and must apply larger separation criteria. When operating outside the operational service volume of ICAO standard navaids, signals from these stations cannot be relied upon as the sole means of conducting long-range operations to the degree of accuracy required for the control of air traffic or as the sole means of obstacle avoidance. Therefore, when operating outside the designated operational service volumes of ICAO standard navaids, operators must use long-range navigation systems (LRNS) (Loran-C, Omega, INS) or special navigational techniques (DR, pilotage, flight navigator, celestial) or both. These systems and/or techniques are necessary to navigate to the degree of accuracy required for the control of air traffic and to avoid obstacles.

The definition of Class II navigation is not dependent upon the equipment installed in the aircraft. All airspace outside the operational service volume of ICAO standard navaids is a three-dimensional volume of airspace within which any type of en route navigation is categorized as Class II navigation. For any type of navigation within this volume of airspace, the IFR navigational performance must be at least as precise as the navigational performance assumed during establishment of the ATC separation minimums for that volume of airspace. The navigational performance for VFR operations in a Class II navigation volume of airspace must be only as precise as VFR navigation operations are required to be.

In many cases when ATC lateral separation minimums are large (usually 90 NM or greater), and the Class II navigation portion of the flight is short (less than 1 hour), it is possible to meet required levels of navigational performance and conduct Class II navigation using ICAO standard navaids supplemented with special navigational techniques such as DR. For example, it is possible in turbojet airplanes (with proper procedures and training) to fly many routes between the southeastern United States, Caribbean Islands, and South America with VOR/DME and NDB equipment. In these situations, Class II navigation requirements can be met even though significant portions of these routes (less than 1 hour) are outside (beyond) the operational service volumes of ICAO standard navaids. In the domestic United States, it is not uncommon for low altitude VFR flights in aircraft such as helicopters to conduct Class II navigation while outside the operational service volumes of ICAO standard navaids when operating over routes of less than 100 NM in length. Obviously, Class II navigation includes transoceanic operations and operations in desolate/remote land areas such as the Arctic.

Class II navigation does not automatically require the use of long-range navigation systems. In many instances, Class II navigation can be conducted with conventional navaids if special navigational techniques are used to supplement these navaids. Any portion of an en route operation in controlled or uncontrolled airspace, with any navigation system or any navigation technique, is defined as Class II navigation for that portion of the route that is outside (beyond) the operational service volumes of ICAO standard en route navaids.

2. LONG-RANGE NAVIGATION PROCEDURES AND COLLISION AVOIDANCE.

a. ***Background.*** Recently an aircraft deviated approximately 60 miles from an assigned NAT track and came within a few feet of colliding with an aircraft assigned to an adjacent track. Following the near miss, the aircraft that had deviated from its track did not follow established contingency procedures for aircraft experiencing navigational uncertainty, thus creating the potential for further conflict with other aircraft as it returned to its assigned track. In this incident, as in the majority of incidents involving gross navigation errors (GNE's), the navigation equipment DID NOT malfunction. The incident was caused by the crew's failure to operate the navigation equipment in a disciplined systematic manner during all phases of flight. The incident was further complicated by the crew's failure to comprehend the relationship between navigation performance, contingency procedure, and collision avoidance.

Although navigation errors are infrequent, human errors account for a majority of the errors attributed to aircraft equipped with automated systems. Most inadvertent navigation errors have occurred when the equipment was functioning normally, but the operating procedures prescribed were either inadequate or were not followed. Experience indicates that the increased accuracy and reliability of modern automatic navigation systems can induce a degree of complacency on the part of flightcrews, and may result in failure to routinely cross-check system performance. Under these circumstances, human errors may remain undetected for excessive periods. A common error associated with automated systems is incorrect programming of the oceanic waypoint latitudes by multiples of one degree (60 NM). In an organized track system (OTS), this can result in the flight maintaining a wrong track with high precision and thereby constituting a serious threat to other aircraft properly occupying that track and FL. Vigilance and diligence in properly applying established procedures are essential to safe oceanic navigation. Although operational procedures (checklists) may differ among navigation systems, many good practices and procedures are basic to all automated and semiautomated systems.

IFR long-range operations using pilot-operated electronic long-range navigation equipment shall use the practices and procedures recommended in this advisory circular (AC). Prior to issuing operation specifications authorizing operations requiring long-range navigation equipment, the FAA principal operations inspector (POI) should ensure that these practices and procedures are included and emphasized in the operator's training program, manuals, and check airman program. These basic practices and procedures should be used in conjunction with the more detailed flight planning guidelines in Chapter 2 of this AC. For operations currently authorized by operation specifications or a Letter of Authorization (LOA), the operator's navigation program should be reviewed to ensure that it follows the guidance contained in Chapter 3 of this AC. Any deviation from these requirements must be approved by an FAA navigation specialist through the Flight Standards National Field Office, AFS-500 at Dulles International Airport, Washington, DC.

b. ***Weather.*** In addition to the normal review of weather information concerning terminals, crews should be alert for hazardous weather that may require a flight plan change or in-flight rerouting. It is important to obtain a copy of the wind flow chart (constant pressure chart or the equivalent) for the FL and route to be flown. This information may be valuable when evaluating wind forecasting errors, or if DR operations become necessary due to equipment failure. It is desirable to plot the flight route on the chart to increase its usefulness. Also, as the flight progresses, consideration should be given to plotting actual wind information on the chart as a means of evaluating the accuracy of the forecast.

c. ***Notices to Airmen (NOTAM's).*** Besides checking NOTAM's for departure, destination and alternate airports, NOTAM's concerning navaids or special airspace restrictions along the planned route should be checked. Omega users should obtain NOTAM's concerning Omega station operational status to ensure that the required stations are in service. Further information concerning Omega is contained in Section 7 of this Chapter.

d. ***Waypoint Symbology.*** The navigation program should include a standard system for indicating waypoint status, as detailed below. The specific symbology recommended is noted in parenthesis. Variations in specific symbology may be necessary to accommodate the individual operator's program.

(1) Waypoint coordinates have been stored in the computer. (Enter the waypoint number next to the relevant waypoint coordinates.)

(2) Coordinates and zone distances have been independently cross-checked by a second crewmember. (Circle the waypoint number.)

(3) Coordinates and zone distances have been cross-checked during the approaching waypoint check. (Draw a diagonal line through the waypoint number.)

(4) Waypoint passage has occurred. (Draw a second diagonal line through the waypoint number.)

(5) Cross-checking during all phases of flight (flight planning, preflight, en route).

(6) Official (master) document.

(7) Plotting.

e. ***Plotting Procedures.*** Use of plotting procedures has had a significant impact on the reduction of GNE's. The use of this technique to plot the flight route on a plotting chart and to plot the computer position approximately 10 minutes after waypoint passage are strongly recommended on all flights when long-range navigation equipment is the sole means of navigation. Use of plotting procedures may be required for routes of shorter duration that transit airspace where special conditions exist, such as reduced lateral separation standards, high density traffic, or proximity to potentially hostile border areas. Plotting procedures should be required for all turbojet operations where the route segment between the operational service volume of ICAO standard navaids (VOR, VOR/DME, NDB) exceeds 725 NM, and for all turboprop operations where the route segment between the operational service volume of ICAO standard navaids exceeds 450 NM. The operational service volume is that volume of airspace surrounding a navaid which is available for operational use, within which a signal of usable strength exists, and where that signal is not operationally limited by cochannel interference. (See Section 1 of this Chapter for additional information on operational service volume.) The operational service volume for a specific navaid can be determined by contacting the Frequency Management Section within each regional Airway Facilities Division. Operational service volume includes the following:

(1) the officially designated standard service volume excluding any portion of the standard service volume that has been restricted

(2) the extended service volume

(3) within the United States (including offshore control areas (CTA's)) by published instrument flight procedures (Victor or jet airways, standard instrument departures (SID's), standard terminal arrivals (STAR's), standard instrument approach procedures (SIAP's), or instrument departure)

(4) outside the United States, any designated signal coverage or published instrument flight procedure equivalent to U.S. standards

f. ***Flight Planning.*** Many operators use a computerized navigation flight plan. Care should be taken to verify that all en route waypoints are correctly and legibly shown on the flight plan. It is good practice to select a waypoint loading sequence and number each waypoint accordingly. If more than one copy of the flight plan is to be used, one copy should be designated as the official copy. To eliminate possible confusion, ensure that all necessary information (i.e., routing changes, estimated time of arrival (ETA), waypoint loading sequence) is recorded on this flight plan, and this official copy is used for all reports to ATC. Additionally, if the flight is within the NAT OTS, obtain a copy of the current track message (ATC expects the flightcrew to have a copy) and be alert for conflict between the flight plan and the track message. Track messages are issued approximately every 12 hours and describe the NAT routes, gateways and FL's available for eastbound and westbound flights during the period indicated. While planning an overwater flight, pilots should review NOTAM's for any condition that may affect the operation and accuracy of long-range navigation systems (LRNS's). This is especially critical for Omega and Loran-C systems, as discussed in those sections of this Chapter. The use of heading information for cross-checking must be approached with caution. In steering a given route segment with a navigation computer, the true heading required to maintain a Great Circle course will change. For example, the true heading to maintain the Great Circle course from 50N 30W to 50N 40W will be 274 degrees at 30W, 270 degrees at 35W, and 265 degrees at 40W. Differences in variation along the route will further change the magnetic heading required to maintain course. The flightcrew must have a thorough understanding of the flight plan heading information and DR technique in order to use this check with any degree of certainty.

g. ***Navigation Preflight (at aircraft).*** Navigation system software identification and modification status codes should be verified. Cross-check inputs to navigation computers. Each insertion should be carried out in its entirely by one crewmember and then recalled and verified by another. Cross-check computer flight plan zone distances with zone distance displayed in navigational computers.

The cross-check of coordinates and zone distances must be performed on all computer systems individually when the remote loading feature is utilized. For INS, after the systems are placed in the navigation mode, the groundspeed should be checked while the aircraft is stationary. A reading of more than a few knots may indicate an unreliable system. INS procedures are covered in Section 6 of this Chapter.

(1) Cross-check computer flight plan (CFP) gate and waypoint coordinates and identifiers with source documents (airfield diagrams, en route charts, and NAT track messages, if applicable).

(2) Plot the flight route on a chart of appropriate scale. Operational experience has demonstrated that a scale of 1 inch to 120 NM provides the most benefit for plotting purposes.

(3) Compare routing information on ATC flight plans, computer flight plans, NAT track messages, plotting charts, and aircraft observations and reports (AIREP) forms.

(4) It is advisable not to copy waypoint coordinates from source documents (track message, en route charts, etc.) to the flight plan for subsequent insertion into the navigation computers. To avoid errors in transcription, waypoint coordinates should be inserted into the computers directly from the source documents.

(5) Since the initial stage of the flight can be very busy, consideration should be given to ensuring the navigation system waypoint transfer switches are placed in the "auto" position to facilitate outbound tracking and waypoint changeover during this period.

(6) With systems such as INS or Omega that navigate during ground operations, it is advisable to cross-check present position, taxi distance, or groundspeed (as appropriate), prior to takeoff to confirm proper system operation and to ensure that the present position remains accurate.

h. ***Equipment Preflight.*** In addition to operating procedures (checklists) to confirm proper system operation, care should be taken to ensure that the navigation equipment is properly programmed. This is a very important procedure and should not be rushed. All navigation information (coordinates or courses and distances) should be programmed by one crewmember and verified by another crewmember. Also, crews should verify that the same waypoint loading sequence is used for each system and indicate on the flight plan that the present position (if applicable) and waypoints have been entered and cross-checked. If time becomes a factor, it is more important to verify that the first two or three waypoints are correct than to rush through the procedure to insert as much information as possible. Consideration should be given to using another cross-check that compares the flight plan or charted distance between waypoints and the distance computed by the navigation system to detect programming or flight planning errors. This serves as a doublecheck on waypoint verification and will also reveal any error in the flight plan. A difference of more than +2 NM or -2 NM may indicate a programming or flight planning error.

i. ***Pretakeoff and Coast Out.*** Before takeoff, cross-check the computer present position to confirm proper system operation. At least two crewmembers should copy and confirm the oceanic clearance. Perform gross error check (accuracy check) to compare navigation computer position with VOR, VOR/DME, or NDB. Procedures are required for direct overflight of a navaid and for cases when the navaid is NOT directly overflown. The gross error should be recorded in the flight log. For Omega, guidance must be established for lane ambiguity resolution (refer to Section 7 of this

Chapter). Outbound from gateway, cross-check VOR, VOR/DME or NDB course and distance information with navigational computers. Compass deviation check (INS only): use for DR and for determining which system is correct when there is disagreement between systems.

j. ***Within Range of the Outbound Gateway.*** Flights should not continue beyond the outbound gateway unless the required long-range navigation equipment is functioning properly. To confirm proper operation, certain cross-checks should be performed while within range of the gateway navaid. Since this may be the last positive position cross-check until the inbound gateway, the following practices may also provide valuable information for resolving any later navigation difficulties.

(1) All ATC oceanic clearances should be cross-checked by two crewmembers to ensure the clearance is copied correctly. Any flight plan waypoints that were revised in an ATC clearance should be crossed out and the revised coordinates entered in a legible manner. Prior to proceeding outbound from the gateway, the current ATC clearance should be compared to the flight plan, and the information in the navigation computers for the gateway and the subsequent waypoints should be verified.

(2) A gross error check is a position accuracy cross-check using normal airway facilities such as VOR, VOR/DME or NDB. The gross error check is usually accomplished by flying directly over the gateway (if possible) and subsequently establishing the aircraft on the outbound course using the gateway navaid. This check serves the following purposes:

(a) detects errors that may have accrued in position information since takeoff

(b) provides information that can be used to determine the most accurate system for use as a steering reference

(c) provides an opportunity to correct position information, if necessary

(d) can be used to confirm that the aircraft is established on the outbound course and is tracking toward the next waypoint

(e) can be used to confirm that the aircraft is proceeding according to the current ATC clearance

(3) When flight instruments are used for the display of either airways (VOR) information or information from the LRNS, the "radio/nav" switches should be left in "radio" position after passing over the gateway navaid until the radio information begins to become degraded. The switches should then be placed in the "nav" position.

(4) Consideration should be given to performing a compass deviation check on systems such as INS that use true heading information from sources independent of the aircraft compass system. The compass deviation can be determined by comparing the INS derived data later in the flight to determine the most accurate system should a divergence between systems occur. The compass deviations can be applied to the respective compasses to determine the actual magnetic heading. Local variation can be applied to the true heading of each INS to obtain the derived magnetic headings. The most accurate INS should be the one with a magnetic heading that compares the most favorably with the actual magnetic heading.

k. ***After Passing the Gateway.*** The system determined to be the most accurate during the gross error (TKE), check should usually be selected as the autopilot steering reference. When not being used for other purposes, this system should display present position. Routinely check cross-track, track angle error and distance to go. Display computer position coordinates and compare with ATC clearance to confirm that track centerline is maintained.

l. ***Approaching Waypoint.*** Within 2 minutes of each waypoint, both pilots should verify that the subsequent waypoint in the navigation display agrees with the current ATC clearance. Cross-check coordinates of the approaching waypoint and subsequent waypoints. Compare zone distance on the flight plan to that displayed on the navigation computer for the next leg. Compare computer flight plan ETA with ETA information displayed in navigation computers. (On some systems this cross-check may be more easily accomplished during waypoint passage.)

m. ***After Passing Each Waypoint.*** Approximately 10 minutes after passing each waypoint, the present position information on the navigation displays should be plotted on a navigation chart to confirm that the ATC clearance is satisfied (not applicable to most Doppler systems). Confirm that the navigation systems have switched to the next flight segment (leg change). Verify that the aircraft is tracking along the next flight segment (tracking outbound).

n. ***Approaching the Inbound Gateway.*** Certain preparations should be made for the transition from long-range navigation to airways navigation. The following practices are recommended:

(1) As soon as feasible, set up the navigation radios to receive the inbound gateway navaid.

(2) When the gateway navaid is providing reliable information, place the "radio/nav" switch in the "radio" position and steer the aircraft to acquire and maintain the proper inbound radial/bearing.

(3) Unless otherwise directed by ATC, the aircraft should be flown directly over the gateway.

(4) When over the gateway, record the position information from the navigation displays. This information can be used to confirm system accuracy. Compare VOR, VOR/DME, NDB course and distance information with that displayed in navigation computers. It is recommended that system accuracy computations be made after arrival to avoid conflicts with other cockpit duties during the critical periods of descent, approach and landing.

o. ***After Arrival.*** The individual navigation system errors and error rates, if applicable, should be computed and recorded for future reference. It is desirable to record this information in a document that remains aboard the aircraft to provide subsequent flightcrews with a recent history of system performance. This information may be used with most systems to predict individual system performance for future flights under similar circumstances. Additionally, this information may prove valuable to subsequent flightcrews for resolving navigation abnormalities, such as divergence between systems.

3. LONG-RANGE NAVIGATION PROBLEMS AND RECOMMENDED ACTIONS.

a. ***Background.*** Although the accuracy and reliability of the newer navigation systems are excellent, malfunctions and failures occasionally occur. When a malfunction occurs, flightcrews should guard against jumping to conclusions since hasty actions are seldom necessary and may further complicate the situation. Experience has shown that successful resolution of navigation difficulties in oceanic areas usually requires a thorough, thoughtful process that normally begins during preflight planning. The training program manuals and check airman program for air carrier operations should emphasize procedures to be followed in the event of partial and total instrument failure. Non air carrier operators should be prepared to demonstrate this emphasis in their training programs if requesting an LOA for oceanic operations in special airspace. The following guidance is presented for consideration when navigation difficulties are encountered or suspected.

b. ***Navigation Errors.*** Monitoring procedures used during oceanic operations indicate the frequency and course of navigation errors. Considering the thousands of flights that are made, errors are actually rather infrequent. Navigation systems are generally so reliable that there is some concern about overconfidence; therefore, crews should guard against complacency.

(1) Frequent causes of errors include the following:

(a) A mistake of one degree of latitude was made in inserting a forward waypoint.

(b) The crew was recleared by ATC, but forgot to reprogram the navigational system.

(c) The autopilot was left in the heading or decoupled position after avoiding severe weather, or was left in the VOR position after departing the last domestic airspace VOR. In some cases, this occurred after distractions by selective calling (selcal) or flight deck warning indications.

(d) The controller and crew had different understandings of the clearance because the pilot heard what he/she wanted to hear rather than what was actually said.

(2) Rare causes of errors include the following:

(a) The lat/long coordinates displayed at the gate position were incorrect.

(b) Because of a defective chip in an aircraft system, although the correct forward latitude was inserted by the crew, it "jumped" one degree.

(c) The aircraft was equipped with an advanced system that included all waypoint coordinates already on tape. The crew assumed the coordinates were correct, but one was not correct.

(d) Although the crew had the correct coordinates available, the information inserted into the system was from an incorrect company flight plan.

c. ***Detection of System Failure.*** In general, system failure is usually considered to have occurred when one of the following situations develops:

(1) a warning indicator is activated and cannot be reset;

(2) self-diagnostic or built-in test equipment (BITE) indicates that the system is unreliable;

(3) the position error over a known geographic location exceeds the maximum permissible tolerance established for a particular navigation system; or

(4) the system's operation is so abnormal that, despite the absence of warning or malfunction indications, the flightcrew considers the system no longer useful for navigation.

d. ***Detection of System Degradation or Malfunction.*** While system failures are usually straightforward, malfunctions or gradual system degradations are usually more difficult to detect. This is particularly true when only two systems are on board. Navigation difficulties of this type are usually detected by a divergence between the navigation systems, a situation that often occurs gradually. This factor may reduce the possibility of identifying the faulty system unless periodic cross-checking practices are diligently used. The following factors should be considered when attempting to identify a faulty system.

(1) Check the BITE codes for indications of system fault.

(2) For Omega, the system receiving the most stations and the best quality signals should generally be the most accurate.

(3) Review the gateway gross error check for indications of the most accurate system.

(4) If a regular record of system performance has been maintained and is available, a review of the record may give a clue as to which system is faulty.

(5) If possible, use VOR, automatic direction finder (ADF), DR, airborne radar, or other navaids to obtain a position fix.

(6) Cross-check heading, groundspeed, track, and wind information between systems and compare this information with the best known positive information such as position over a fix.

(7) Attempt to contact nearby aircraft to obtain wind or groundspeed and drift correction information that may identify the malfunctioning system.

(8) The compass deviation check discussed in Section 2 of this Chapter my provide a clue as to which system is faulty for systems such as INS.

Even though these steps are taken, a divergence between systems may occur, but the flightcrew may be unable to determine which system is at fault. When this occurs, the practices described in the following paragraph should be used.

e. ***Recommended Actions Following System Failure.*** After a system malfunction or failure has been detected, ATC should be informed that the flight is experiencing navigation difficulties so that separation criteria can be adjusted, if necessary. Reporting malfunctions to ATC is an ICAO requirement and compliance is required by FAR Part 91. If the failed system can be identified with a high degree of confidence and the other system appears normal, the best course of action may be to fly the normal system and carefully monitor its performance using any additional navaids available, including DR. In the unlikely event that a total navigation failure occurs and other aids are unavailable, the only action may be to fly by DR using the flight plan headings and times. Under these circumstances, flightcrews should continue to use all means available to obtain as much navigational information as possible. Flightcrews should be alert for visual sightings of other aircraft, since a hazard may exist due to an inadvertent deviation from the assigned track. In some cases, it may be possible to establish and maintain visual contact with another aircraft on the same track.

f. ***Recommended Action Following a Divergence Between Systems.*** Since a small divergence between systems may be normal, the significance of the divergence should be evaluated. In general terms, if the divergence is less than 10 NM, the best course may be to closely monitor system performance and continue to steer the system considered most accurate. If the divergence between systems is greater than 10 NM, one of the systems may be degraded. Therefore, attempts should be made to determine which system may be faulty. If the faulty system cannot be determined using the practices described in this section, and both systems appear normal, the action most likely to limit gross tracking error may be to position the aircraft so that the actual track is midway between the crosstrack differences for as long as the position uncertainty exists. ATC should be advised that navigation difficulties are being experienced so that separation criteria may be adjusted as necessary. Consideration should be given to abandoning this "split-the-difference" practice if the divergence exceeds the separation criteria currently in effect on the route of flight. If a divergence of this magnitude occurs and the faulty system cannot be isolated, the best course may be to fly by DR using the best known wind information. However, in some cases, the best known information may be flight plan headings and times.

4. PROVING TESTS AND VALIDATION FLIGHTS.

a. ***Introduction.*** FAR Parts 121 and 135 require evaluation of an operator's ability to conduct operations safely and in accordance with the applicable regulations before issuing an operating certificate or authorizing a certificate holder to serve an area or route. The testing method used by the FAA to determine an operator's capabilities are proving tests and validation flights. FAR §§ 121.163 and 135.145 require operators seeking authority to operate certain types of aircraft to conduct proving tests before being granted operating authority. Proving tests consist of a demonstration of ability to conduct flights and to maintain the aircraft to the appropriate standards. Proving tests should not be confused with aircraft certification tests, which are tests conducted by the aircraft manufacturer to demonstrate the airworthiness of the aircraft. FAR § 121.163 requires an operator to successfully conduct proving tests before the FAA authorizes the operation of each aircraft type. FAR § 135.145 requires proving tests before the FAA authorizes the operation of each type of turbojet aircraft or each type of aircraft for which two pilots are required for VFR operations. FAR §§ 121.93, 121.113, and 135.13(a)(2) require an operator to demonstrate the ability to conduct operations over proposed routes or areas in compliance with regulatory requirements before being granted FAA authority to conduct these operations. The FAA requires validation flights for authorization to add any areas of operation beyond the continent of North America and Mexico, and before issuance of operations specifications (OpSpecs) that authorize special means of navigation. Though proving tests and validation flights satisfy different requirements, it is common practice for operators to conduct both tests simultaneously. However, validation flights are important to consideration of oceanic operations.

b. ***Validation Flights.*** FAR §§ 121.93, 121.113, and 135.13(a)(2) require operators to show the capability to conduct line operations safely and in compliance with regulatory requirements before being authorized to conduct those operations in revenue service. The most common method of validating an operator's capability is to observe flight operations. The FAA normally requires validation flights before issuing OpSpecs granting authority to conduct operations beyond the populated areas of the North American continent. When the FAA conducts a validation flight, an in-depth review is conducted of the applicable portions of the operator's proposed procedures (especially flight following), training programs, manuals, facilities, and maintenance programs. There are four situations that require validation flights in association with approval of Class II navigation: initial approval; addition of an LRNS or a flight navigator; operations into new areas; and addition of special or unique navigation procedures. Validation flights are required when an operator proposes to conduct operations that require confirmation of the ability to operate an aircraft type within specified performance limitations. These limitations are based on the character of the terrain (or extended overwater areas), the type of operation, and the performance of the aircraft. Validation flights are also required when an operator proposes to conduct in-flight or ground maneuvers that require special operational authorizations.

c. ***Carriage of Revenue Passengers on Validation Flights.*** The FAR do not forbid the carriage of revenue passengers on validation flights. The operator may receive FAA authorization to carry revenue passengers during the validation flight when the proposed operation is similar to those in the applicant's previous experience. However, carriage of revenue passengers is normally not permitted during validation flights in the following situations:

(1) when the operator is seeking initial approval to conduct Class II navigation in any airspace designated as a special area of operation;

(2) when the operator is seeking approval to conduct Class II navigation by an LRNS or using a flight navigator not previously approved for that means of navigation;

(3) when the operator is seeking approval to conduct Class II navigation by means of a long-range navigation procedure that has not previously been approved for that operator; and

(4) when the operator has not previously operated a specific aircraft type in operations requiring special performance authorization.

d. ***Special Areas of Operation.*** Certain areas of Class II airspace are considered special operating airspace for purposes of validation. These areas include:

(1) extensive areas of magnetic unreliability;

(2) NAT MNPS airspace and Canadian MNPS airspace;

(3) Central Pacific (CEPAC) composite airspace and Northern Pacific (NOPAC) airspace;

(4) Arctic Ocean and Antarctic airspace; and

(5) politically sensitive areas of operation.

e. ***Special Navigation Procedures.*** Validation flights are normally required when an applicant proposes to use navigation procedures not previously demonstrated. These procedures include the following:

(1) pilotage, including DR;

(2) flight navigator procedures;

(3) celestial navigation;

(4) pressure pattern and Bellamy drift DR;

(5) free gyro or grid procedures; and

(6) any combination of the preceding procedures.

f. ***Other Situations Requiring Validation Flights.*** Validation flights may also be required for special operational authorizations and special performance authorizations. Operators who require additional information on validation flights are encouraged to contact their local FAA flight standards district office (FSDO).

5. DOPPLER NAVIGATION - SPECIAL PROCEDURES.

In addition to the general navigational practices and procedures contained in this Chapter, the following information applies to Doppler navigation systems. A Doppler system (sensor plus computer) is a semiautomatic DR device that is less accurate than an INS or Omega system. A means of updating the Doppler is usually required if acceptable position accuracy is to be achieved on long-range flights. INS, Omega or Loran-C may be used as the updating reference for the Doppler system. The following factors should be considered when using a Doppler navigation system.

a. ***Compass Accuracy.*** Most Doppler systems measure groundspeed to an accuracy of about one percent and drift angle to a fraction of a degree. Its directional reference, however, is the aircraft's compass system. If the overall Doppler/compass system is to be usefully accurate, the compass should be swung and compensated so that its error does not exceed one degree on any heading.

b. ***Preflight.*** During preflight, the flight plan course and distances for those flight segments where Doppler navigation is required should be verified. Normally, the courses should be determined to the nearest one tenth of a degree and the distances to the nearest NM. This is routinely accomplished by using course and distance tables designed for this purpose. Extreme care and accuracy are important considerations during this cross-check. If the Doppler system is to be used for navigation from takeoff, both "A" and "B" stages should be programmed and the "auto/manual" switch should be placed in "auto." Also, the proper position for the "land/sea" switch should be determined since this affects the accuracy of the groundspeed information.

c. ***When Approaching the Outbound Gateway.*** The Doppler system performance records for recent flights over similar routes should be reviewed to determine if a system deviation correction should be applied. If the records indicate that a deviation correction may be necessary, apply the correction to the Doppler system used. Both pilots should verify that the outbound course and distance programmed in the active stage conforms to the currently effective ATC clearance. Unless otherwise required by ATC, the aircraft should be flown directly over the gateway fix to obtain the most accurate starting position practical. When directly over the gateway, both pilots should ensure that the Doppler computers have been activated and that the proper stage is selected. The aircraft should be established on the outbound track by using the gateway navaid. Once this is accomplished, the gross error cross-checks discussed in Section 2 above should be accomplished. Consideration should be given to using an additional cross-check. This is accomplished by applying drift angle to the compass heading and comparing the result (actual track) to the flight planned magnetic course.

d. ***Updating the Doppler Computer.*** Since Doppler systems (in a magnetically slaved model) fly a "rhumb line" (curved track) and most navigation charts commonly used reflect "Great Circle" (straight tracks), certain precautions should be observed when updating Doppler systems. Although a great circle course and a rhumb line course begin and end at common points, the two courses diverge between the waypoints. This divergence normally reaches a maximum near the midpoint of the leg, and the magnitude of the divergence increases as the latitude and distance between waypoints increase. Under normal circumstances, position fixes for Doppler updating purposes should be obtained within 75 NM of a waypoint to minimize the possibility of inducing an error into the Doppler system due to the rhumb line effect. This practice should be applied to both manually obtained and automatically obtained position fixes. When Doppler systems are used in the grid (free gyro) mode, the Doppler track will approximate a great circle, and the rhumb line effect is not a factor. Under these conditions, the updating restrictions detailed above are not normally applicable.

6. INS NAVIGATION - SPECIAL PRACTICES AND PROCEDURES.

a. ***Preflight.*** Since INS is a DR device and not a position-fixing device, any error induced during alignment will be retained and possibly incremented throughout the flight unless it is removed through updating procedures. Therefore, during preflight, care should be exercised to ensure that accurate present position information is inserted into the INS. Although most INS will automatically detect large errors in present position latitude during alignment, large errors in present position longitude may exist without activating a warning indication. When cross-checking present position coordinates, be alert for the correct hemispheric indicator (i.e., N, S, E, W) as well as the correct numerical values. Since most INS cannot be realigned in flight, special procedures such as ground realignment may be required to correct a significant error in present position. If the INS in use has the capability of "gang-loading" (simultaneous loading) by use of a remote feature, care should be taken so that any data entered by this method is cross-checked separately on each individual INS to detect data insertion errors. The INS software identification and modification status codes should be verified to ensure that the proper equipment is installed and the appropriate operating checklist is used. The operating checklists should include a means of ensuring that the INS is ready to navigate and that the navigation mode is activated prior to moving the aircraft. Any movement of the aircraft prior to activating the navigation mode may induce very large errors that can only be corrected by ground realignment. After the system is placed in the navigation mode, the INS groundspeed should be checked when the aircraft is stationary. An erroneous reading of more than a few knots may indicate a faulty or less reliable unit. If this occurs, a check should be made of the malfunction codes.

b. ***In-Flight Updating.*** INS are essentially accurate and reliable, but it is possible to introduce errors in an attempt to improve accuracy by in-flight updating. On the other hand, INS errors generally increase with time and are not self-correcting. If large tracking errors are permitted to occur, aircraft safety and separation criteria may be significantly degraded. These factors should be considered in any decision relative to in-flight updating. As a guide to flightcrews, some operators consider that unless the ground facility provides a precise check and unless the error is fairly significant (e.g., more than 6 NM or 2 NM/hour), it is preferable to retain the error rather than update.

7. OMEGA INFORMATION.

This section addresses only dual Omega installations. However, operators should be aware that if an operation requires two LRNS and one of the systems used is an Omega system, all requirements specified for Omega as the sole means of navigation must be met. 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 individual systems as discussed in other sections of this Chapter.

a. ***Background.*** Omega is a radio navigation system that uses a worldwide network of VLF signals from eight ground-based transmitters. The principal attributes of the Omega system are the high degree of signal stability and low signal attenuation that produce reliable position information over great distances. Various methods of signal processing are used by different manufacturers to develop position information and navigation guidance (rho-rho, hyperbolic, single frequency, 3.4 KC tracker, etc.). Because of these variations in processing methods, each design will be evaluated and approved individually. When Omega systems meet the provisions described below, they may be used as the 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 communication stations may be used to supplement Omega navigation systems. 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 AC should be capable of operating on Omega systems alone.

The approval process is divided into two parts. The first part deals with approval under FAR Part 25 and the second part deals with operational approval under FAR Part 121. Guidance concerning compliance with FAR Part 91 regarding NAT MNPS airspace is contained in Chapter 3, Section 1 of this AC.

b. ***Airworthiness Approval.*** Applicants desiring airworthiness approval of dual Omega navigation systems in accordance with this AC 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 (CDU's), and two antennas.

c. ***Operational Approval.*** FAR Part 121 requirements for en route navigation facilities are contained in FAR §§ 121.103 and 121.121. Air carrier applicants desiring operational approval for use of dual Omega systems should contact the FSDO charged with the administration of their operating certificate a minimum of 30 days prior to the proposed start of evaluation flights. FAR Part 91 operators desiring approval of dual Omega systems for flights in MNPS airspace should contact the FSDO nearest their principal base of operations to obtain an LOA. Requests should include evidence of FAA airworthiness approval of the system, a description of the system installation, and the operator's experience with the system. 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 proposed system. The applicant may include previous or related operational experience of other operators who have used the same equipment on the same type aircraft, and operational experience gained during type certification or supplemental type certificate of the aircraft. Once a particular system has received an equipment approval, subsequent evaluation and approval in the same type of 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. A comprehensive summary of any flight experience that establishes a history of adequate signal coverage (during day or night operations), accuracy, lane ambiguity detection/resolution, and in-service reliability should be provided to show competency in the proposed operation and maintenance of the equipment.

The applicant must present proposed revisions to the operation manual, describing all normal and abnormal system operating procedures and flightcrew error protection procedures including cross-checking of data insertion, detailed methods for continuing the navigation function with partial or complete Omega system failure, reacquiring the proper lane after any power outages, and procedures for continuing operation in the event of a divergence between systems. The applicant must also present proposed revisions to the minimum equipment list (MEL) concerning Omega, with appropriate justification. The applicant must present a list of operations to be conducted using the system including an analysis of each operation 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 navaids, and adequacy of gateway facilities to support the system. (For the purpose of this AC, a gateway is a specific navigation fix where the use of LRNS commences or terminates.) The operator must develop a procedure for timely dissemination of Omega NOTAM information to crewmembers. The operator must also develop 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 FAR Part 121, Subpart L.

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 ensure proper operation. Normal flight maneuvering should include 180 degree turns to verify dynamic response. An applicant for airworthiness approval should provide data from sufficient flights in the area of intended use to show that the Omega navigation system can meet the accuracy requirements stipulated for LRNS in FAR § 37.205, technical standard order (TSO) C-94, and Radio Technical Commission for Aeronautics (RTCA) DO-164, Section III, paragraph 3.8. Consideration should be given to time of day, season, station outages, station geometry, and poor signal-to-noise ratio.

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

(2) The DR mode should be evaluated to determine the maximum period for which interim use is permissible. The information should be included in the airplane flight manual.

d. *Ground Evaluation.* 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. The Omega velocity and heading (or track) information presented on the control display unit (CDU) 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 ensure compatibility of input to interfaced equipment. This evaluation may be conducted in-flight. Displays of all data basic to the installed Omega systems should be demonstrated to show no instability or discontinuity utilizing those stations identified by the system as usable and necessary for navigation. This evaluation may be conducted in-flight.

e. ***Evaluation and Final Approval.*** Prior to final approval for the use of Omega as a sole means of long-range navigation, a thorough evaluation of an operator's training program and a flight evaluation by an FAA inspector will be required. This flight evaluation should be requested on the operator's application for the use of Omega as a sole means of long-range navigation.

(1) The evaluation by an FAA inspector will include the adequacy of operating procedures and training programs; availability of terminal, gateway, area, and en route ground-based navaids; 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 flightcrew by use of the Omega equipment in normal and abnormal operations.

(2) After the evaluation is completed, FAA approval is indicated by issuance of OpSpecs for air carriers and by an LOA for other operators who desire to fly in airspace where an authorization is required. The operation 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 by an air carrier will limit the operations to areas where compliance with FAR Part 121 or FAR Part 135 requirements were demonstrated. Requirements for LOA's are detailed in Chapter 3 of this AC.

(3) The OpSpecs should contain applicable limitations or special requirements needed for particular routes or areas and, where necessary, list a sufficient number of Omega ground transmitters required to be in operation to provide the necessary amount of signal redundancy.

f. ***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 TSO C-94, "Airborne Omega Receiving Equipment" and Section 3 of RTCA Document No. DO-164 titled "Minimum Performance Standards Airborne Omega Receiving Equipment" dated March 19, 1976. When installed, the system should provide a means of entry for at least the following data inputs and functions:

(1) present position (initializing, reinitialization and update);

(2) waypoints;

(3) heading, wind and true airspeed (TAS); or track and groundspeed; or other external information required for operation in the secondary or direct ranging mode;

(4) time;

(5) date;

(6) deselection and reselection of any station (automatic deselection and reselection is acceptable if shown to be effective and reliable); and

(7) lane ambiguity resolution. Automatic lane ambiguity resolution is acceptable if sbown to effective and reliable.

g. ***System Displays.*** If the equipment is to be operated by the pilot(s), the system controls and data display should be visible to, and usable by, each pilot seated at a pilot duty station. The system controls should be arranged to provide adequate protection against inadvertent system turnoff. The system should also provide a means of displaying 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 visual or aural warning of system failure, malfunctions, power interruption, lack of synchronization, or operation without adequate signals

(9) waypoint coordinates

(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, TAS and heading; or track and groundspeed

(16) stations currently being installed to determine position

(17) steering information on the horizontal situation indicator (HSI) or equivalent

(18) confirmation of data insertion

h. ***Failure Protection.*** Normal operation or probable failure of the airborne Omega navigation system should not derogate the normal operation of interfaced equipment. Likewise, the failure of interfaced equipment should not render an Omega system inoperative.

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

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

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

l. ***Preflight Test.*** A preflight test capability should be provided to inform the flightcrew of system status.

m. ***Aircraft Electrical Power Source.*** One Omega system should be installed so that it receives electrical power from a bus that provides maximum reliability 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, should not adversely effect the operation of either Omega system. After power interruption of 7 + or - 2 seconds, the Omega equipment should automatically resynchronize and resume normal operation within 3 minutes without operator intervention. 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 provide power for this function. 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.

n. ***Steering Outputs.*** The Omega system should provide steering outputs to the autopilot and/or HSI or equivalent so that the equipment interface is compatible.

o. ***Airplane Flight Manual.*** The airplane flight manual should contain the following information regarding 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

p. ***Demonstration of Performance.*** An applicant for approval of dual Omega navigation system installation should ensure that the installed Omega system can demonstrate adequate performance by a combination of ground and flight evaluations defined in the following two paragraphs.

q. ***Equipment and Equipment Installation.*** Omega navigation systems should be installed in accordance with the airworthiness approved system installation requirements. If evaluation flights are made for operations requiring an LRNS, a navigation system already approved for the operator under FAR Part 121 should be used as the primary means of navigation.

r. ***Omega Training Programs.*** The training program curriculum must include initial and recurrent training and checking for those crewmembers who will be operating the Omega equipment. Initial training programs should include the following:

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

(2) For the flightcrews who are to operate the Omega equipment, 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 divergence 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 course; and

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

(3) 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.

(4) For flight crewmembers without previous Omega experience, the training and qualification program should include an in-flight qualification check based on the training program. Accomplishment of such training during evaluation flights is acceptable. Sufficient flightcrews considered fully qualified by the applicant should be observed in-flight by an FAA inspector to determine the overall effectiveness of the training and qualification program. Flightcrews 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 of long-range navigation, if applicable.

(5) Annual line checks as required by FAR § 121.440 should include a check of Omega operating procedures. Required annual checks of flight navigators, if they are to operate the Omega equipment, should also include a check of these procedures.

s. ***Accuracy and Reliability.*** The applicant should show the following:

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

(2) That in the process of proposed operation, the Omega navigation system meets the accuracy requirements stipulated for Omega navigation systems. If the proposed system is to be operated in

areas with special navigation requirements (e.g., MNPS airspace), the accuracy required for those areas must also be demonstrated. Systems that become exceedingly inaccurate without displaying a warning indication should be included in the accuracy accounting. Systems that display a failure warning and are subsequently shut down or disregarded should be included in the accounting of failed systems but excluded from the accuracy accounting.

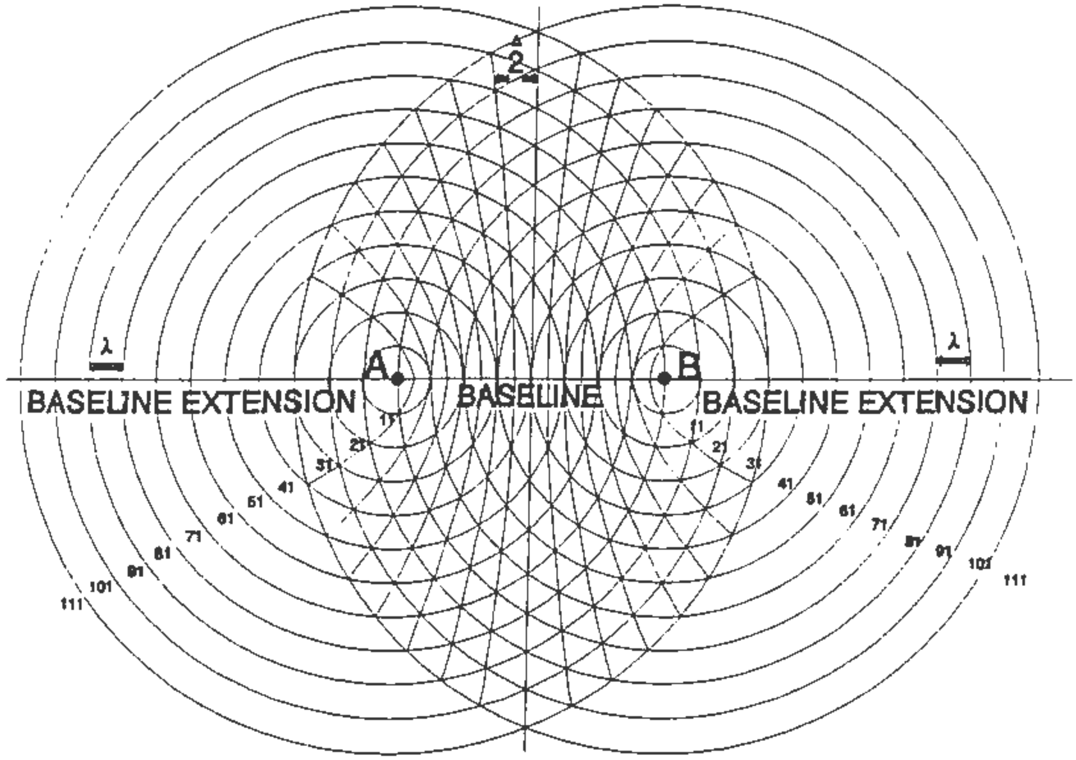
(3) That Omega navigation systems which are subject to lane ambiguity have a reliable means of reacquiring the proper lane.

(4) That the Omega sole means system 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.

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

t. ***Special Practices and Procedures.*** Since the CDU's of most Omega systems are similar in appearance to those used for INS, persons familiar with INS may have a tendency to assume that Omega has similar performance characteristics. This assumption could create significant problems. INS is a precision DR device which is wholly self-contained within the aircraft and has a nominal position degradation of about 1 mile per hour of flight. Omega, in contrast, continuously resolves aircraft position by processing radio signals received from a global network of transmitters. It is therefore possible for Omega to be affected by signal propagation disturbances and abnormally high local radio noise levels. In normal operation, Omega provides a position accuracy of 1 to 3 NM which, unlike INS, does not degrade with increasing flight time. However, most Omega systems compute position in signal "lanes," which are a function of the signal wavelength. A disturbance of sufficient magnitude may force the computed position into an adjacent lane and thereby cause an error which is measured in multiples of the basic lane width. This occurrence is termed a "lane slip." Most Omega systems possess an auxiliary operating mode termed "lane ambiguity resolution" (LAR). The purpose of this mode is to correct the lane slip by returning the present position to the correct lane. Details of lane ambiguity follow.

FIGURE 8-1. OMEGA LANES FORMED BY HYPERBOLIC ISOPHASE CONTOURS



u. *Omega Lanes Formed by Hyperbolic Isophase Contours.* (Figure 8-1) The set of isophase contours between a station pair forms a series of lanes, each corresponding to one complete cycle of phase difference. In the direct ranging mode, lanes are formed by concentric rings of zero phase with a constant interval of one wavelength (16 NM at 10.2 kilohertz (kHz)). In the hyperbolic mode, one complete cycle of phase difference occurs every one half wavelength. Therefore, 10.2 kHz hyperbolic lanes are 8 NM wide on the baseline, and gradually diverge as the distance from the baseline increases. Each lane, or cycle of the phase, is divided into hundredths of a lane called centilanes (cel). The phase difference between station pairs, measured in hundredths of a cycle or centicycles (cec), gives a hyperbolic line of position (LOP) within an Omega lane. (The term cel refers to the fraction of the charted lane. The term cec refers to the phase measurement as a percentage of a cycle. At 102 kHz, they are numerically equal and often used interchangeably, with cec used most commonly.) For example, in Figure 8-2 phase differences of 20 cec and 50 cec between stations A and B would give LOP's as shown. Twenty cec would indicate an LOP 20 percent of a lane width from the lane boundary; 50 cec would indicate an LOP 50 percent of a lane width from the lane boundary. Fractional lane widths are taken from a given lane boundary toward the direction of the station with the letter designation occurring later in the alphabet (from the "lower" letter to the "higher" letter). Since the same phase difference will be observed at any point on an LOP, a second LOP must be taken using another station pair to obtain a position fix. In Figure 8-3, the phase difference A-B is 50 cec, and the phase difference B-C is 80 cec. The intersection of these LOP's gives a position fix. In actual practice, propagation corrections (PPC's) would be applied to the observed phase difference readings before plotting.

FIGURE 8-2. PHASE MEASUREMENT WITHIN AN OMEGA LANE

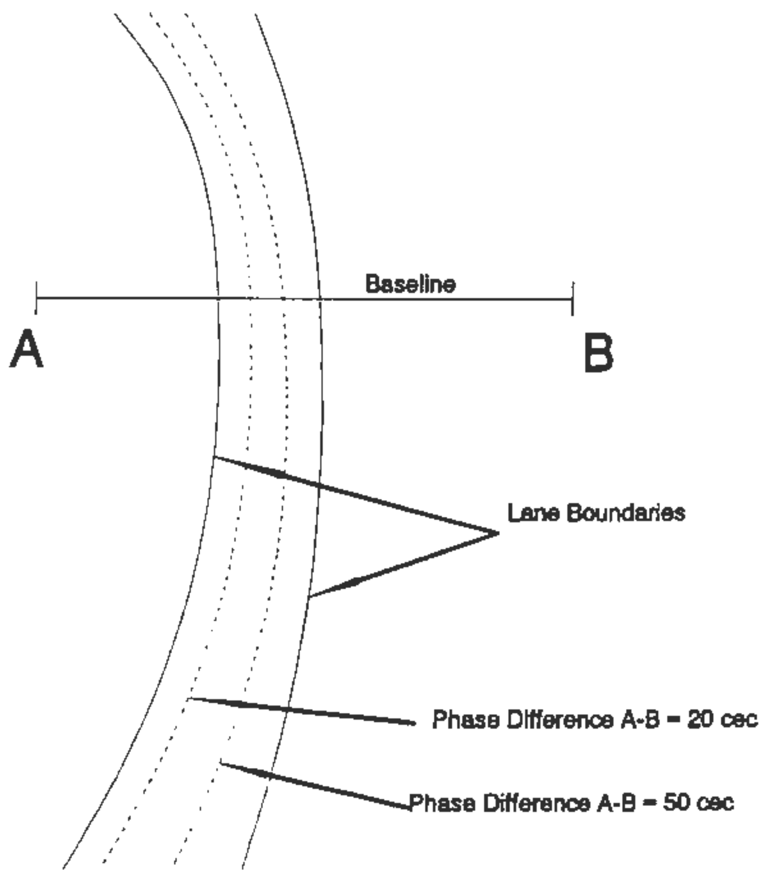
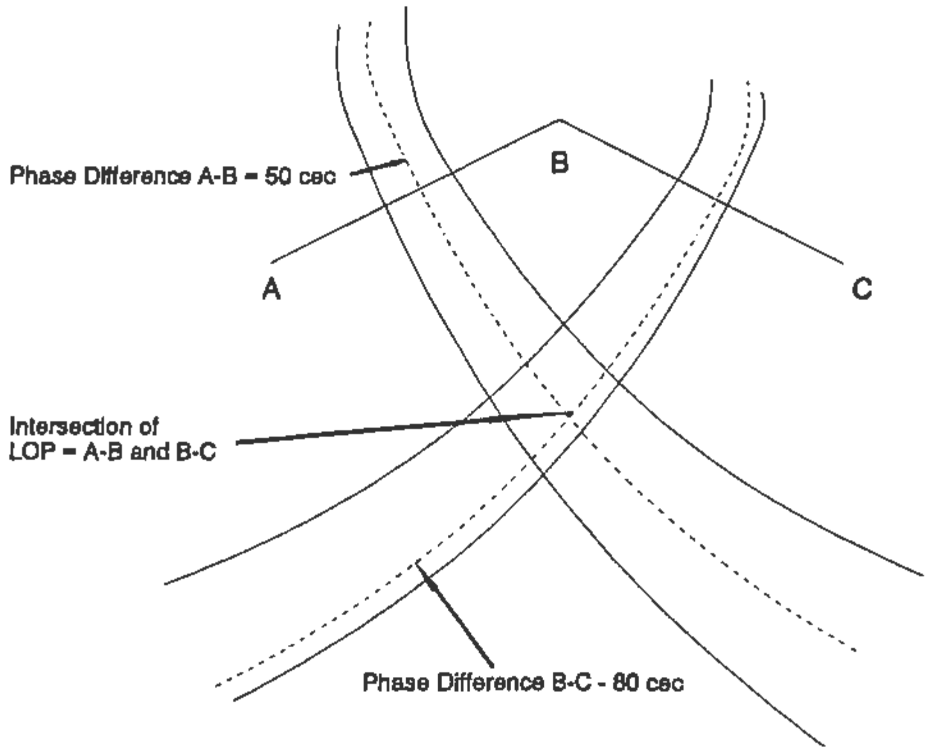


FIGURE 8-3. POSITION FIX BY INTERSECTION OF HYPERBOLIC LOP'S



v. ***Lane Ambiguity***. In the preceding examples, it is assumed that the aircraft's position is known to within a particular set of lanes. Because of the cyclic nature of the phase differences, the same phase difference can be observed in any lane. This is known as lane ambiguity. On the baseline between station pairs, there are about 600 10.2 kHz lanes. Each lane is 8 NM wide on the baseline, and diverges to about 12-15 NM near the limits of coverage. The navigator must know which of these lanes the aircraft is in before plotting a fix. Lane ambiguity can be resolved by three methods. The preferred method is to set the receiver's lane count at a known location, such as the point of departure. As the aircraft moves across lane boundaries, the receiver will automatically update the lane identification numbers, allowing the navigator to plot fixes with phase difference measurements in a known lane. If the lane count is lost, the lane count must be reset based on DR, celestial fix, or other means. The third alternative is to derive a course lane using multiple frequencies.

The preceding examples have considered only 10.2 kHz. Many receivers are capable of using the other Omega frequencies for various purposes. One such purpose is lane ambiguity resolution. There is a 3:4 frequency ratio between 10.2 kHz and 13.6 kHz. This relationship also applies to other wavelengths. Three 10.2 kHz wavelengths are the same length as four 13.6 wavelengths (Figure 8-4), or 24 NM on the baseline in the hyperbolic mode (48 NM in the direct ranging mode). A wavelength of 24 NM would correspond to a frequency of 3.4 kHz, which is the difference between 10.2 and 13.6 kHz. The receiver can synthesize a 3.4 kHz Omega signal by combining the 10.2 and 13.6 kHz signals. The 10.2 kHz lane numbers, which are evenly divisible by 3, form the boundaries of 3.4 kHz course lanes (Figure 8-5). The 3.4 kHz phase differences can be plotted in these course lanes. The resulting fix is then used to reset the 10.2 kHz lane count.

FIGURE 8-4. USING FREQUENCY DIFFERENCES TO DERIVE COURSE LANES

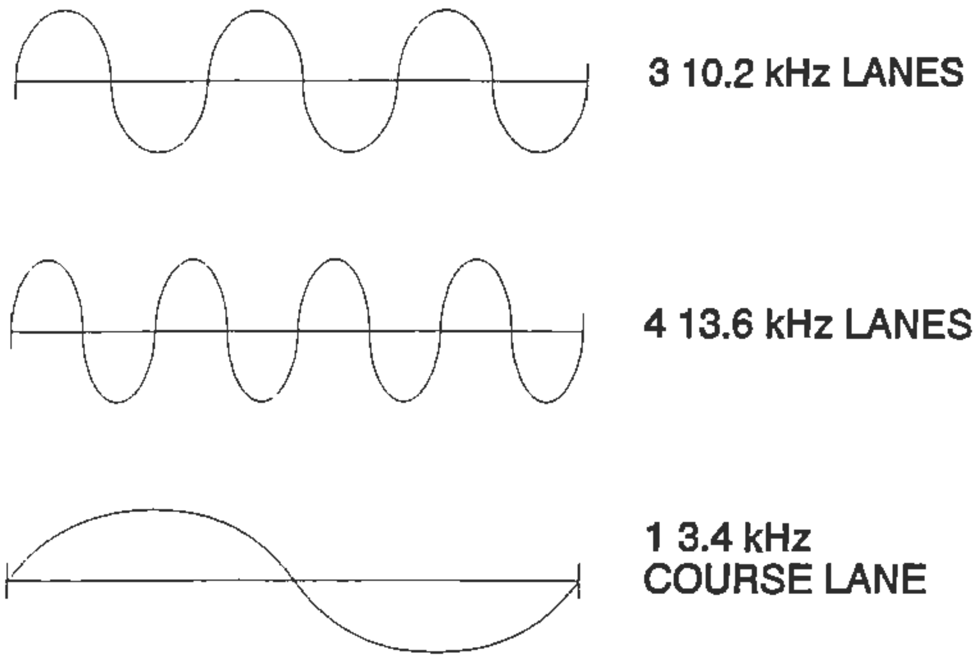
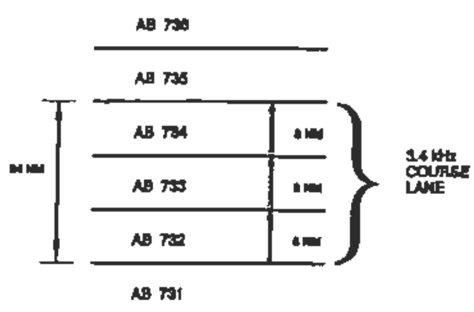


FIGURE 8-5. COURSE LANE BOUNDARIES IN THE HYPERBOLIC MODE



w. ***Omega Navigation System Center.*** The Omega Navigation System Center (ONSCEN) is the Coast Guard unit responsible for the operational control of Omega. ONSCEN is staffed on weekdays between 7:00 a.m. and 3:30 p.m., eastern time. During these hours information on Omega, including the current system status, scheduled off-air periods, and any navigational warnings in effect may be obtained by calling (703) 866-3800. At other times a command duty officer (CDO) is on watch and can be contacted by calling the same number; a recorded message will give the name and telephone number of the CDO. Written inquiries may be addressed to: Commanding Officer, Omega Navigation System Center, 7323 Telegraph Road, Alexandria, VA 22310-3998. A recorded message giving the current status of Omega is available at any time by calling (703) 866-3801. This recording gives the dates and times of scheduled off-air periods, any navigational warnings in effect due to signal disturbances, and any other important system information. Routine Omega status reports and navigational warnings are also available through the following means.

(1) ***Telex/mail.*** Omega status reports are issued weekly by telex or mail to users of Omega equipment. Navigational warnings are not issued by telex or mail. Write to ONSCEN at the address given above.

(2) ***Radio broadcast.*** The U.S. Department of Commerce (DOC), National Institutes of Standards and Technology, broadcasts Omega status advisories on radio stations WWV, Fort Collins, CO and WWVH, Kauai, HA on 2.5, 5, 10, and 15 MHz. WWV also broadcasts on 20 MHz. Omega status advisories are broadcast at 16 minutes past each hour on WWV, and at 47 minutes past each hour on WWVH. These advisories contain dates for scheduled off-airs and any navigational warnings in effect. Because each announcement is limited to 40 seconds, the specific times for each off-air period may not be given.

(3) ***NOTAM.*** When alerted by the Coast Guard, the FAA issues NOTAM's to warn of signal disturbances or unscheduled off-air periods. Airmen should consult their local FAA office for details regarding the issuance of Omega NOTAM's.

x. ***Aviation Use of Omega.*** Whereas INS position errors normally accrue gradually with elapsed flight time, most Omega errors occur suddenly and are usually multiples of the basic lane width. Effective cross-checking procedures should be accomplished at regular intervals and LAR or in-flight updating should be initiated when the position accuracy is in doubt. In addition to the general practices and procedures contained in Section 1, above, the following recommendations apply to Omega systems.

(1) ***Preflight.***

(a) Crews should be alert for any NOTAM's affecting the operational status of the individual Omega transmitters, particularly for possible abnormal operation. Deselection of any station reported to be in abnormal operation should be considered at the onset of the flight. Also, crews should be alert for any NOTAM's relating to the propagation disturbances, such as sudden ionospheric disturbances, sudden phase anomalies, or polar cap anomalies, which may affect Omega positioning accuracy. Scheduled Omega status broadcasts on station WWV should be monitored as a means of obtaining current Omega information.

(b) The Omega software and modification status codes should be verified by flightcrews to ensure that the proper equipment is installed and that the appropriate checklist is available and is used.

(c) At certain ground locations, particularly at congested terminals, abnormally high radio noise levels may adversely affect Omega. For example, synchronization may take longer than normal or the inserted ramp coordinates may drift after insertion. Synchronization or DR warning lights usually indicate this situation. This problem normally disappears, if the Omega equipment is serviceable, shortly after the switch to aircraft power or after the aircraft is moved from the gate. Care should be exercised during taxi, since abrupt turns may cause a momentary loss of signals which could affect system accuracy. It is good practice to cross-check present position coordinates or taxi distance before takeoff to detect any errors which may have occurred since initialization.

(2) ***In-Flight Updating.*** The same considerations basic to updating an INS also apply to Omega due to the normal accuracy and reliability of these systems. However, in addition to the capability to update over a navaid, most Omega systems are capable of performing a LAR if certain signal strength and station geometry requirements are met. Unless an apparent Omega error exceeds 6 NM, a lane slip may not necessarily have occurred and LAR or updating is not normally recommended. If an LAR appears to be necessary, the LAR should be initiated on only one system at a time so that the other system remains unaffected for use as a cross-check. The LAR should be attempted first on the system believed to be the least accurate.

y. ***Navigation Errors by Omega Equipped Aircraft.*** If a navigation error is discovered by a crew of an Omega equipped aircraft, or if a crew of an Omega equipped aircraft is notified of a navigation error by ATC, a report containing the information listed in Figure 8-6 should be submitted to the FAA. This information should be sent by mail or facsimile (fax) to the FSDO nearest the aircraft's base of operation or, if applicable, to the FSDO that holds the operator's operating certificate.

8. GLOBAL POSITIONING SYSTEMS (GPS).

a. *GPS.* The GPS is a satellite based radio navigation system that uses precise range measurements from GPS satellites to determine a precise position anywhere in the world. The GPS constellation consists of 24 satellites in various orbital planes approximately 11,000 NM above the earth. The satellites broadcast a pseudorandom code timing signal and data message that the airborne equipment processes to obtain satellite position and status data, and to measure how long each satellite's radio signal takes to reach the receiver. System performance specifications contained in this AC are based upon that achieved with above constellation configuration once declared operational, and with selective availability (SA) active. By knowing the precise location of each satellite and precisely matching timing with the atomic clocks on the satellites, the receiver can accurately measure the time the signal takes to arrive at the receiver and thus determine the satellite's precise position. A minimum of three satellites must be in view to determine a two-dimensional position. Four satellites are required to establish an accurate three-dimensional position. GPS equipment determines its position by precise measurement of the distance from selected satellites in the system and the satellite's known location. The accuracy of GPS position data can be affected by equipment and various geometric factors. Many of these errors can be reduced or eliminated with mathematics and sophisticated modeling, while other sources of errors cannot be corrected. Accuracy measurements are effected by satellite geometry or geometric dilution of precision (GDOP), which multiplies the effect of pseudorange errors in the system. The following are sources of pseudorange errors.

(1) Atmospheric propagation delays can cause relatively small measurement errors, typically less than 100 feet. Ionospheric propagation delays can be partially corrected by sophisticated error correction capabilities.

(2) Slight inaccuracies in the atomic clocks on the satellites can cause a small position error of approximately 2 feet.

(3) Receiver processing (mathematical rounding, electrical interference, etc.) may cause errors that are usually either very small (which may add a few feet of uncertainty into each measurement) or very large (which are easy to detect). Receiver errors are typically on the order of 4 feet.

(4) Conditions that cause signal reflections (multipath) before the satellite's transmitted signal gets to the receiver can cause small errors in position determination or momentary loss of the GPS signal. While advanced signal processing techniques and sophisticated antenna design are used to minimize this problem, some uncertainty can still be added to a GPS measurement.

(5) Satellite ephemeris data can contain a small error of approximately 4 feet.

The U.S. Department of Defense (DOD) is responsible for operating the GPS satellite constellation and constantly monitors the GPS satellites to ensure proper operation. Every satellite's exact measured orbital parameters (ephemeris data) are sent to each satellite for broadcast as part of the data message sent in the GPS signal. The GPS coordinate system is the cartesian earth-centered, earth-fixed coordinates as specified in the DOD World Geodetic System 1984 (WGS-84). Navigation values such as distance and bearing to a waypoint, groundspeed, etc. are computed from the aircraft's latitude/longitude and the location of the waypoint. Course guidance is usually provided as a linear deviation from the desired track of a Great Circle course between defined waypoints. GPS navigation capability from the 24 satellite constellation is available 24 hours a day anywhere in the world. GPS status is broadcast as part of the data message transmitted by the satellites. Additionally, system status is planned to be available through NOTAM's. Status information is also available by means of a telephone data service from the U.S. Coast Guard. Availability of suitable navigation capability from the satellite constellation is expected to approach 100 percent. GPS signal integrity monitoring will be provided by the GPS navigation receiver using receiver autonomous integrity monitoring (RAIM). For GPS sensors that provide position data only to an integrated navigation system (FMS, multisensor navigation system, etc.), a level of GPS integrity equivalent to that provided by RAIM may be provided by the integrated navigation system. Availability of RAIM capability to meet nonprecision approach requirements in the United States with the 24 satellite constellation is expected to exceed 99 percent.

b. ***Selective Availability (SA).*** SA is essentially a method by which DOD can artificially create a significant clock and ephemeris error in the satellites. This feature is designed to deny an enemy the use of precise GPS positioning data. SA is the largest source of error in the GPS system. When SA is active, the DOD guarantees horizontal position accuracy will not be degraded beyond 100 meters (2 drms) 95 percent of the time, and beyond 300 meters 99.99 percent of the time. System performance specifications contained in this AC assume that SA is active.

c. ***Oceanic Operations.*** A GPS system or sensor that meets the requirements specified in TSO-C129 may be approved as a means, but not the sole means, of oceanic navigation, including navigation in NAT MNPS airspace.

d. ***Portable Units.*** All portable electronic systems and portable GPS units must be handled in accordance with the provisions of FAR § 91.21. The operator of the aircraft must determine that each portable electronic device will not cause interference with the navigation and communications systems of the aircraft on which it is to be used. The current FAA approval process involves structural mounting of GPS equipment. Mounting procedures should ensure that the units will be restrained when subject to emergency loads appropriate to the aircraft category. Portable GPS units which are attached by Velcro tape and require an externally mounted antenna are considered to be portable electronic devices and are subject to the provisions of FAR § 91.21. A critical aspect of any GPS installation is the installation of the antenna. Shadowing by the aircraft structure can adversely affect the operation of the GPS equipment. Each portable GPS antenna installation should be evaluated to the extent necessary to determine whether the structural modification to the airframe will be a major or minor alteration. FAA approval of avionic components, including antennas, requires an evaluation of the applicable aircraft certification regulations prior to approval of an installation. The regulations require that the components perform their intended functions and be free of hazards in and of themselves and to other systems as installed. The FAA also reviews the structural analysis of the equipment installation, including the antenna, to ascertain whether structural mounting requirements are satisfied. Antenna installations in close proximity to a Traffic Alert and Collision Avoidance System (TCAS), satellite communication, or other transmitting antennas will be evaluated for potential, mutual interference. A portable GPS unit will not be approved by the FAA for flights under IFR or VFR unless the complete system is installed and evaluated in accordance with the FAA's interim policy guidance dated March 20, 1992, as amended. This guidance states, in part, that the installed GPS unit must not interfere with the normal operation of any other installed equipment or structural mounting requirement, and that a placard stating "GPS Not Approved for IFR" is mounted in the aircraft.

Pilots should be aware that a GPS signal is weak, typically below the value of the background noise. Electrical noise in the vicinity of the antenna can adversely affect the performance of the system. It is recommended that installations be flight tested in conjunction with other navigation equipment prior to using the system for actual navigation.

In March 1993, the FAA granted approval for U.S. civil operators to use GPS to fly FAR Part 97 VOR, VOR/DME, NDB, tactical air navaid (TACAN), and various area navigation (RNAV) instrument approach procedures (IAP). This approval does not constitute approval of GPS as long-range navigation equipment. Additionally, GPS units used for the approved approaches must meet the requirements of TSO C-129 or equivalent and AC 20-130, Airworthiness Approval of Multi-Sensor Navigation Systems for use in the U.S. National Airspace System and Alaska.

FIGURE 8-6. NAVIGATION DEVIATION REPORT FOR OMEGA EQUIPPED AIRCRAFT

1. Details of aircraft and reported error.
Name of operator:
Aircraft identification:
Date/time of observed error:
Flight level (FL):
Position (lat/long):
Approximate cross-track deviation (NM):
2. Was Omega being used as the primary means of navigation and steering guidance?
3. Do you consider failure of, or difficulty with, the Omega system as a contributory cause of the deviation? (If not, do not complete items 5-10)
4. Manufacturer of Omega equipment, type of equipment, most recent modification date.
5. Give details of cleared track within NAT oceanic airspace.
6. Give details of any problems experienced with Omega, together with the approximate geographic location.
7. Give details of Omega/VLF signals used and received signal strength.
8. Have there been previous difficulties with the Omega installation? If so, give details.
9. Have any faults been discovered during general checks/maintenance work?
10. What rectification work has been performed?
11. Please provide any additional information that you feel is relevant.

CHAPTER 9. HELICOPTER OCEANIC OPERATIONS

1. GULF OF MEXICO.

a. ***Background.*** Although helicopter operations in the Gulf of Mexico have an enviable safety record, recent statistics indicate that a significant rise in weather-related accidents has occurred. It is imperative that pilots performing oceanic (offshore) operations do not exceed the minimum weather criteria for visual flight rules (VFR) and instrument flight rules (IFR) flight or the minimum flight altitude parameters for all phases of flight. The operator must comply with all applicable minimum equipment requirements for the operation.

Two documents that address issues and requirements for improving rotorcraft operations within the National Airspace System are "Rotorcraft Terminal ATC Route Standards" (FAA/RD-90/18) and "Rotorcraft En Route ATC Route Standards" (FAA/RD-90-19). These documents are available to the public through the National Technical Information Service, Springfield, Virginia 22161. All operators should obtain these two documents and ensure that crews are familiar with the operating procedures discussed in these documents.

b. ***Flight in Environmentally Sensitive Areas.*** Protection of endangered species and overflight of environmentally sensitive areas are of increasing concern in the Gulf of Mexico. Infringements by low flying airplanes and/or rotorcraft operating en route to airways in the Gulf of Mexico or to helidecks can be disruptive to wildlife while over the shore or near the shore. Guidelines for flights in these areas are contained in the Airman's Information Manual (AIM), in Advisory Circular (AC) 91-36 "VFR Flight Near Noise-Sensitive Areas," on VFR sectional maps, and on specially designed maps published by Minerals Management Service of the Department of the Interior.

2. IFR OFFSHORE OPERATIONS.

a. ***General.*** Any operator that desires to conduct IFR operations in uncontrolled airspace shall submit a letter describing the proposed operation to the certificate holding district office (CHDO). This letter should include the specific routes to be flown, the exact location of the destination, the type of aircraft to be used, the navigation equipment on the aircraft, and the specific navigational aids (navaids) to be used at the offshore facility, if any.

b. ***Offshore Operators.*** FAR Part 91 offshore operators are required to obtain a Letter of Authorization (LOA) for IFR operations. The LOA will be issued once all certification requirements are met.

c. ***FAA Coordination.*** After reviewing the request, the CHDO will arrange a coordination meeting with air traffic elements that will he involved (such as the center, approach control, flight service station (FSS), etc.). If a navaid exists at the offshore facility, the regional flight procedures branch may also be represented at the coordination meeting. If the proposed operations are to be conducted in a region other than that of the CHDO, the CHDO will coordinate with the FSDO having jurisdiction of the geographic area where operations are to be conducted. The jurisdictional flight standards district office (FSDO) will perform route checks and other required inspections, and forward reports of these inspections to the CHDO. When all requirements have been met, the CHDO approves the operation and issues operation specifications or an LOA.

d. ***Navigation Requirements and Procedures.*** Operators will be inspected to ensure that the required navigational equipment, including radar altimeter and mapping radar, is appropriately installed and approved for the proposed operation. If flight routes are predicated on the use of an area navigation (RNAV) system, operators should ensure that they are in compliance with AC 90-45, "Approval of Area Navigation Systems for use in the U.S. National Airspace System." An operator that seeks approval for IFR operations must ensure that the following navigation requirements are met.

(1) ***Route Requirements.*** Operators may develop proposed routes using Class I station-referenced navaids where adequate signal coverage is available. In areas where signal coverage is not available, the operator must provide a suitable means of Class II navigation. The FAA will require a validation test in VFR conditions to ensure that the operator is able to demonstrate adequate navigational performance for the route(s) before granting approval for use of the route(s).

(a) For approval of IFR operations using Class I navaids, appropriate approach plates and operating procedures must be approved by the FAA and published in the operator's manual. Use of the procedures will be authorized through a nonstandard operations specifications paragraph that refers to the operator's manual containing these procedures.

(b) For approval of IFR operations using nonterminal navaid facilities, the operator must submit a written request to the CHDO for a helicopter offshore procedure according to AC 90-80, "Approval of Offshore Helicopter Approaches."

(2) ***Extended Overwater or IFR Operations Equipment.*** All navigation equipment to be used in extended overwater or IFR operations must meet FAR § 135.165(b) requirements. If positive course guidance for any portion of the route is obtained through the use of long-range navigation equipment such as very low frequency (VLF), Omega, or Loran-C, two independent receivers for navigation must be installed and be operative before approval is granted.

e. ***Weather Reporting Requirements.*** A weather reporting facility approved by the National Weather Service (NWS) or the FAA must be present and operable within 10 nautical miles (NM) of the destination. A remote source may be approved by the FAA (with NWS concurrence) as a deviation from the provisions of FAR § 135.213(b) when the operator is able to demonstrate an adequate level of safety for the proposed operations. The approval for this deviation will be published in the operation specifications.

f. ***Helicopter En Route Descent Areas (HEDA's).*** An operator that desires to establish a HEDA shall submit a written request to its CHDO. If the proposed HEDA is outside the CHDO's geographic area of responsibility, the CHDO will forward the request to the jurisdictional FSDO. The letter of request should include the following information:

(1) A pictorial and/or a written description of the proposed HEDA

(2) The means by which positive course guidance is to be established

(3) Equipment requirements for use in the HEDA

(4) Proposed operations and training manual revisions to incorporate HEDA's, if an initial application for approval of a HEDA

(5) The date of first intended use and the proposed length of service for which authorization is sought

g. ***HEDA Procedures and Requirements.*** Prior to granting authorization, the CHDO or jurisdictional FSDO will coordinate with a flight inspection procedures specialist to determine if the proposed HEDA is clear of obstructions and that positive course guidance is available for the entire route, including descent to the lowest authorized altitude (LAA). All required flight and navigation equipment must be installed and operative to utilize the 400-foot minimum. Figures 9-1 and 9-2 portray the en route dimensions contained in FAA Order 8260.3, "U.S. Standards for Terminal Instrument Procedures," that should be used to develop the primary and secondary areas for HEDA use. HEDA's have the profile of Figure 9-3 and the dimensions of the plan view as shown in Figure 9-4. The descent area begins at the descent fix and ends at the descent altitude fix. This area must be located over water and be free of obstacles.

(1) *Inoperative Equipment.*

(a) The LAA will be increased to 700 feet as shown in Figure 9-5 with the radar altimeter inoperative.

(b) The LAA will be increased to 700 feet as shown in Figure 9-6 with the mapping radar inoperative.

(c) When the radar altimeter is inoperative, altitude will be adjusted upward 5 feet for each mile over 5 miles from the altimeter setting source to the descent altitude fix.

(2) Operations specifications for HEDA's are valid for 1 calendar year from the date of issue. Operators wishing to obtain HEDA revalidation must submit written confirmation to the CHDO that the HEDA is clear of obstructions and that positive course guidance is available. The operator must provide the means for any on-site inspections requested by the CHDO or FSDO.

FIGURE 9-1. EN ROUTE PROFILE

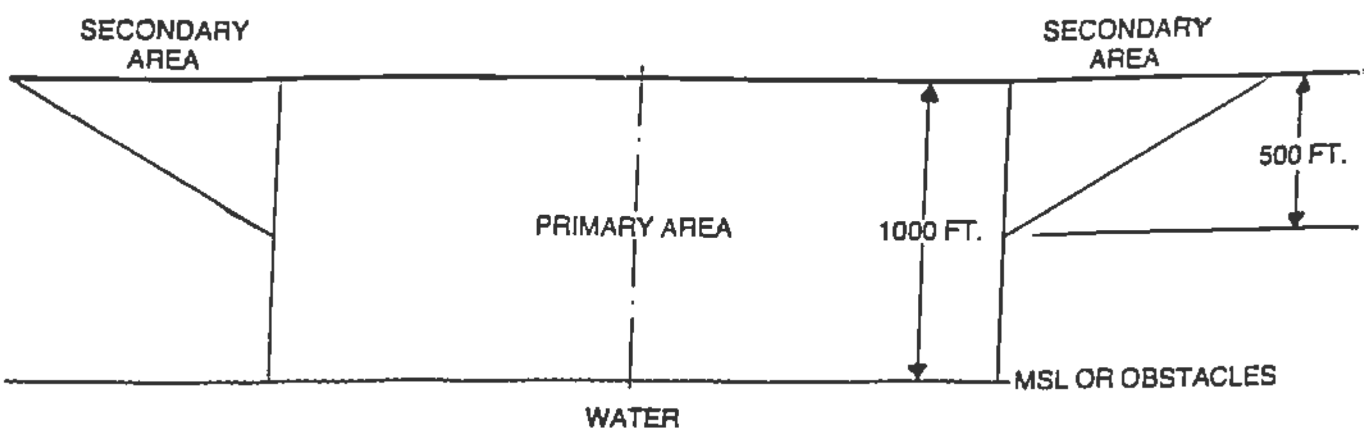


FIGURE 9-2. EN ROUTE PLAN VIEW

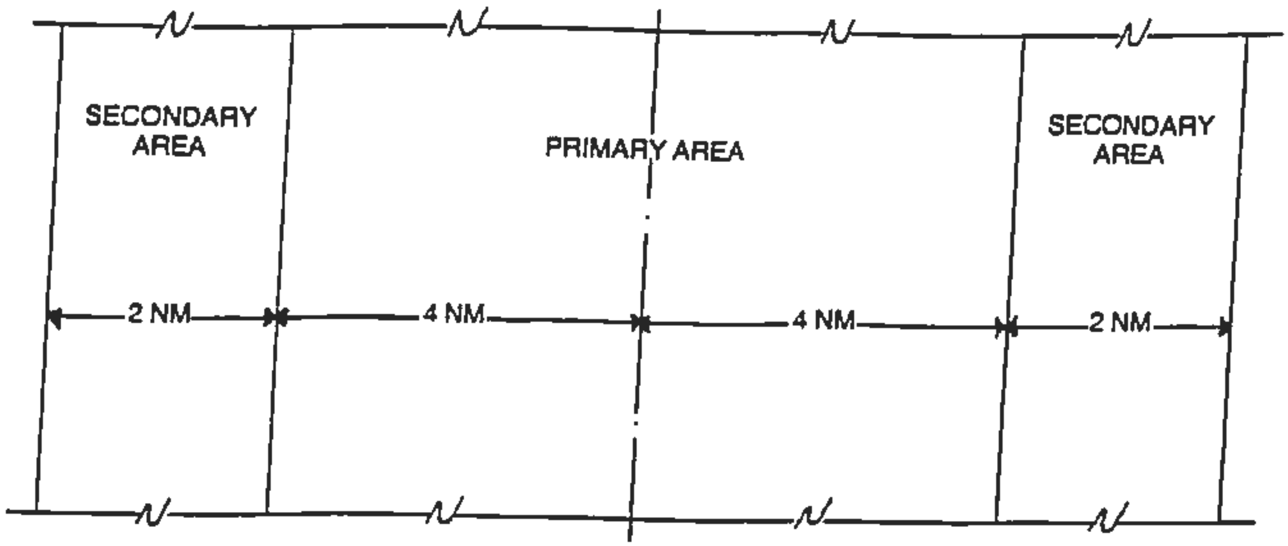


FIGURE 9-3. HEDA PROFILE

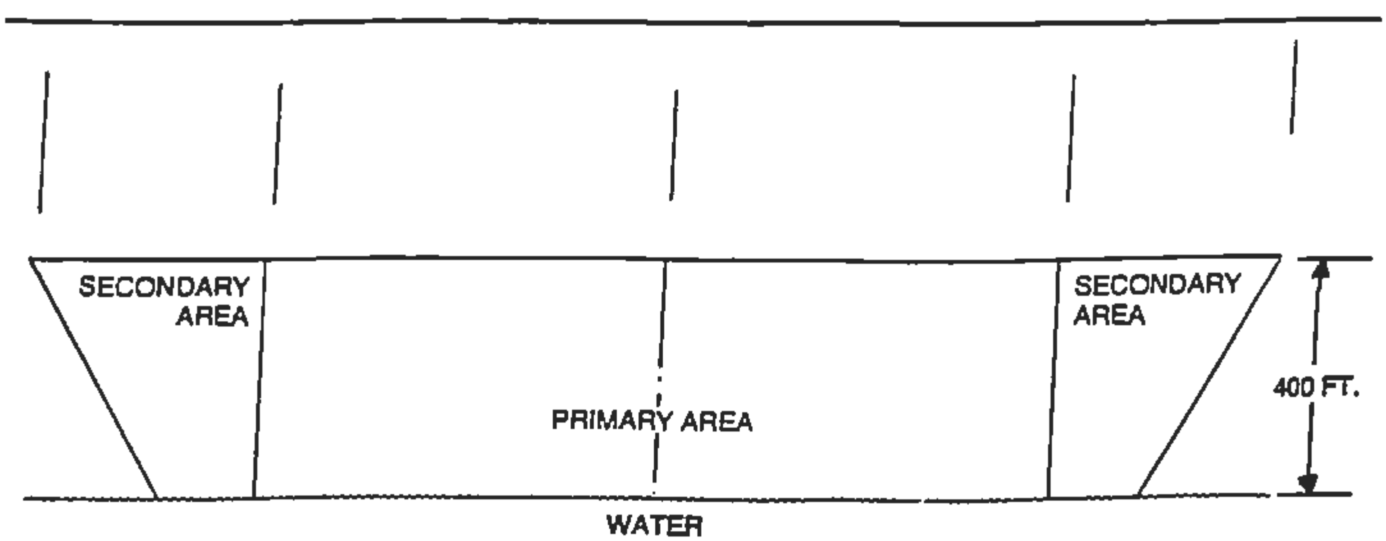


FIGURE 9-4. HEDA DIMENSIONS

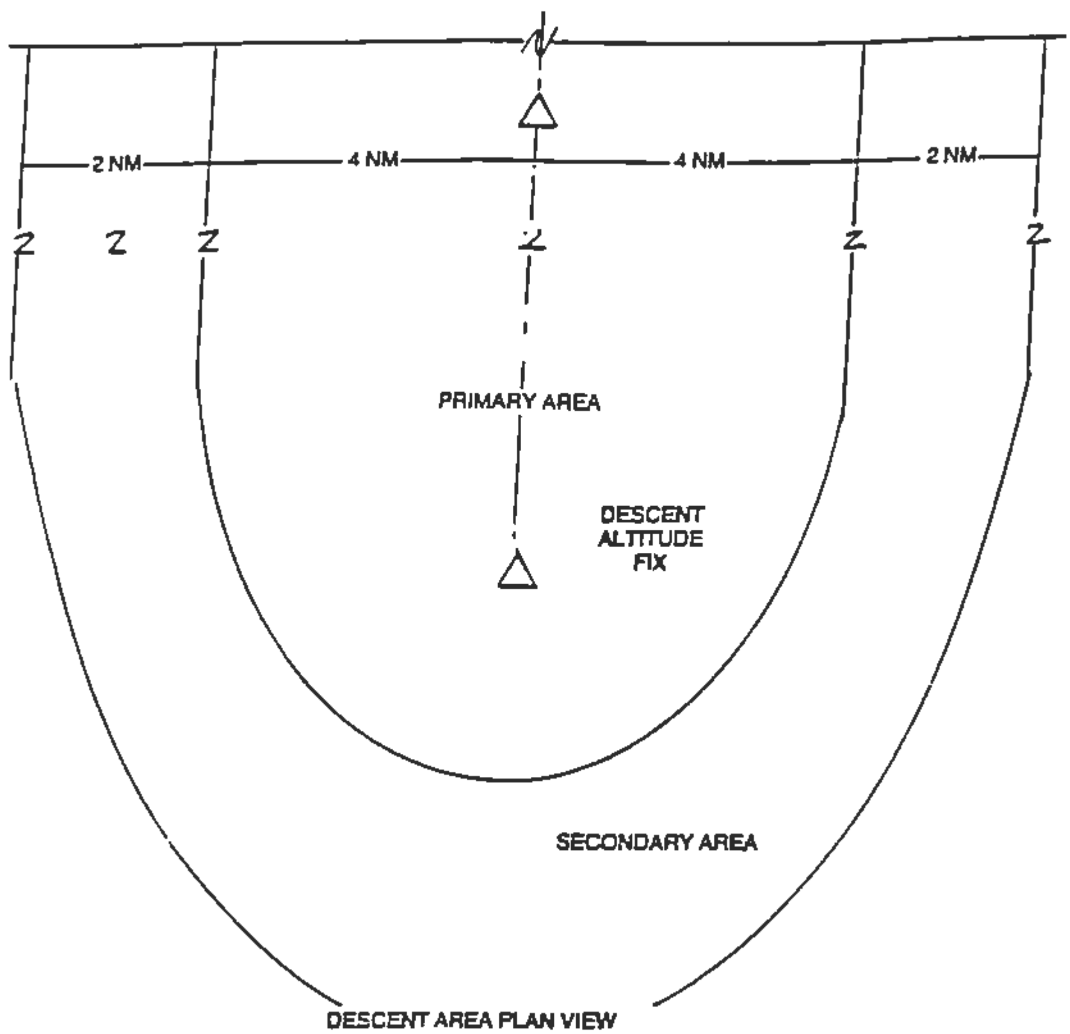


FIGURE 9-5. RADAR ALTIMETER INOPERATIVE

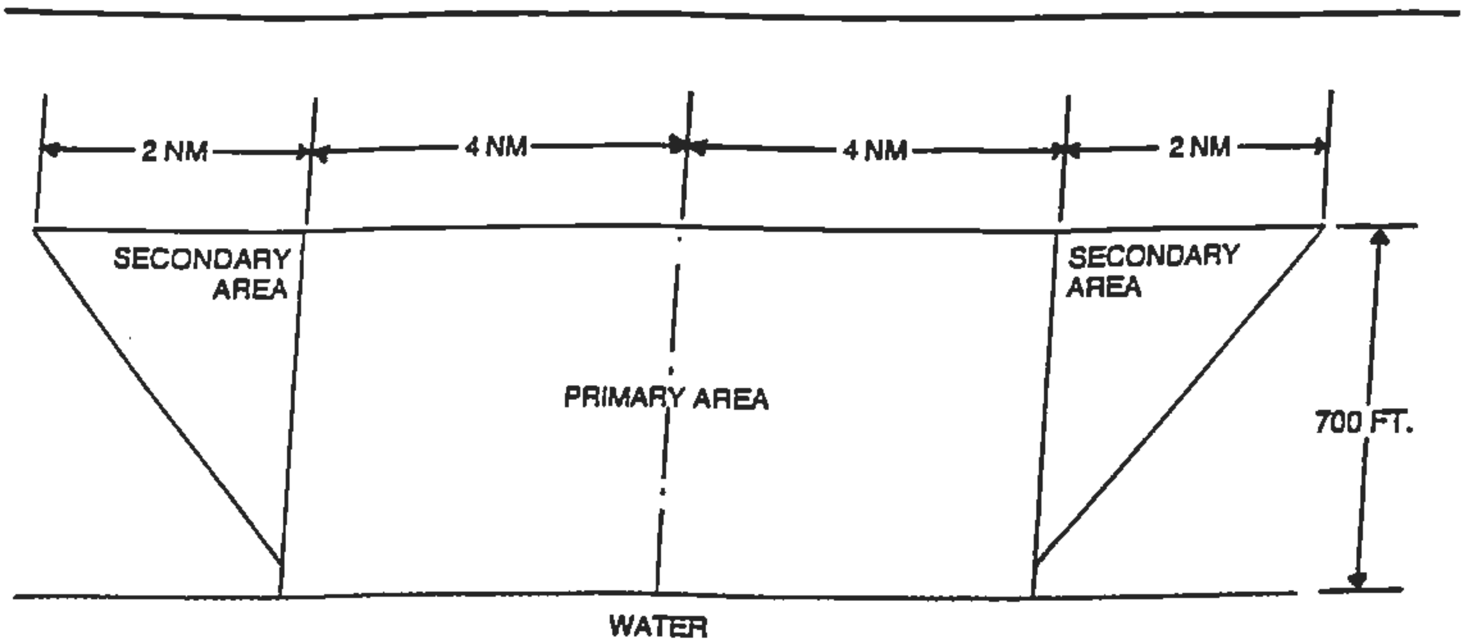
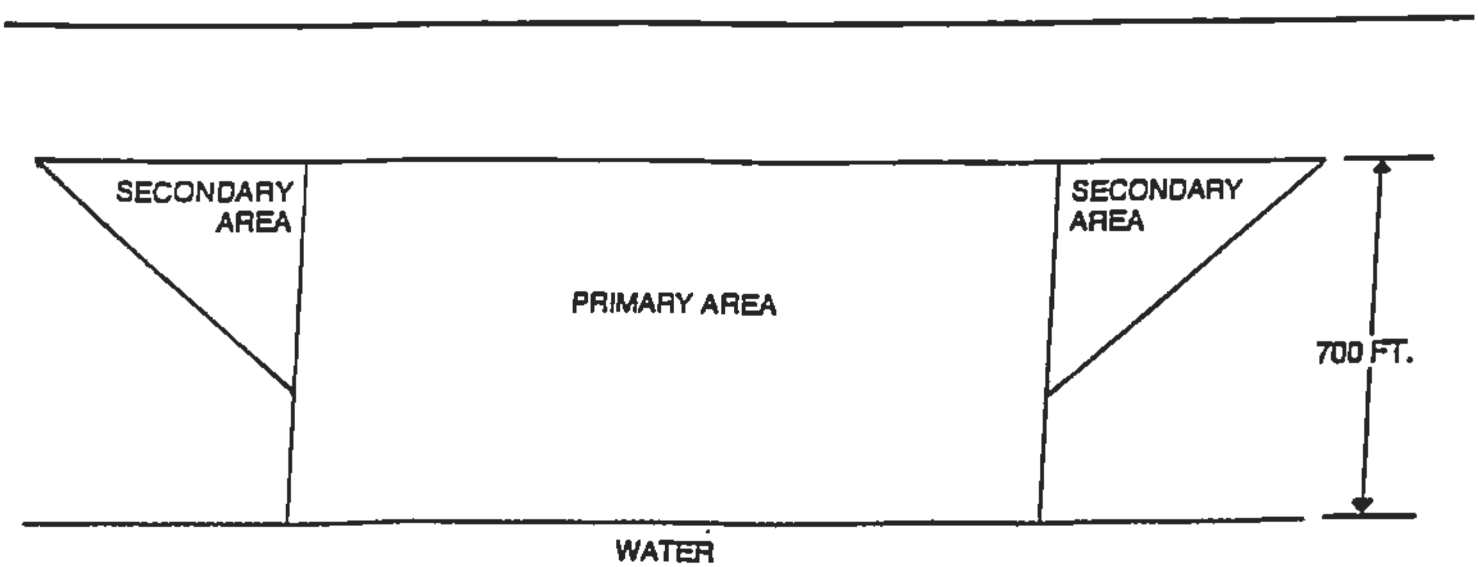


FIGURE 9-6. MAPPING RADAR INOPERATIVE



3. OFFSHORE INSTRUMENT APPROACH PROCEDURES.

a. *General.* These procedures are to be used by IFR-approved helicopter operators in an offshore environment to conduct instrument approaches to rigs, platforms, or ships that are at least 5 NM offshore in uncontrolled airspace. The helicopter will use the airborne radar approaches (ARA's) or the offshore standard approach procedures (OSAP's) for conducting instrument approaches in this environment.

b. *Approach Approval Procedures.* AC 90-80, "Approval of Airborne Radar Approach (ARA) Procedures for Helicopters to Offshore Platforms," contains approval guidance, procedures criteria, and a sample training program for offshore instrument approaches. ARA procedures are special instrument approach procedures approved under the provisions of FAA Order 8260.19, "Flight Procedures and Airspace," and FAA Order 8260.3.

(1) *ARA Approval Procedures.*

(a) The FSDO with geographic responsibility for the area in which the ARA will be conducted must verify the adequacy of obstacle clearances.

(b) Operators must demonstrate acceptable performance of en route and instrument approach procedures to the CHDO prior to the operator's obtaining approval to use these procedures.

(c) ARA's are documented on FAA Form 8260-7, "Special Instrument Approach Procedures."

(d) The FAA regional flight inspection and procedures (FIP) staff will inspect ARA's prior to approval by the CHDO. Minor changes of rig locations will be made in pen and ink, provided the en route egress point and procedures remain the same and the controlling obstacle does not change. Otherwise, the FIP staff will develop a new procedure.

(2) *OSAP Approval Procedures.*

(a) Operators that desire to conduct OSAP's must submit a written request to the CHDO according to the procedures stated in AC 90-80, as amended.

(b) The procedures contained in the request for approval will be evaluated and tested by the CHDO. Additionally, the operator's maintenance and training programs will be inspected prior to issuance of the authorization.

(c) Authorization for FAR Part 135 operators to conduct OSAP's will be made as part of the operations specifications.

(d) Authorization for FAR Part 91 operators to conduct OSAP's will be issued in an LOA (Figure 9-6)

FIGURE 9-7. SAMPLE LETTER OF AUTHORIZATION (LOA)

(Figure 9-7 is a sample LOA from AC 90-80, Appendix 5.)

January 20, 1993

Energy Resources, Inc.
1234 Fifth Avenue
Wellhead, LA 98765

Gentlemen:

Energy Resources, Inc. is authorized to conduct helicopter offshore standard approach procedures (OSAP) under Federal Aviation Regulations (FAR) Part 91 within the areas listed in this letter. Energy Resources, Inc. shall conduct all OSAP operations in compliance with the conditions, limitations, and procedures in this letter and shall conduct no other OSAP operations.

(a) Energy Resources, Inc. is authorized to use the following OSAP approach and landing minimums for the helicopters listed in the following table, provided that the conditions and limitations in paragraphs (b) and (e) are met.

HELICOPTER TYPE MAKE/MODEL	MDA NOT LESS THAN	LOWEST VISIBILITY AUTHORIZED

(b) The flight instruments, radio navigation, and other airborne systems required by the applicable FAR must be installed and must be operational for OSAP operations. The airborne radar, Loran-C, and radar altimeter equipment listed in the following table is also required and, except for the radar altimeter, must be operational for OSAP operations.

HELICOPTER MAKE/MODEL/SERIES	ADDITIONAL EQUIPMENT

(c) Energy Resources, Inc. shall not conduct any OSAP operations unless an approved source of weather observations (including wave height) is located within 10 nautical miles of the approach target to which a particular OSAP is oriented, or extended operations are approved using enhanced weather information systems.

(d) No pilot or airborne radar operator shall conduct any OSAP operations in any helicopter unless that person has successfully completed the Energy Resources, Inc. training program and has been certified by an FAA inspector as qualified for OSAP operations.

FIGURE 9-7. SAMPLE LOA - Continued

(e) No pilot-in-command shall begin or continue the final approach segment of an OSAP unless all of the following conditions and limitations are met:

(1) the maximum indicated airspeed does not exceed 90 knots

(2) the maximum groundspeed does not exceed 70 knots (never slower than Vyse for multiengine helicopters) between the decision point altitude (DPA) and the missed approach point (MAP)

(3) there is no indication on the weather radar display of contouring due to the intensity of precipitation

(4) all obstructions that are observed on radar are avoided by at least 0.5 NM when below 900 feet MSL during a takeoff and departure procedure

(5) whenever a required radar altimeter is inoperative, the MDA must be increased by 5 feet for each NM in excess of 5 NM distance between the approach target and an approved altimeter setting source

(f) A missed approach shall be executed when any of the following conditions exist:

(1) any of the airborne equipment (other than a radar altimeter) required for the OSAP operations becomes inoperative

(2) at least 0.5 NM lateral separation from obstacles cannot be maintained after passing the DPA

(3) the approach target disappears from the radar display

(4) the reliability or accuracy of the Loran-C signal cannot be ascertained

(5) whenever the approach target is not in visual contact at any distance less than 0.7 NM

[Signed by the FSDO or CHDO office manager]

CHAPTER 10. CREW TRAINING FOR OCEANIC OPERATIONS

1. CREW QUALIFICATIONS.

a. ***Background.*** In the "International Standards and Recommended Practices - Annex 6, Operation of Aircraft," the International Civil Aviation Organization (ICAO) makes the following stipulations for flights outside the jurisdiction of member states:

(1) An operator shall ensure that all employees, when abroad, know that they must comply with the laws, regulations, and procedures of those states where operations are conducted.

(2) An operator shall ensure that all pilots are familiar with the laws, regulations, and procedures pertinent to the performance of their duties that are prescribed for the areas to be traversed, the airports to be used, and the related air navigation facilities. The operator shall ensure that other members of the flightcrew are familiar with such of these laws, regulations, and procedures that are pertinent to the performance of their respective duties in the operation of the aircraft.

(3) When the operation is conducted by the pilot-in-command (PIC), the PIC must:

(a) Comply with the relevant laws, regulations and procedures of the United States.

(b) Assume responsibility for the operation and safety of the aircraft and for the safety of all persons aboard during flight time.

(c) If an emergency situation that endangers the safety of the aircraft or persons necessitates action involving a violation of local regulations or procedures, the PIC shall notify the appropriate local authorities without delay. If required by the state where the incident occurs, the PIC shall submit a report on any such violation to the appropriate authority of that state. In that event, the PIC shall also submit a copy in writing to the FAA Flight Standards National Field Office, AFS-500, P.O. Box 20034, Washington, DC 20041-2297. Such reports shall be submitted within 10 days of the incident.

(d) The PIC shall be responsible for notifying the nearest appropriate authority by the quickest available means of any accident involving the airplane resulting in serious injury or death of any person or substantial damage to the airplane or property.

b. ***Pilot as PIC.*** An operator shall not use a pilot as PIC of an aircraft on a route or route segment for which that pilot is not currently qualified until that pilot has demonstrated to the operator an adequate knowledge of the following:

(1) The route to be flown and the airports to be used

(2) The terrain and minimum safe altitudes

(3) The seasonal meteorological conditions

(4) The meteorological, communication and air traffic facilities, services and procedures

(5) The search and rescue procedures

(6) The navigational facilities and procedures, including any long-range navigation procedures associated with the planned route

The PIC must also demonstrate an adequate knowledge of procedures applicable to flight paths over heavily populated areas and areas of high air traffic density; obstructions; physical layout; lighting; approach aids and arrival, departure, holding and instrument approach procedures (IAP's); and applicable operating minimums. The PIC shall have made an actual approach into each airport of landing on the route, accompanied by a pilot who is qualified for that aircraft, as a member of the flightcrew or as an observer on the flight deck, unless:

(1) The approach to the airport is not over difficult terrain and the IAP's and aids available are similar to those which the pilot is familiar, and a margin to be approved by the Administrator is added to the normal operating minimums, or there is reasonable certainty that a specific approach can be made in visual meteorological conditions (VMC).

(2) The descent from the initial approach altitude can be made by day in VMC.

(3) The operator qualifies the PIC to land at the airport concerned by means of an adequate pictorial presentation.

(4) The airport concerned is adjacent to another airport at which the PIC is currently qualified to land.

2. TRAINING CONSIDERATIONS.

a. Crews conducting oceanic flights shall be trained in a manner approved by the Administrator. Approval of air carrier's training programs will be granted in conjunction with their certification and subsequent issuance of operations specifications. General aviation aircraft desiring to fly in special use airspace will be granted approval through the issuance of a Letter of Authorization (LOA) (See Chapter 3 of this AC.) Crew qualifications for the issuance of an LOA may be satisfied by one of the following:

(1) Completing an operator's oceanic operations training program

(2) Completing a commercial oceanic operations training program

(3) Submitting military training records indicating prior oceanic operations experience

(4) Other methods indicating to the operator that the crew can safely conduct oceanic operations (Examples could include written or oral testing)

b. For a crew to be considered as being qualified for oceanic operations, crew members must be knowledgeable in the following subject areas:

(1) ICAO operational rules and regulations

(2) ICAO measurement standards

(3) Use of oceanic flight planning charts

(4) Sources and content of international flight publications

(5) Itinerary planning

(6) FAA international flight plan, ICAO flight plan, and flight log preparation

(7) Route planning within the special use airspace where flights are to be conducted

(8) En route and terminal procedures - different to U.S. procedures

(9) Long-range, air-to-ground communication procedures

(10) Structure of the special use airspace where the flights are to be conducted

(11) Air traffic clearances

(12) International meteorology, including significant weather charts, prognostic weather charts, tropopause prognostic charts, and terminal area forecasts (TAF's)

(13) Specific en route navigation procedures for each type of navigation equipment required for use in the special use airspace

(14) Emergency procedures, including required emergency equipment, search and rescue techniques, navigation equipment failure techniques, and communication equipment failure techniques

CHAPTER 11. GENERAL AVIATION SHORT-RANGE AIRCRAFT OCEANIC OPERATIONS

1. INTRODUCTION.

This Chapter provides guidance to the general aviation pilot who is flying a light, general aviation aircraft in oceanic operations, and specifically addresses aircraft with a relatively short range that cannot transverse an ocean without intermediate fuel stops.

Many of the chapters in this advisory circular (AC) contain important information relative to oceanic operations. All pilots should scan each of these chapters and determine the pertinence of each chapter relative to the flight being planned. In addition, the information contained in this Chapter should be read in detail. It is important to note that this Chapter includes International Civil Aviation Organization (ICAO) rules and Canadian departure requirements for transoceanic flights. These requirements become regulatory to U.S. pilots by virtue of the content of FAR § 91.703. Most short-range aircraft crossing the North Atlantic (NAT) will, out of necessity, make a Canadian departure. These aircraft are bound by Canadian regulations in addition to U.S. regulations and ICAO rules. Although emphasis in this Chapter is on NAT flights by short-range aircraft, the majority of the information is pertinent to all oceanic operations by short-range aircraft with the exception of operations in minimum navigation performance specification (MNPS) airspace. MNPS operations are covered in detail in Chapter 3.

2. ICAO GUIDANCE.

A number of incidents have occurred with NAT international general aviation (IGA) flights that were caused by noncompliance with basic requirements for navigation and communication equipment needed for oceanic flights or flights over remote areas. Most of the incidents were potentially bazardous to the aircraft occupants and to aircrew members called upon to conduct the searches. Some of the incidents resulted in needless and expensive alert activities on the part of the air traffic control (ATC) communicators and controllers, and in search activities by rescue facilities. The incidents generally involved flights that were considerably off-course or had not made the required position reports. This Section provides information for flight planning and operation of IGA flights across the NAT, in particular those operations carried out by light aircraft. IGA pilots planning to cross the Atlantic at altitudes between flight level (FL) 275 and FL 400 (the altitude limits of MNPS airspace) must obtain a Letter of Authorization (LOA) for FAR Part 91 operations, or must receive operations specification approval if conducting an air carrier operation. The approval processes are discussed in Chapter 3, Section 4 of this AC. Pilots planning to cross the Atlantic above MNPS airspace (FL 410 or higher) may wish to take advantage of the special climb-out provision detailed in Chapter 3, Section 2 of this AC.

a. ***The NAT Environment.*** The climate affecting NAT flight operations is demanding throughout the year, with storms or other adverse weather likely to be encountered during any season. It is probable that any transatlantic flight will encounter adverse weather on at least a portion of the flight. The scarcity of alternate airports available to transatlantic flights requires that all significant weather systems along the route be considered during the flight planning phase. Flights at higher NAT FL's (FL 275 - FL 400) are required to be equipped and authorized by the FAA for flights in the NAT MNPS airspace. Radio navigation systems available to pilots include Omega/very low frequency (VLF), Loran-C, and global positioning system (GPS). However, Loran-C coverage is incomplete in many areas, Omega equipped aircraft using E-field antennae are likely to suffer prolonged loss of signal reception when in or near a cloud covering, and a GPS system or sensor that meets the requirements specified in TSO-C129 may be approved as a means, but not the sole means, of oceanic navigation in NAT MNPS airspace. Therefore, it is extremely important that pilots understand the capabilities of their equipment and ensure that accurate navigation facilities exist to support their equipment throughout all of their proposed flight route. Several high power non-directional radio beacons (NDB's) located in the NAT region are useful to automatic direction finder (ADF)-equipped aircraft. Some of these stations, including commercial band transmitters, are not monitored for outages or interference by transmitters on adjacent frequencies and may be severely affected by atmospheric conditions without warning.

Very high frequency (VHF) communications coverage extends to line-of-sight distance from facilities in Canada, Iceland, Greenland, the Azores and coastal Europe. The Canadian VHF coverage is extended by use of a remote facility in southern Greenland. Charts showing the theoretical VHF coverage at FL 100, FL 150, FL 200, and FL 300 are shown in Figures 2-10, 2-11, 2-12, and 2-13 in Appendix 2 of this AC. High frequency (HF) communications are available throughout the NAT region for ATC purposes. Use of HF by pilots on IGA flights permits proper monitoring of the flight's progress. HF-equipped flights should be able to receive HF meteorological information for aircraft in flight (VOLMET) broadcasts, including significant meteorological information (SIGMET) and continuous meteorological updates, at major terminals in Europe and North America. Search and rescue (SAR) vessels and aircraft are stationed at some locations in the NAT region, but SAR aircraft may not always be available. The availability of SAR vessels may depend on the disposition of a nation's civil emergency fleet. These fleets are often composed of a nation's fishing fleet, and their proximity may depend on the current fishing situation.

b. ***Pilot Qualification Requirements.*** The minimum pilot qualification for any flight across the NAT is a private pilot certificate. Unless operating below FL 60 (6000 feet mean sea level (MSL)), the pilot-in-command (PIC) must hold an instrument rating. The demanding NAT operational environment requires that the PIC have the following flight experience in addition to cross-country flight time:

(1) The PIC must meet the recency of experience requirements stipulated in FAR Part 91.

(2) The PIC must have adequate recent flight experience in the use of the long-range navigation and communication equipment to be used. It is highly recommended that pilots document training received and their experience using this equipment prior to embarking on any oceanic flights. This documentation will be invaluable should a navigation error report be filed due to equipment difficulties that cause an error.

c. ***National Regulations.*** Pilots of U.S.-registered aircraft must comply with all applicable U.S. regulations, ICAO Annex 2, and the regulations of the states in which they land or overfly. In cases when U.S. regulations are more stringent than ICAO rule or vice versa, pilots are bound to adhere to the more stringent regulation or rule.

d. ***Flight Rules Over the High Seas.*** ICAO member states have agreed that ICAO flight rules will be in effect for operations over the high seas. However, responsibility for enforcement of these rules rests with the state of registry of the aircraft or the state of registry of the operator. ICAO flight rules are contained in ICAO Annex 2. Procedural aspects are covered in ICAO

Document 7030/3-NAT, "Supplementary Procedures Applicable in the NAT Region." Under FAR § 91.703, U.S.-registered aircraft must comply with ICAO Annex 2. U.S.-registered aircraft planning to operate in MNPS airspace must also comply with FAR § 91.705. Some of the more significant ICAO rules are paraphrased below:

(1) All flights that cross an international border must file a flight plan.

(2) All flights must file an instrument flight rules (IFR) flight plan when intending to fly in NAT airspace at FL 60 and above in New York, Gander, Shanwick, Santa Maria and Reykjavik Oceanic flight information regions (FIR's); at FL 60 and above in the Bodo Oceanic FIR beyond 100 nautical miles (NM) seaward from the shoreline; and at FL 200 and above in the Sondrestrom FIR.

(3) While en route, all changes to IFR flight plans shall be reported as soon as practicable to the appropriate air traffic service (ATS) as prescribed.

(4) An arrival report must be sent to the appropriate ATS unit. When the flight plan cannot be closed by means of the aircraft radio, either a telephone or telegraphic message should be sent. Failure to close flight plans may result in a needless search operation.

e. ***Operation of Aircraft.*** ICAO member states have agreed that aircraft with their registration mark will comply with the standards concerning the operation of aircraft contained in ICAO Annex 6, as a minimum. Some of the more pertinent standards are paraphrased below:

(1) Before commencing the flight, the pilot must be satisfied that the aircraft is airworthy, duly registered, and that appropriate certificates are on board. Pilots flying U.S.-registered aircraft should be especially concerned with the "duly registered" aspects of this section. FAR §§ 47.3 through 47.11 are specific regulations relative to the legality of U.S.-registered aircraft.

(2) Aircraft instruments and equipment must be appropriate for the operation, considering expected flight conditions. Chapter 2, Section 5 of this AC provides details of required instruments and equipment in addition to the information provided below.

(3) Meteorological information relevant to the flight must be obtained by the PIC and evaluated with regard to the planned route, destination, and alternative courses of action.

(4) Maps and charts that are current, suitable for the flight, and include alternative routes must be available on the aircraft.

(5) SAR information, including location of facilities and procedures to be used, should be obtained by the PIC.

(6) Notices to Airmen (NOTAM's) should be checked prior to departure to ascertain the status of radio navigational aids (navaids) and airport restrictions.

(7) Night operations can present additional problems that must be considered, such as increased navigation difficulties, fatigue, more demanding pilot skills, and other factors.

(8) The Aeronautical Information Publication (AIP) of states where landings will be made or for states that will be overflown should be checked prior to departure. Various chapters in this AC

provide the necessary operational information derived from the AIP's, particularly with respect to the requirements for the carriage of survival equipment.

f. *Equipment Requirements.* Life rafts will be carried when single engine aircraft operate more than 100 NM from shore, and when multiengine aircraft operate more than 200 NM from shore. These life rafts will contain at least the following:

(1) Pyrotechnic distress signals

(2) Food and water

(3) A VHF survival radio

g. *Navigation Equipment.* On transatlantic flights, aircraft shall be equipped with navigation equipment that will enable it to proceed in the following capacities:

(1) In accordance with the flight plan

(2) In accordance with the requirements of the ATS's

(3) In accordance with MNPS requirements when operating in that airspace (also see Chapter 3 for additional information relative to navigation equipment requirements in MNPS airspace)

h. *Communication Equipment.* In controlled airspace, flights must be able to conduct two-way radio communication on required frequencies. Use of emergency frequencies as a planned operation is in conflict with this rule. The VHF emergency frequency 121.5 megahertz (MHz) is not authorized for routine use. The frequency 131.800 MHz has been designated for use as the air-to-air communication channel in the NAT region. In the Gander, Shanwick, Santa Maria, Reykjavik, Sondrestrom and New York FIR's, HF radios are required to contact ATS units when beyond the range of VHF. Subject to prior arrangement, VHF-only flights may be made via Canada/Greenland/Iceland/Europe, provided the Shanwick FIR is avoided. It is recommended that pilots planning these types of flights obtain and study the individual AIP's pertaining to their route of flight.

i. *Special Requirements for Flights Transiting Greenland.* The elevation of the highest point in Greenland is 13,120 feet MSL, and the general elevation of the icecap is 9,000 feet MSL. Due to the low temperatures and high wind speeds, the lowest useable FL under certain conditions may be FL 235 near the highest point, and FL 190 near the icecap. High-capacity cabin heating systems are needed due to the very low in-flight temperatures usually encountered, even in summer. Rapidly changing weather situations involving severe icing, severe turbulence, and heavy precipitation are common and require extra vigilance by pilots. The changes may be so rapid that they are difficult to forecast. An emergency locator transmitter (ELT) is required to transit Greenland due to the very difficult terrain that hampers searches. Regulatory compliance is monitored and states will be informed of any infractions.

Airport flight information is provided at Narssarssuaq Airport, Nuuk/Godthab Airport, Kulusuk Airport and Ilulissat/Jakobshavn Airport at Constable Point. The general locations of these airports are as follows:

- Narssarssuaq is on the southern tip of Greenland at the end of a fjord

- Nuuk/Godthab is on the west coast of Greenland halfway between Narssarssuaq and Sondrestrom

- Kulusuk is on the east coast of Greenland 343 NM northeast of Narssarssuaq

- Ilulissat/Jakobshavn is on the west coast of Greenland 137 NM north of Sondrestrom

Only flight information service and alerting service are provided within the Sondrestrom FIR below FL 195. IFR flights operating within the Sondrestrom FIR below FL 195 must have functional radio equipment capable of operating on the published HF's for Sondrestrom. Flights operating within the Sondrestrom FIR below FL 195 must have functional radio equipment capable of operating on the published HF's for Sondrestrom. Flights operating within the Sondrestrom FIR above FL 195 (i.e., Reykjavik or Gander control areas (CTA's)), and outside of VHF coverage of Iceland or Gander, must have functional radio equipment capable of operating on the published HF's for Iceland/Gander.

j. ***Special Requirements for Flights Transiting Iceland.*** The general elevation of mountainous areas in Iceland is approximately 8000 feet MSL. Due to the great difference in pressure and high wind speeds, the lowest useable FL may, under certain conditions, be FL 120. An ELT with an energy supply independent of the aircraft shall be carried. The ELT must be capable of functioning continuously outside the aircraft for at least 48 hours, and of transmitting simultaneously on the frequencies 121.5 and 243 Mhz. Aircraft should be equipped with sufficient and appropriate arctic survival equipment. Aircraft operating in the oceanic sector of the Reykjavik FIR must maintain a continuous watch on the appropriate frequency of Iceland Radio. When operations take place outside of VHF coverage of the air-ground station, carriage of an HF transceiver operational on appropriate frequencies is mandatory. However, prior approval may be obtained for flight outside VHF coverage and without HF equipment. Flights operating under this special approval are responsible for obtaining similar approval for operating in the airspace of adjacent ATC units. Flights between FL 80 and FL 195 on the route between Sondrestrom and Keflavik passing through 65N 30W and Kulusuk, and flights above FL 240 operating between the United Kingdom and Iceland that are routed at or north of 61N 10W, are considered adequately covered by VHF and are exempted from HF requirements. Navigation equipment adequate to navigate in accordance with the flight plan and in accordance with ATC clearances will be carried aboard the aircraft. Secondary surveillance radar (SSR) transponders with Mode 3/A and C are required in Iceland. Pilots shall operate SSR transponders continuously on Mode A, Code 2000, except that departing aircraft shall retain the last assigned code for 30 minutes after entry into NAT oceanic airspace unless otherwise instructed by ATC. AIP's and NOTAM information are available on request at all Iceland airports of entry and from:

Directorate of Civil Aviation	Telegraph address: CIVILAIR ICELAND
Aeronautical Information Service	TELEX: 2250 FALCON ISLAND
Reykjavik Airport, Iceland	AFTN: BICAYN
101 Reykjavik	

k. ***Special Requirements for Canadian Departures.*** Canadian Air Regulation S.540 prohibits single-engine aircraft from transoceanic flight departing Canada unless authorization is obtained from the Minister. This regulation also applies to multiengine aircraft that cannot maintain flight after failure of the critical engine. Authorization to commence a transatlantic flight from Canada must be obtained by the PIC of a single-engine or multiengine aircraft as described above after landing at Moncton, New Brunswick, Canada. When the Regional Director, Aviation Regulation (or a representative) is satisfied that requirements are met, the authorization will be granted. At least 48 hours prior to landing at Moncton, the pilot should inform the Regional Director, Aviation Regulation, 95 Foundry Street, Moncton, New Brunswick, Canada, EiC 8K6, Telex 0142 666, of the intended transatlantic flight, stating date and time of arrival at Moncton, aircraft type, registration mark, and pilot's and passenger's names and addresses. Inspections are also possible at other regional offices in Montreal, Toronto, Winnipeg, Edmonton, and Vancouver. However, it is requested that the first contact be made with Moncton to coordinate the details of an alternate inspection site.

(1) At Moncton or the alternate inspection site, the PIC shall satisfy an examining officer of the following:

(a) Certification as a pilot with a valid and current instrument rating

(b) Knowledge of the meteorological, communication, ATC, and SAR facilities and procedures on the route to be flown

(c) Knowledge of radio and other navaids, and ability to use these aids en route

(2) Authorized routes will be those that will provide a minimum of 3 hours fuel reserve at destination considering useable fuel, an appropriate flight manual fuel consumption and true airspeed (TAS) indication (documented or charted), and a ZERO wind component. The PIC must present a complete navigation log for the ocean crossing. The log must show 5 degree longitude checkpoints, tracks, variation, and distances with the capability to recalculate on the basis of the most recent forecast en route winds. In anticipation of equipment problems, pilots should make preparations to complete the flight using dead reckoning (DR) navigation techniques.

NOTE: Some experienced ferry pilots apply the forecast wind to each 5 degree longitude segment of track to the nearest 10 degrees, then add 10 knots if a headwind, or subtract 10 knots if a tailwind. Next they ensure that both wind direction and track are in magnetic units by applying variation to the true course. If the crosstrack wind component is over 20 knots, or the drift angle is over 10 degrees, they wait for a better wind before departing. High speed, unforecast winds can easily increase the flight time to the extent that a short range aircraft cannot comply with the 3 hour fuel reserve regulation.

(3) Upon arrival at the inspection site, present the following documents for inspection:

(a) Certificate of Registration from the state of registry. U.S.-registered aircraft are required to have a permanent registration. Temporary (pink slips) are not satisfactory for oceanic flights.

(b) Certificate of Airworthiness, Flight Permit, or Special Airworthiness Certificate.

(c) Certification and special conditions issued by the state of registry to allow over gross weight operations, if applicable.

(d) Certification issued by the state of registry for fuel tank modifications and/or the installation of temporary long-range tanks. For U.S.-registered aircraft, the certification requirements are satisfied by obtaining a completed FAA Form 337, "Major Repair and Alteration."

(e) Revised weight and balance records in the case of aircraft modified to carry extra fuel.

CAUTION: An export Certificate of Airworthiness does not constitute authority to operate an aircraft. It must be accompanied by one of the authorities listed in (b) above. These documents are not available at Moncton, and Canadian authorities have no authority to issue these documents to U.S.-registered aircraft.

(4) Aircraft are required to carry the following sea survival equipment:

(a) A readily accessible watertight immersion suit for each occupant, including undergarments which provide thermal protection

(b) A readily accessible lifejacket, complete with light, for each occupant

(c) A readily accessible Type W, water-activated, self-buoyant, water-resistant ELT

(d) A readily accessible life raft sufficient to accommodate all persons on board the aircraft. The life raft must be fitted with the following items:

(aa) Water, or a means of desalting or distilling saltwater, sufficient to provide at least one pint of water per person

(bb) A water bag

(cc) Water purification tablets

(dd) Food that:

- is in the form of carbohydrates
- has a caloric value of at least 500 calories per person
- is not subject to deterioration by heat or cold

(e) Flares (at least three per life raft)

(f) Hole plugs

(g) A bail bucket and sponge

(h) A signal mirror

(i) A whistle

(j) A knife

(k) A survival-at-sea manual

(l) Waterproof flashlights (minimum two per life raft)

(m) A first aid kit containing eye ointment, burn ointment, compresses, bandages, merthiolate, and seasick pills

(n) A dye marker

(5) The water and food may be stored and carried in appropriate containers separate from the rafts if the containers can be readily and quickly attached to the raft. In addition to the items listed as "sea survival equipment" (above), aircraft shall carry the following polar survival equipment for flights over Labrador, and for any flight routing north of Prins Christian Sund over Greenland:

(a) A signalling sheet (minimum 1 x 1 meters = 3.28 feet by 3.28 feet) in a reflecting color

(b) A magnetic compass

(c) Winter sleeping bags in sufficient quantity to accommodate all persons carried

(d) Matches in waterproof covers

(e) A ball of string

(f) A stove and supply of fuel or a self-contained means of providing heat for cooking and the accompanying messkits

(g) A snow saw

(h) Candles or some other self-contained means of providing heat with a burning time of about 2 hours per person. The minimum candles to be carried shall not be less than 40 hours of burning time

(i) Personal clothing suitable for the climatic conditions along the route to be overflown

(j) A suitable instruction manual in polar survival techniques

(k) Mosquito netting and insect repellant

(6) Aircraft must be equipped with the following instruments and equipment in serviceable condition:

(a) An airspeed indicator and heated pitot head

(b) A sensitive pressure altimeter

(c) A direct reading magnetic compass that has been swung within the preceding 30 days with the aircraft in the same configuration as for the intended transoceanic flight

(d) A gyroscopic direction indicator or a gyromagnetic compass

(e) A turn and bank indicator

(f) A rate of climb and descent indicator

(g) An outside air temperature gauge

(h) A gyroscopic bank and pitch indicator

(i) Unless another timepiece with a sweep-second hand is available, a reliable, installed timepiece with a sweep-second hand

(j) If there is a probability of encountering icing conditions along the route to be flown, deicing or anti-icing equipment for the engine, propeller, and airframe

(k) If any portion of the flight is to be made at night, the following must be included:

- Navigation lights
- Two landing lights or a single landing light having two separately energized filaments
- Illumination for all instruments that are essential for the safe operation of the aircraft
- An electric flashlight at each required flight crewmember's station

NOTE: All equipment and cargo carried in the cabin shall be secured to prevent shifting in flight and placed in such a position so as to not block or restrict the aircraft's exits.

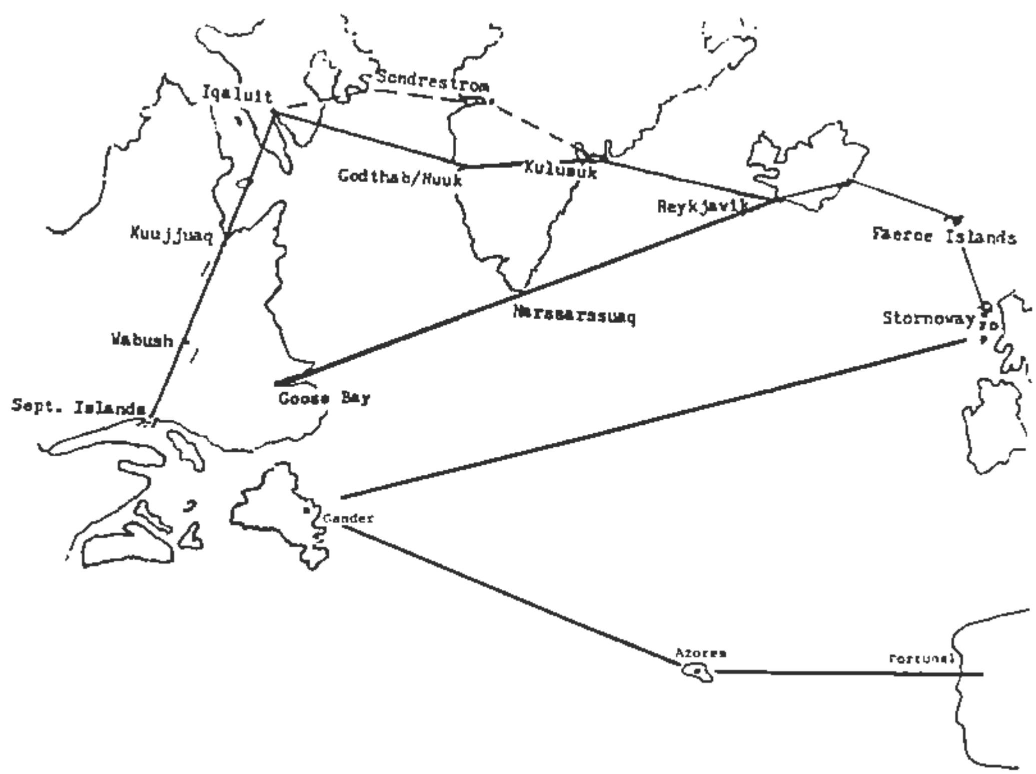
NOTE: Portable oxygen equipment is recommended. This equipment is useful when trying to avoid icing and/or for the additional altitude required over the Greenland icecap.

(7) In the oceanic control areas (OCA's) and FIR's, VHF coverage is not sufficient to ensure continuous two-way communications with ground stations. Although relay through other aircraft is sometimes possible, it is not guaranteed. As mentioned elsewhere in this AC, emergency frequencies are not to be used for planned position relays or any other purposes except for bona fide emergencies. HF radio is mandatory for each aircraft crossing the Atlantic. The only exception is for aircraft flying at FL 250 or above crossing Greenland. See Figure 2-10, Appendix 2 for VFR coverage in the NAT at 10,000 feet MSL. Route-specific navigation equipment requirements for navigation in accordance with the flight plan and any ATC clearances are listed below:

(a) Iqualuit [Frobisher Bay] (CFYB) to Greenland: Two independent ADF receivers with BFO/CW capability. Portable ADF's are no longer acceptable.

(b) Goose Bay, Labrador to Narssarssuaq, Greenland: Two independent ADF receivers with BFO/CW capability.

FIGURE 11-1. FOUR MAJOR ROUTES USED BY SHORT-RANGE AIRCRAFT CROSSING THE NAT



(9) The four major routes used by short-range aircraft to cross the NAT are depicted in Figure 11-1 above. All except the northern route require the installation of long-range fuel tanks to satisfy the 3 hour reserve fuel requirement. In addition, each of these routes presents its own peculiar set of problems.

(a) The northern route is the longest route, but has the shortest overwater legs. It does, however, transverse long distances over remote, hostile, unpopulated terrain. This route for relatively short-range aircraft normally follows a route that heads almost due north from Moncton to Sept-Isle to Shefferville to Kuujjuaq to Iqualuit (formerly known as Frobisher). At Iqualuit, the flight heads eastbound overwater to Greenland. Pilot reports from Kuujjuaq indicate that there are times when fuel is not available at Kuujjuaq, and that quarters are primitive (if available at all). Once reaching Greenland, the route traverses the icecap, which can mean flying at FL 130 or higher. This presents the potential for cold temperature, icing, and severe weather. Pilots should expect no Loran-C reception; good ADF tracking is essential.

(b) The direct route from Goose Bay, Labrador (CYRR) to Reykjavik, Iceland via Prins Christian Sund, Greenland NDB is one of the best routes with Narssarssuaq a midway alternate, although the NAT storm track can cause problems with wind and weather. This route means potential icing and weather problems over the Davis Straight (between Greenland and Iceland), plus coping with a demanding day-only VFR approach. Loran-C is unreliable at both ends of this approach, and there is steeply rising terrain on both sides and at the end of the approach.

(c) Gander, Newfoundland direct to Shannon, Ireland presents the usual problems of NAT severe weather, plus the significant effect that an unforecast wind shift can have on a slow aircraft flying a 1700 NM leg. In addition, the amount of extra fuel that would be used with even a 5 knot unanticipated headwind would be significant over such a long range. The one positive factor that favors this route is that Loran-C coverage is continuous throughout the route.

(d) The route from St. John's, New Brunswick in Canada to Santa Maria in the Azores has the advantages of generally better weather and higher temperatures. The airport at Flores, located 300 NM west of Santa Maria, is a good alternate. The disadvantages are that Loran-C coverage is not reliable for the whole distance, and an unforecast or unsuspected wind shift coupled with poor ADF equipment and/or procedures could mean missing the Azores altogether.

l. ***Additional Notes.*** Since icing is a severe hazard for light aircraft, temperatures should play a significant part in flight planning. June to September is the best time of year for all of the routes. At other times, the St. John's to Santa Maria route is the best choice because it overflies the Gulf Stream. An analysis of the most favored routes by professional ferry companies indicates that the route from Goose Bay direct to Reykjavik is the most popular, with the Santa Maria route being the next in popularity. However, it must be emphasized that most light aircraft need to have long-range tanks installed to traverse these routes.

m. ***Flight Plans.*** Flight plans for international flights originating in Canada, flights in Europe, and flights entering Canada from overseas must be filed in the ICAO format. A sample ICAO flight plan is located in Appendix 1 of this AC. IFR (ICAO) flight plans are mandatory at or above FL 60 (6000 feet MSL) in all oceanic CTA's, the Reykjavik FIR, and at or above FL 195 in the Sondrestrom FIR (Greenland and off the coast of Greenland). Although VFR flight under the OCA (5500 MSL and below) is possible, there is little advantage in flying VFR. In fact, the Canadian government predicates their requirements upon the assumption that IFR will be encountered at some time during the flight. Therefore, it is prudent to take advantage of the flexibility, winds, safety factor, and navigation/communication radio reception of the higher altitudes afforded by an IFR flight.

n. ***Additional Canadian Inspection Notes.*** Transport Canada will no longer approve for transatlantic flight an aircraft fitted with a "placarded" ferry tank where it is obvious that the intent of the placarding is to avoid regulatory inspection of the installation, and issue of a Special Airworthiness Certificate for over-gross operation. A permanent waiver of the Canadian transoceanic inspection is available providing a pilot has successfully completed at least two inspections and transoceanic flights. However, a waivered pilot is still subject to spot checks by any NAT ICAO Provider State.

o. ***Canadian Customs Procedures.*** Pilots must land at a Canadian Customs authorized airport of entry (AOE), and a flight plan must be filed for all transborder operations. It should also be noted that VFR at night is not allowed, nor is VFR-on-top allowed in Canada. Canadian customs must receive notification in sufficient time to enable designated customs officers to inspect the aircraft.

3. OTHER CONSIDERATIONS.

a. ***Personal Physical Needs.*** These include nourishment, body comfort and provisions for biological relief. Certain foodstuffs are required for Canadian departures, but all pilots should familiarize themselves of the caloric content, sugar content, ease of access, digestibility and weight of the food that they intend to use during flight. Foods should be high in calories but low in sugar content. Sweets will provide the body with an immediate energy lift but will dissipate in effectiveness very rapidly and will have a tendency to create thirst. Biological relief is an extremely important factor to consider. A pilot who has overextended his/her human range (HR) can be distracted by pain to the point where intelligent decision making and physical skills will deteriorate to the point of creating a serious safety hazard. Pilots can increase HR by eating and drinking prudently prior to each leg of the flight. Another consideration is that of body comfort. Although watertight immersion suits are required for flights departing Canada, this is only one form of protective clothing that should be considered. The potential need to climb to a high altitude to escape detrimental winds or to fly over the icecap in Greenland demands that the pilot has warm clothing readily available and easily accessible. Glare is also a significant hazard when flying above the clouds or flying over an icecap which indicates that a pair of good sunglasses are an important consideration. Noise creates a fatigue factor and should be reduced as much as possible. If not intending to use a head set for the complete flight, pilots should have a set of ear plugs available. The last consideration is extremely important if flights above 10,000 feet are anticipated (as part of the planned flight or as a possible contingency). This consideration is for oxygen requirements. No matter what a pilot's health status happens to be, prolonged flights above 10,000 feet without oxygen are an invitation to disaster.

b. ***The Aircraft.*** Fuel burn and the range of an aircraft are important considerations in the preflight planning stage of any trip, whether, international or domestic, and most pilots will take great care in ensuring that there is adequate fuel for a flight. One consideration, however, that is not quite so evident is oil usage. Domestically, one can make an emergency landing if some indication of excessive oil usage presents itself. On an oceanic flight, the preflight oil level is the maximum oil available for a trip leg unless some ingenious invention is devised to measure oil levels and to replenish the oil in-flight. Because this situation is nearly impossible (early pilots were known to climb out on struts, etc., and replenish oil), it is advisable to make oceanic crossings only with aircraft that have engines which have not exceeded their half-life.

c. ***Equipment.*** Various equipment requirements including navigation and communication equipment are discussed in above sections of this Chapter. It is important, however, to make another equipment check: the condition of the magnetic compass, its accuracy, and the extreme variations that can be encountered in various sections of the world. Pilots should also review those turning errors that may have been forgotten since their last check ride.

d. ***Charts.*** When making a transoceanic flight, no one type of chart is totally adequate. It is important that the characteristics of various types of charts be known and carried. Some of these characteristics are itemized below.

(1) ***Jeppesen Plotting Charts.*** These charts have magnetic variation information, but the NAT charts have no radio navigation or topographic information although the Pacific charts do have the radio navigation frequencies. These charts do have up-to-date OCA boundaries, FIR, air defense identification zone (ADIZ), distant early warning identification zone (DEWIZ), and their required

reporting points. The scale of these charts is 1:10,000,000, and their size make them convenient for cockpit use.

(2) *Defense Mapping Agency's Global Navigation Chart (GNC).* These charts indicate variation, topography, ADIZ, and the location of VHF omnidirectional radio ranges (VOR's) and NDB's. They do not have the FIR boundaries shown or the navigation frequencies listed.

(3) *Global Loran-C Charts (GLCC).* These charts only contain Loran-C information for navigation and isogonic lines. They do not depict topography, and the OCA information is not necessarily up-to-date.

(4) *National Oceanic and Atmospheric Administration (NOAA) Route Charts.* These charts are primarily designed for planners and controllers. Although not particularly useful to pilots, the charts do depict latitude and longitude information and the frequencies of some VOR's and NDB's. These charts are particularly useful to pilots planning their first transoceanic flight because they cover a large geographical area and provide an excellent overview of the area to be overflown.

(5) *Operational Navigation Charts (ONC).* These charts are similar to the U.S. World Aeronautical Charts (WAC's) and detail topographical features. They are extremely important to a pilot planning routes which have long legs over land masses (such as the route from Moncton to Frobisher).

(6) *Approach Plates (Jeppesen or NOAA).* On trips of the length required for a transoceanic crossing, the potential for having to make an IFR approach is a real possibility. These plates become a real necessity when one is forced to make an unscheduled landing at an airport with a hazardous NDB approach such as Narssarssuaq, Greenland. It would be nearly impossible, even in an emergency, to try and make an approach to this airport without any guidance. In fact, a note appears on the Jeppesen version of this approach which states, "Caution: Pilots w/o a good knowledge of the local topographical and met conditions are advised not to make any attempt to approach through the fjords, unless ceiling at least 4000" and visibility 800 m." (2624.67 feet or approximately 1/2 mile). Approach plates should not only be carried for airports of intended landing and alternate airports, but also for every airport along the intended route of flight. Flight information publication (FLIP) charts may be preferred by some pilots, but a word of caution is needed regarding these charts: they do not depict every airport for which an instrument approach is available.

e. ***Weather.*** Although pilots are required to have a knowledge of weather, weather charts, and the procedures for accessing weather information, in the United States weather information is readily accessible and easy to decipher. On transoceanic flights weather information is often outdated, difficult to obtain, and is in a format unique to the geographical area in which it is disseminated. Pilots must hone those long-forgotten skills of interpreting charts and making their own prognosis of pending weather. They must also be aware of all of the available sources of weather along the route of their flight. Terminal area forecasts (TAFORS) are similar to the U.S. terminal forecasts, and they are referred to as airport forecasts (TAF's). A complete listing of TAF codes is included in Appendix 1 of this AC. It is important that pilots have a knowledge of these codes, and are able to interpret them and apply their meanings to an actual flight situation.

FIGURE 11-2. GENERAL SAFETY NOTES

1. Know your aircraft. Pull cowling and inspect for leaks and check the general condition of the aircraft. The following aircraft components must be reviewed:

- Fuel system and management
- Radio equipment and condition
- Engine condition
- Oil consumption
- Oil pressure
- Oil temperature
- Instruments

2. Check compass on nearest runway heading to your course (use a compass rose if one is available):

- Swing compass with radios and navigation lights **ON**
- Check compass deviation with master switch **OFF**
- Check compass deviation with VHF **OFF**
- Check compass deviation with HF ON and then **OFF**
- Check compass deviation with pitot heat **ON**
- Check compass deviation with rotating beacon **ON** and then **OFF**
- Log results of the above deviations
- Keep alternator load at or below 50 percent during compass testing, if possible
- **DO NOT** assume that the compass card is accurate

3. ADF may be affected by the alternator, the VHF, the HF, the pitot heat, the rotating beacon, the autopilot, costal refraction, and atmospheric conditions. Check and recheck all navigation equipment under all operating conditions.

4. En route freezing levels should be 3000 feet AGL or higher to allow room for ridding aircraft of ice. If a departure must be made in below freezing temperature, it is imperative that the flight is in VFR conditions and clear of clouds until an area with higher freezing levels is reached.

5. Significant icing has been encountered at Goose Bay, Narssarssuaq, and Reykjavik as late in the year as early June.

6. The departure alternate should be VFR.

7. Destination weather should be well above IFR minimums and forecast to remain above minimum or improving. It is important to remember that after long flights at altitude, a pilot's capability to handle marginal weather will be in serious doubt. Personal weather minimums should be much higher than published minimums. An alternate airport should be selected with the same minimums criteria.

8. Do not deviate from the flight plan unless the aircraft's position can be positively identified without navigation equipment. This prevents serious consequences in the event of radio failure.

FIGURE 11-2. GENERAL SAFETY NOTES - Continued

9. Make all position reports when required, and report any problems to ATC as soon as possible. When reporting, it is prudent to provide ATC with a fuel remaining report in hours and minutes. Although not required, this information can be invaluable to ATC in the event of an emergency.

10. If in trouble, report the situation to ATC immediately by HF or VHF on 121.5 MHz and request assistance. Do not wait to report. It might take SAR an extended period of time to reach a troubled aircraft's position. The aircraft should not deviate from its flight plan unless Air/Sea Rescue advises the use of a new heading. If unable to make contact by radio, the ELT should be manually activated.

11. Air carrier traffic over the Atlantic is heavy. Do not hesitate to enlist the assistance of these aircraft in relaying a position fix, obtaining weather updates, or reporting an emergency. Air carriers are quite willing to assist anyone having difficulties and often their FL is high enough to relay communications. However, emergency frequencies should only be used for actual emergencies. It is acceptable to utilize emergency frequencies to make an initial contact, but only to request that someone communicate with the caller on another frequency.

12. Fatigue is a "sneaky" killer. A pilot often does not realize that he/she was fatigued until after an accident has taken place. Realistic work loads should be determined prior to commencing a flight and should not be exceeded unless an extreme emergency requires one to do so. The following situation is one in which it is very evident that fatigue contributed to a dual fatality.

> A ferry pilot and his passenger departed Goose Bay in a Bonanza early one morning. They refueled in Reykjavik, then flew on to Scotland. The aircraft crashed 2 miles short of the runway at Glasgow, Scotland during a standard ILS approach. No severe weather existed and no aircraft problems were reported. Investigation revealed that all systems had been operating correctly and that the engine was running at the time of the crash. A synopsis of all factors involved indicated that pilot fatigue was the course of this accident.

No person shall fly an aircraft, nor should an operator require a person to fly an aircraft, when the person is suffering from fatigue or will encounter a workload that will induce fatigue.

13. Pilot reports (PIREPS) are significantly more important in remote areas and in oceanic areas of operation. The absence of weather reporting stations demands that pilots experiencing weather conditions that are likely to affect the safety of other aircraft or other hazardous flight conditions, report these to ATC as soon as possible.

CHAPTER 12. POLAR FLIGHTS

Like most other North Atlantic (NAT) traffic flows, traffic on the Europe-Alaska axis is predominantly unidirectional; in the Reykjavik control area (CTA) the westbound peak is between 1200 - 1800 coordinated universal time (UTC), and the eastbound peak is between 0001 - 0600 UTC. To facilitate the flow of this traffic during the peak period and to avoid a multiplicity of random routes, a polar track structure (PTS) consisting of 10 fixed tracks has been established (Figure 2-2, Appendix 2). Although not mandatory, flights planning to operate on the Europe-Alaska axis at flight level (FL) 310 - 390 inclusive during peak periods are strongly recommended to submit flight plans in accordance with one of the promulgated PTS tracks.

Even though equipment has improved greatly since Admiral Byrd's day, the inherent hazardous conditions still exist. The following excerpt indicates how important planning and preparation are to making a polar flight. Admiral Byrd wrote:

> "For months previous to this hour, utmost attention had been paid to every detail that would assure our margin of safety in case of accident, and to the perfection of our scientific results in case of success.
>
> We had a short-wave radio set operated by a hand dynamo, should we be forced down on the ice. A handmade sledge presented to us by Amundsen was stowed in the fuselage, on which to carry our food and clothing should we be compelled to walk to Greenland. We had food for ten weeks. Our main staple, pemmican, consisting of chopped-up dried meat, fat, sugar and raisins, was supplemented by chocolate, pilot-bread, tea, malted milk, powdered chocolate, butter, sugar and cream cheese, all of which form a highly concentrated diet.
>
> Other articles of equipment were a rubber boat for crossing open leads if forced down, reindeer-skin, polar-bear and seal fur clothes, boots and gloves, primus stove, rifle, pistol, shotgun and ammunition; tent, knives, ax, medical kit and smoke bombs — all as compact as humanly possible.
>
> If we should come down on the ice the reason it would take us so long to get back, if we got back at all, was that we could not return Spitzbergen way on account of the strong tides. We would have to march Etah way and would have to kill enough seal, polar-bear and musk-ox to last through the Arctic nights."

On navigation in the North Polar region, Byrd wrote:

> "Our chief concern was to steer as nearly due north as possible. This could not be done with the ordinarily dependable magnetic compass, which points only in the general direction of the North Magnetic Pole, lying on Boothia Peninsula, Canada, more than a thousand miles south of the North Geographic Pole.

If the compass pointed exactly toward the Magnetic Pole the magnetic bearing of the North Geographic Pole could be calculated mathematically for any place on the Polar Sea. But as there is generally some local condition affecting the needle, the variation of the compass from true north can be found only by actual trial.

Since this trial could not have been made over unknown regions, the true directions the compass needle would point along our route were not known. Also, since the directive force of the earth's magnetism is small in the Far North, there is a tendency of the needle toward sluggishness in indicating a change in direction of the plane, and toward undue swinging after it has once started to move.

Nor would the famous gyroscopic compass work up there, as when nearing the Pole its axis would have a tendency to point straight up in the air.

There was only one thing to do--to depend upon the sun. For this we used a sun-compass. The same type instrument that had been invented and constructed for our 1925 expedition by Albert H. Bumstead, chief cartographer of the National Geographic Society. I do not hesitate to say that without it we could not have reached the Pole; it is even doubtful if we could have hit Spitzbergen on our return flight.

Of course, the sun was necessary for the use of this compass. Its principle is a kind of a reversal of that of the sundial. In the latter, the direction of north is known and the shadow of the sun gives the time of day. With the sun-compass, the time of day is known, and the shadow of the sun, when it bisects the hand of the 24-hour clock, indicates the direction after the instrument has been set.

Then there was the influence of the wind that had to be allowed for. An airplane, in effect, is a part of the wind, just as a ship in a current floats with the speed of the current. If, for example, a thirty-mile-an-hour wind is blowing at right angles to the course, the plane will be taken 30 miles an hour to one side of its course. This is called 'drift' and can be compensated for by an instrument called the drift-indicator, which we had also developed for the first trans-Atlantic flight."

[Excerpt from "First to the North Pole" by Richard Evelyn Byrd, from "Men in the Air," Crown Publishers, Inc., New York. Copyright 1990 by Brandt Aymar.]

It is evident from the above excerpt that flight in the far north is difficult. These trips require detailed planning, an abundance of equipment, extensive knowledge, and some luck in not experiencing any undue circumstances such as unforecast weather, navigation and/or communication failure, engine problems, or airframe problems. These excerpts were included in this advisory circular (AC) as "food for thought." In spite of the advances in aircraft and navigation/communication equipment, the harsh realities of flight in the far north are ever present. Loss or failure of any equipment reduces the flight to one that relies on the basic and emergency equipment that is carried and the extent of knowledge which the crew has in its use.

CHAPTER 13. OCEANIC OPERATIONS TO THE FORMER SOVIET UNION

1. INTRODUCTION. The geopolitical area formerly known as the Soviet Union is now comprised of the Commonwealth of Independent States (CIS) and other independent states. This group of aligned and independent states is referred to as the CIS throughout this document. This section of the world is undergoing rapid and often unanticipated changes in the field of international and domestic aviation. As updated information becomes available, it will be included in a future revision of this advisory circular (AC).

2. GENERAL. As a result of the new bilateral air transportation agreement between the United States and the CIS, a significant increase in air transportation between the two countries is expected. Operators of both large and small aircraft will be increasing scheduled and chartered air service. Due to the short distance between the state of Alaska and the CIS, significant increases in air traffic are expected in the far eastern portion of this region. This area has traditionally been called the Soviet Far East (SFE).

a. ***Overview of Regional Differences in the CIS.*** The CIS is more than twice the size of the United States and is significantly more diverse in terms of aviation infrastructure. Flight operations within the western part of the country (generally west of the Ural mountains) are considerably less challenging than flights within the eastern part of the country. In the east, primarily due to limited facilities, sparse population, and harsh winter weather, routine flight planning can be quite challenging. Communications, navigation, and airport availability require special emphasis when planning flights within this region. Although operating aircraft in the western CIS is generally less demanding, many significant operational differences exist. The airports and airways in the CIS are divided into two categories: international and domestic.

b. ***International Airports and Airways.*** International routes and airports in the CIS are generally available for use by foreign aircraft operators, provided the operators have received appropriate flight authorizations. These routes and airports are published in the U.S.S.R. Aeronautical Information Publication (AIP). Air traffic control (ATC) communications are provided in English, and airports have customs and immigration services as well as fuel (AVGAS availability is limited). Instrument approach procedures (IAP's) are generally available in the International Civil Aviation Organization (ICAO) format, and are similar to approach procedures used worldwide.

c. ***Domestic Airports and Airways.*** Domestic airports and routes in the CIS are generally not usable by foreign aircraft operators unless a Soviet navigator is utilized to communicate with ATC and provide instructions to the flightcrew regarding navigation principles and procedures. En route and terminal ATC within the domestic systems are accomplished using the Russian language, since a large percentage of CIS air traffic controllers do not speak English. En route charts and IAP's for the domestic system are not published in English, are generally not available to foreign aircraft operators, and may not meet ICAO requirements. Weather and Notice to Airmen (NOTAM) information is difficult or impossible to obtain, and is not provided in English or in standard format.

d. ***General Navigational Considerations.*** Navigation off established airways in the CIS is generally not permitted. Foreign aircraft operations are restricted to published international routes and airports, even for refueling stops and alternate airports. Appropriate flight crewmember training on metric conversion and the in-flight availability of conversion charts are necessary to enable crewmembers to convert metric altitudes, weights, and windspeeds. Although operators are technically permitted to conduct flights to or within the CIS under visual flight rules (VFR), there are significant CIS flight rules differences that normally preclude foreign aircraft operators from conducting flights under VFR. In some areas, ATC procedures have been developed to allow operations off published routings using radar vectors. If clearance is received to operate off airways, the carrier is authorized to accept the clearance. However, due to military concerns, it is possible that the radar vectors received may not be the most expeditious for the carrier.

e. ***Aeronautical Information Publication (AIP).*** The U.S.S.R. AIP is the primary document available concerning foreign aircraft operations within the CIS. The U.S.S.R. AIP is published by the Aeronautical Information Service (AIS), which is part of the Ministry of Civil Aviation (MCA) of the Soviet Union. It is published in both Russian and English and contains detailed flight operational requirements as well as terminal, airport, and instrument approach charts in ICAO format. It is available from the AIS on an annual subscription basis, including monthly revisions. The navigation charts and standard instrument approach procedures (SIAP's) for the CIS domestic system are not included in the AIP and are usually not available in English. Further information may be obtained from:

Embassy of the Russian Federation
1125 16th Street, N.W.
Washington, DC 20035
Telephone (202) 628-7751

f. ***ATC Communications.*** The ATC communication system within the CIS is generally good. Very high frequency (VHF) is commonly used for en route communications, but high frequency (HF) is required for certain routes. Communication equipment requirements are listed in the U.S.S.R. AIP. However, CIS air traffic controllers have limited access to weather and NOTAM information.

g. ***Aeronautical Fixed Telecommunications Network (AFTN) or Society Internationale de Telecommunications Aeronautique (SITA) Networks.*** Data transmission and reception in the CIS is accomplished using the AFTN or SITA networks, although in remote areas only AFTN may be available. Transmitting or receiving messages using the AFTN system within the CIS to and from many remote areas, especially in the SFE, may be less timely than desirable. Most messages enter and depart the CIS in Moscow, and the manual manipulation of messages is required at many transfer stations before and after reaching Moscow. For example, an AFTN message from Anchorage, Alaska to Magadan, Russia, will be transmitted via Moscow, and then to several switching stations between there and Magadan. At the switching stations, messages must be hand-carried from the receiving area to the transmitting machine.

h. ***Telephone Service.*** Telephone service to, from, and within the CIS is limited. A variety of systems are used, including an HF troposcatter system which, due to technical limitations, makes communication extremely difficult. Establishing reliable communications to and from line stations within the CIS may be more challenging than in other areas.

i. ***Navigation.*** Navigation on international routes within the CIS is permitted using Class I or Class II navigation systems. Route widths vary from 8 km to 20 km, as indicated in the U.S.S.R. AIP. It is the pilot's responsibility to keep the aircraft within established airway boundaries. Available altitudes also vary from one route to another as identified in the U.S.S.R. AIP. When planning flights, operators must ensure that the desired and required altitudes are available for particular routes. This is especially important in the SFE, where there is usually only one route available for flights. As an example, from the Anadyr nondirectional beacon (NDB) along A-81 on the eastern coast of Russia to the Troitskoye NDB there is no parallel airway for a distance of over 1600 miles. Deviation from this route due to weather requirements may be impossible to obtain. In the SFE, Class I en route navigation on international routes is primarily accomplished using NDB's; however, numerous compatible VHF omnidirectional radio range (VOR) transmitters will be installed in the coming years. In western Russia, compatible VOR transmitters are also utilized to define international routes. In certain situations, especially in the SFE, it may be necessary to require operators to utilize Class II navigation receivers to supplement Class I navigation receivers due to the distance between navigational aids (navaids) and the limited width of airways. Class II en route navigation on international routes should be relatively simple, provided two conditions are properly addressed. The first condition is that, depending on the published route widths, length of flight, and type of Class II navigation equipment utilized, it may not be possible for an operator to maintain the course centerline accuracy required by the CIS. Limitations on the operation of some very low frequency (VLF)/Omega systems, as shown in the Flight Manual Supplement, may preclude their use in some areas of the CIS. The second condition concerns the lack of VOR/distant measuring equipment (DME) transmitters, especially in the SFE, which means that special consideration must be given by operators to navigation accuracy requirements when using inertial reference systems (IRS's) such as B-757, B-767, and A310. Again, it may not be possible to obtain the required navigation accuracy unless, considering the specific route and length of flight, VOR/DME updates are provided to the IRS.

j. ***Alternate Airports.*** For flight planning purposes, especially in the SFE, operators must give careful consideration to the location of, and routing to, suitable alternate airports. Fuel planning must be carefully considered due to potential difficulties with communications, diversion airport routings, and the lack of suitable airports in the SFE. It is not uncommon for the closest alternate airport to be over 500 nautical miles (NM) from a given destination.

k. ***Extended-Range Operations with Two-Engine Airplanes (ETOPS).*** Operations in the SFE with two engine aircraft may require ETOPS approval due to the lack of adequate/suitable airports within 60 minutes of the operator's route. AC 120-42, "Extended Range Operations with Two-Engine Airplanes" as amended, provides additional information.

l. ***CIS Navigator Assistance.*** Navigation within the CIS is the responsibility of the pilot-in-command (PIC). Flights operating off of established international routes, or on the domestic route system, usually are not permitted unless a CIS navigator is aboard. In unique situations, a radio operator will also be required; however, these two functions are usually performed by the navigator. The assistance of a navigator is also be required for flights to or from any CIS domestic airport. Although navigators may be required by the CIS, they are not required flight crewmembers under the FAR and are not responsible for the conduct of the flight. The navigator's purpose is to assist in cross-checking course information en route and to assist in cross-checking information on terminal arrivals, departures, and IAP's. FAA approval is required for U.S. operators to carry CIS navigators/radio operators. The following information should also be considered when evaluating CIS navigator/radio operator requirements:

(1) Due to the lack of informational and technical data pertaining to operations in the CIS domestic system which are needed to meet requirements of FAR Parts 121 and 135, it may not be possible for operators to conduct operations at most CIS domestic airports.

(2) CIS navigators are required to use a cockpit jumpseat, which may preclude an FAA inspector from accomplishing a required en route inspection or a validation test on a particular flight or series of flights.

(3) The charts for the CIS domestic system are usually not available in English.

(4) The U.S.S.R. MCA charges a substantial fee for the use of navigators.

m. ***Area of Magnetic Unreliability.*** Depending on the latitude of the routes flown, operations may be conducted within the CIS area of magnetic unreliability.

n. ***Aeronautical Weather Data and NOTAM's.*** Aeronautical weather data and NOTAM's should be available in standard ICAO format through normal channels for all international airports within the CIS. This data is normally not available for any airport within the domestic system. Within the CIS, weather data and NOTAM's for airports within and outside the area is normally available from the weather service office at international airports. Extremely limited data is available at domestic airports within the CIS and usually requires translation into English.

o. ***Terminal IAP's.*** Terminal IAP's at international airports within the CIS are conventional and should not be confusing to foreign operators. Arrival and departure procedures are similar to U.S. standard terminal arrival routes (STAR's) and standard instrument departures (SID's). Radar vectoring is uncommon, so flight crewmembers should expect to fly the full charted procedures published in the AIP or Jeppesen charts. Flight crewmembers should be aware that use of atmospheric pressure at airport elevation (QFE) is common and transition levels vary from one sector to another. IAP's are standard (instrument landing system (ILS), VOR, NDB) and, due to a lack of radar vectoring, full approaches (requiring a course reversal) are normally flown. Precision radar approaches are also very common throughout the CIS. Terminal IAP's at domestic airports within the CIS are usually not published in English or readily available to foreign air carriers. Operators must obtain the necessary data and comply with the appropriate FAR concerning routes, airports, weather, and communication. CIS navigators, who are required for foreign aircraft operators within the domestic system, will carry en route, terminal area, and instrument approach charts for use within the domestic system. These charts are generally available in Russian only. STAR's, SID's, en route, terminal, and standard instrument approach (SIA) charts in English may be obtained from commercial sources and shall be utilized by the flightcrew during all operations. Class II navigation capability will likely be required for operators navigating within the domestic system due to the inability of foreign aircraft to receive signals from the CIS VHF (RSBN) system. Many navaids (VHF [RSBN] and NDB) within the domestic system use identifiers that do not have an English translation.

p. ***Air Carrier Training Programs.*** Revisions to air carrier training programs and/or international procedures training for flight crewmembers may be required, prior to issuing operations specifications, in order to adequately address the unique environment of the CIS. Appropriate information contained in the U.S.S.R. AIP should be incorporated in air carrier training programs. Careful consideration should be given to training programs in the following areas.

- Communications procedures - including procedures to be followed to ensure communications are available between the aircraft and dispatch center.

- Inflight weather updates - flight crewmembers may require training on how to update en route and terminal area forecasts.

- Metric conversions - flight crewmembers may require training in procedures to convert to or from the metric system.

- Navigation procedures - depending on the geographic area of operations and navigation equipment used, flight crewmembers may require additional training on unique navigation systems and procedures.

- Emergency procedures - these procedures may require special attention due to airspace restrictions, limited alternate airports in certain locations, limited knowledge of domestic airports, limitations in CIS air traffic controllers' ability to speak English, and in-flight emergency procedures within the CIS.

q. ***Flight Approval.*** According to both the U.S.S.R. AIP and the International Flight Information Manual (IFIM), an operator must receive written approval from MCA-Moscow before initiating a flight which will enter CIS airspace. Operators shall not request flight approval through any regional ministry or Aeroflot office. Any approval granted by a regional office should not be considered sufficient unless accompanied by approval from MCA-Moscow. Aircraft operators intending to utilize standard air corridors and international airports in the CIS should submit their request via telex directly to the MCA, far enough in advance so as to reach the ministry at least 5 working days (3 weeks suggested) before departure.

Telegraphic Address:
International Department
Ministry of Civil Aviation
Leningradsky Prospect 37
Moscow
Telex: 411182 AFL SU

It is recommended that a simultaneous request be made to the Central Department of Operational Services (CDOS).

Telegraphic Address:
Central Department of Operational Services
Telex: 412303 CDS SU
ATTN: UUUUYAYW
SITA: MOWZGSU

Operator requests to use nonstandard routings and/or land at airports normally serving domestic traffic should be submitted through the Economic Section of the U.S. Embassy in Moscow, APO, NY, 09862 (Telegraphic address: Amembassy Moscow, Telex: 413160 USGSO SU). Information to be included in the telex is listed in the AIP and IFIM. Recent operator experience indicates that the communication infrastructure may preclude receiving this authority in a timely manner. Personal presentations, including objectives and justification, may be more effective.

r. ***Validation Flight Requirements.*** Validation flights are required for all U.S. operators seeking approval to operate within CIS airspace. Validation flights are also required for any operator seeking a significant expansion in service or operating area within the CIS. Some examples of situations requiring validation flights include the following:

- An air carrier previously serving in the western CIS that desires to operate east of the Ural mountains
- An air carrier approved to serve a coastal airport only that desires to expand service to inland airports
- Air carriers that have not operated within the CIS within the past 6 months
- Any proposed operation that requires the use of a CIS navigator
- Any other situation that the FAA determines is necessary to ensure a safe operation

Validation flights may be conducted with revenue passengers or cargo aboard, unless special situations dictate otherwise. The following items will be considered during validation flights:

- Flight approval
- Adequacy of FAR § 121.445 special airport qualification procedures
- Flight planning and flight release/dispatch procedures, when applicable
- Contingency planning - alternate airports for takeoff, en route, and destination
- Communication and navigation procedures
- IAP's

- Data communications with CIS (telex, ATTN, SITA)
- Weather and NOTAM availability within the CIS
- Fueling and cargo loading procedures

In view of the problems described in the preceding areas of consideration, it may be beyond the capabilities of many operators to conduct operations to most CIS domestic airports at this time.

3. OPERATIONS TO THE FORMER REPUBLIC OF YUGOSLAVIA.

Under the provisions of United Nations Security Council (UNSC) Resolution 757 (1992), U.N. member states are required to prohibit takeoffs, landings, and overflight of their territories by aircraft flying to or from the Federal Republic of Yugoslavia, including Slovenia, Croatia, Bosnia-Herzegovina, Macedonia, Serbia (including the provinces of Vojvodina and Kosovo), and Montenegro. Flights which operate into the Federal Republic of Yugoslavia under this operating limitations policy must conform with SFAR No. 66. The PIC must receive an intelligence briefing from the Air Mobility Command (AMC) for each flight to any of the airports located in that geographic area.

Air carriers should observe the following precautions:

(1) Current intelligence information must be obtained from AMC regarding the best arrival and departure routes and the minimum safe altitude (safe from hostile acts) to maintain at various points along the route.

(2) Obtain current intelligence information from AMC regarding safe diversion airports and routes.

(3) If AMC determines that navaid interference and ATC voice communication intrusions can be expected, the air carrier must develop countermeasure procedures and train flightcrews in their use.

(4) If the authority controlling operations into a particular airport has procedures for communicating emergency diversion information over air/ground communication systems, the air carrier must obtain call signs and frequencies for dissemination to flightcrews.

When planning a flight to the hostile area, the flightcrew should check current NOTAM's for the most current information. Flightcrews should also observe the following precautions.

(1) Before each flight into a hostile area airport, the flightcrew must obtain a current intelligence briefing from AMC regarding the best routes and minimum altitudes to avoid known and possible threats.

(2) The briefing must be given at the airport where the flight departs for the hostile area airport, and shall be given when the flightcrew reports for duty to prepare for the final leg of the flight.

(3) Before the flight is authorized to depart, the flightcrew must ensure that the briefer provides at least the following information:

(a) The flightcrew must be informed of known or suspected threats located relatively close to the arrival and departure routes, available diversion routes, and the destination airport.

(b) If known or suspected threats are located relatively close to arrival, departure, or diversion routes, or to the airport, the pilot must be advised whether or not it would be prudent to revise the planned routes and/or altitude.

(c) Any reports of intentional navaid interference or ATC voice intrusions should be communicated to the flightcrew before departure.

(d) The flightcrew must receive updated information on emergency diversion procedures and call signs and frequencies of air/ground communication stations that issue emergency diversion advisories.

U.S. air carriers who have contracted with AMC to conduct operations into the former Yugoslavia must ensure that their operators comply with the preceding information. U.S. air carriers who do not have contracts with AMC to conduct such operations must ensure that the operations conform to SFAR No. 66. Air carrier operations must be conducted in accordance with all pertinent sections of FAR Part 121 and the air carrier's operations specifications at all times. U.S. air carriers who have contracted with AMC to conduct operations to any airport located in the former Republic of Yugoslavia shall amend paragraph C67 of the operations specifications by listing the airports to which such operations are authorized. Also, paragraph C67 must be amended to include a limitation prohibiting operations to such airports unless the requirements of this section have been met.

FIGURE 1-1. INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) FLIGHT PLAN

FLIGHT PLAN

PRIORITY
ADDRESSEE(S)

<<≡ FF →

<<≡

FILING TIME
ORIGINATOR

→ <<≡

SPECIFIC IDENTIFICATION OF ADDRESSEE(S) AND/OR ORIGINATOR

3 MESSAGE TYPE
7 AIRCRAFT IDENTIFICATION
8 FLIGHT RULES
TYPE OF FLIGHT

<<≡ (FPL — — <<≡

9 NUMBER
TYPE OF AIRCRAFT
WAKE TURBULENCE CAT.
10 EQUIPMENT

— / — / <<≡

13 DEPARTURE AERODROME
TIME

— <<≡

15 CRUISING SPEED
LEVEL
ROUTE

— →

<<≡

16 DESTINATION AERODROME
TOTAL EET
HR MIN
ALTN AERODROME
2ND ALTN AERODROME

— → → <<≡

18 OTHER INFORMATION

—

) <<≡

SUPPLEMENTARY INFORMATION (NOT TO BE TRANSMITTED IN FPL MESSAGES)

19 ENDURANCE
HR MIN
PERSONS ON BOARD
EMERGENCY RADIO
UHF VHF ELBA

— E/ → P/ → R/ U V E

SURVIVAL EQUIPMENT
POLAR DESERT MARITIME JUNGLE
JACKETS
LIGHT FLUORES UHF VHF

→ S / P D M J → J / L F U V

DINGHIES
NUMBER CAPACITY COVER COLOUR

→ D / → → C → <<≡

AIRCRAFT COLOUR AND MARKINGS

A/

REMARKS

→ N / <<≡

PILOT - IN - COMMAND

C/) <<≡

FILED BY
ACCEPTED BY
ADDITIONAL INFORMATION

DEPARTMENT OF COMMUNICATIONS DUBLIN
AC 90 Rev. 85

FIGURE 1-2. INTERNATIONAL FLIGHT PLAN FAA FORM 7233-4

INTERNATIONAL FLIGHT PLAN

Form Approved OMB No. 2120-0026

CIVIL AIRCRAFT PILOTS. FAR Part 91 states that each person operating a civil aircraft of U.S. registry over the high seas shall comply with Annex 2 to the Convention of International Civil Aviation International Standards — Rules of the Air. Annex 2 requires the submission of a flight plan containing items 1—19 prior to operating any flight across international waters. Failure to file could result in a civil penalty not to exceed $1000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended).

PRIORITY INDICATOR | ADDRESS INDICATOR(S)

FILING TIME | ORIGINATOR INDICATOR | SPECIFIC ADDRESSES AND/OR ORIGINATOR IDENTIFICATION(S)

3 DESCRIPTION | 7 AIRCRAFT IDENTIFICATION AND SSR DATA | 8 FLIGHT RULES AND TYPE OF FLIGHT | 9 NO. & TYPE AIRCRAFT AND WAKE TURBULANCE DATA | 10 EQUIPMENT — COMM NAV SSR

13 AERODROME OF DEPARTURE AND TIME | FIR BOUNDARIES AND ESTIMATED TIME(S)

15 CRUISING SPEED | LEVEL | ROUTE

17 AERODROME OF DESTINATION AND TIME | ETA | ALTERNATE AIRPORT(S) | 18 OTHER (General) INFORMATION

SUPPLEMENTAL INFORMATION — Not Transmitted (To Be Completed By Pilot)

19 FUEL / S POB S RDO 121.5 S 243 S 500 S 8364 | POLAR S DESERT S MARITIME S JUNGLE S COLOR OF AIRCRAFT

LIGHT S FLUORESEIN S | DINGHIES (Specify No. & Capacity) S COVER (Specify Color) RMK

U.S. Department of Transportation
Federal Aviation Administration

FAA Form 7233-4 (10-83) | NAME OF PILOT-IN-COMMAND | SIGNATURE OF PILOT **CLOSE FLIGHT PLAN UPON ARRIVAL** (SEE REVERSE)

PRE-FLIGHT PILOT CHECKLIST

AIRCRAFT IDENTIFICATION | TIME OF BRIEFING

REPORT WEATHER CONDITIONS ALOFT

Report immediately weather conditions encountered—particularly cloud tops, upper cloud layers, thunderstorms, ice, turbulance, winds and temperature

		REMARKS	POSITION	ALTITUDE	TIME	WEATHER CONDITIONS
WEATHER (Destination) (Alternate)	☐ PRESENT					
	☐ FORECAST					
WEATHER (En Route)	☐ PRESENT					
	☐ FORECAST					
	☐ PIREPS					
WINDS ALOFT	BEST CRZG ALT					
NAV AID & COMM STATUS	☐ DESTINATION					
	☐ EN ROUTE					
AIRPORT CONDITIONS	☐ DESTINATION					
	☐ ALTERNATE					
ADIZ	☐ AIRSPACE RESTRICTIONS					

U.S. Government Printing Office: 1984-436-492

FIGURE 1-3. NAVIGATION PERFORMANCE DATA

Reporting Period:	From:	To:	Aircraft Registration:

NAVIGATION PERFORMANCE DATA

Note 1: *Check (V)INS system used for steering where applicable*
Note 2: *Insert relevant data for each system as follows:*
a) For INS: on arrival at the ramp
b) for OMEGA: on ramp, or if preferable, after touch-down or on arrival over land-fall point
Note 3: *With INS, give the time in the navigation mode: with OMEGA, give the time in the MNPS area*
Note 4: *Give details of any relevant aspects of up-dating*

				RADIAL ERROR						Time		Did A/c stay 25 NM of cleared track	Remarks	INS RATE NM/HR		
				INS System		1	2	3	Note 1							
				Note 2												
				Brg.	Dist.	Brg.	Dist.	Brg.	Dist.	Note 3						
Date	Flight	From	To	DGR	NM	DGR	NM	DGR	NM	H	MIN		Note 4	1	2	3
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16

NAT[illegible] WS1 November [illegible]

FIGURE 1-4. OMEGA INFORMATION

The International Omega Association, Inc. (IOA): The IOA publishes the "Bibliography of Omega Publications" and the "Proceeding of Annual Meetings," containing papers on Omega use, equipment, research and policy. The address is:

International Omega Association
P.O. Box 2324
Arlington, Virginia 22202-0324

The Institute of Navigation (ION): The ION publishes a quarterly journal, "Navigation," which periodically contains papers on Omega. The Fall 1986 issue of "Navigation" (Volume 33, No. 3), was dedicated to Omega and is a good general reference. The address is:

Institute of Navigation
1026 16th Street, N.W., Suite 104
Washington, D.C. 20036

Gross navigation errors (GNE's) should be reported to the Central Monitoring Agency. The address is:

Central Monitoring Agency
CAA House
45-59 Kingsway
London WC2B6TE
United Kingdom

FIGURE 1-5. NOTAM OFFICES (NOF's) THAT EXCHANGE NOTAM'S WITH THE UNITED STATES

The following tabulation is a listing of NOFs that currently exchange NOTAMs with the U.S. NOF:

Country	[City]	Country	[City]	Country	[City]
Afghanistan	[Kabul]	Algeria	[Algiers]	Angola	[Luanda]
Argentina	[Buenos Aires]	Australia	[Sydney]	Austria	[Vienna]
Azores	[Santa Maria]	Bahamas	[Nassau]	Bahrain	[Bahrain]
Bangladesh	[Dacca]	Belgium	[Brussels]	Bermuda	
Bolivia	[La Paz]	Brazil	[Rio de Janeiro]	Bulgaria	[Sofia]
Burma	[Rangoon]	Canada	[Ottawa]	Cape Verde	[Amilcar Cabral]
Chile	[Santiago]	China	[Beijing]	Colombia	[Bogota]
Cuba	[Havana]	Cyprus	[Nicosia]	Czechoslovakia	[Prague]
Denmark	[Copenhagen]	Dom. Rep.	[Santo Domingo]	E. Germany	[Berlin]
Ecuador	[Guayaquil]	Egypt	[Cairo]	England	[London]
Fiji	[Nandi]	Finland	[Helsinki]	France	[Paris]
Ghana	[Accra]	Greece	[Athens]	Greenland	[Sondre Stromfjord]
Guyana	[Georgetown]	Haiti	[Port au Prince]	Honduras	[Tegucigalpa]
Hong Kong		Hungary	[Budapest]	Iceland	[Reykjavik]
India	[Bombay]	India	[Calcutta]	India	[Madras]
India	[New Delhi]	Indonesia	[Jakarta]	Iran	[Tehran]
Ireland	[Shannon]	Israel	[Tel Aviv]	Italy	[Rome]
Jamaica	[Kingston]	Japan	[Tokyo]	Kenya	[Nairobi]
Lebanon	[Beirut]	Liberia	[Roberts]	Libya	[Tripoli]
Malaysia	[Kuala Lumpur]	Malta	[Luqa]	Mexico	[Mexico City]
Morocco	[Casablanca]	Net. Antilles	[Curacao]	Netherlands	[Amsterdam]
New Zealand	[Auckland]	Nigeria	[Lagos]	Norway	[Oslo]
Pakistan	[Karachi]	Panama	[Tocumen]	Papua New Guinea .	[Port Moresby]
Paraguay	[Asuncion]	Peru	[Lima]	Philippines	[Manila]
Poland	[Warsaw]	Portugal	[Lisbon]	Romania	[Bucharest]
S. Africa	[Johannesburg]	S. Korea	[Seoul]	Senegal	[Dakar]
Singapore	Solomon Islands	Soviet Union	[Moscow]	Spain	[Madrid]
Sri Lanka	[Colombo]	Suriname	[Paramaribo]	Sweden	[Stockholm]
Switzerland	[Zurich]	Syria	[Damascus]	Tahiti	
Taiwan	[Taipei]	Thailand	[Bankok]	Trinidad and Tobago.	[Port of Spain]
Turkey	[Ankara]	Uruguay	[Montevideo]	Venezuela	[Caracas]
W. Germany	[Frankfurt]	Western Samoa	[Faleolo]	Yugoslavia	[Belgrade]
Zaire	[Kinshasa]	Zambia	[Lusaka]	Zimbabwe	[Salisbury]

The following tabulation is a listing of locations from which the U.S. NOF does not receive Class I NOTAMs:

Country	Country	Country
Albania	Botswana	Burundi
Cameroon	Central African Republic	Chad
Comoros	Congo	Equatorial Guinea
Ethiopia	Gabon	Gibraltar
Iraq	Jordan	Kampuchea
Korea (North)	Kuwait	Laos
Madagascar	Malawi	Mauritius
Mongolia	Mozambique	Nepal
Rwanda	Sao Tome & Principe	Saudi Arabia
Seychelles	Somalia	Sudan
Swaziland	Tunisia	Viet-Nam
Yemen Arab Republic	Yemen Democratic Republic	

FIGURE 1-6. DISTANCE CONVERSIONS

DISTANCE CONVERSION
CONVERSIONS

NOTE: CONVERSIONS ARE ROUNDED OFF TO NEAREST WHOLE NUMBER EXCEPT FOR THE FIRST ROW

KILOMETERS			STATUTE MILES			NAUTICAL MILES		
to SM		to NM	to KM		to NM	to KM		to SM
0.62137	1	0.53996	1.6093	1	0.86898	1.8520	1	1.1508
1.24	2	1.08	3.22	2	1.74	3.70	2	2.30
1.86	3	1.62	4.83	3	2.61	5.56	3	3.45
2.49	4	2.16	6.44	4	3.48	7.41	4	4.60
3.11	5	2.70	8.05	5	4.34	9.26	5	5.75
3.73	6	3.24	9.66	6	5.21	11.11	6	6.90
4.35	7	3.78	11.27	7	6.08	12.96	7	8.06
4.97	8	4.32	12.87	8	6.95	14.82	8	9.21
5.59	9	4.86	14.48	9	7.82	16.67	9	10.36
6.21	10	5.40	16.09	10	8.69	18.52	10	11.51
12.43	20	10.80	32.19	20	17.38	37.04	20	23.02
18.64	30	16.20	48.28	30	26.07	55.56	30	34.52
24.85	40	21.60	64.37	40	34.76	74.08	40	46.03
31.07	50	27.00	80.47	50	43.45	92.60	50	57.54
37.28	60	32.40	96.56	60	52.14	111.12	60	69.05
43.50	70	37.80	112.65	70	60.83	129.64	70	80.56
49.17	80	43.20	128.75	80	69.52	148.16	80	92.06
55.92	90	48.60	144.84	90	78.20	166.68	90	103.57
62.14	100	54.00	160.93	100	86.90	185.20	100	115.08
124.27	200	107.99	321.87	200	173.80	370.40	200	230.16
186.41	300	161.99	482.80	300	260.69	555.60	300	345.23
248.55	400	215.98	643.74	400	347.59	740.80	400	460.31
310.69	500	269.98	804.67	600	434.49	926.00	500	575.39
372.82	600	323.97	965.61	600	521.39	1111.20	600	690.47
434.96	700	377.97	1126.54	700	608.28	1296.40	700	805.55
497.10	800	431.97	1287.48	500	695.18	1481.60	800	920.62
559.23	900	485.96	1448.41	900	782.01	1666.80	900	1035.70
621.37	1000	539.96	1609.34	1000	868.98	1852.00	1000	1150.78

METERS to FEET			METERS to YARDS			INCHES to MILLIMETERS (MM)		
Meters	Ft / Meters	Ft	Meters	Yds/ Meters	Yds	Inches	mm / Inches	mm
.3048	1	3.2808	.9144	1	1.0936	.03937	1	25.4
1	2	7	2	2	2	.07874	2	50.8
1	3	10	3	3	3	.11811	3	76.2
1	4	13	4	4	4	.15748	4	101.6
2	5	16	5	5	5	.19685	5	127.0
2	6	20	5	6	7	.23622	6	152.4
2	7	23	6	7	8	.27559	7	177.8
2	8	26	7	8	9	.31496	8	203.2
3	9	30	8	9	10	.35433	9	228.6
3	10	33	9	10	11	.3937	10	254.0
6	20	66	18	20	22	.7874	20	508.0
9	30	98	27	30	33	1.1811	30	762.0
12	40	131	37	40	44	1.5748	40	1016.0
15	50	164	46	50	55	1.9685	50	1270.0
18	60	197	55	60	66	2.3622	60	1524.0
21	70	230	64	70	77	2.7559	70	1778.0
24	80	262	73	80	88	3.1496	80	2032.0
27	90	295	82	90	99	3.5433	90	2286.0
30	100	328	91	100	110	3.9370	100	2540.0
61	200	656	183	200	219	7.8740	200	5080.0
91	300	984	274	300	329	11.8110	300	7620.0
122	400	1312	366	400	438	15.7480	400	10160.0
152	600	1640	457	500	548	19.6850	500	12700.0
183	600	1968	549	600	656	23.6220	600	15240.0
213	700	2296	640	700	767	27.5590	700	17780.0
244	800	2625	732	800	877	31.4960	800	20320.0
274	900	2953	823	900	987	35.4330	900	22860.0
305	1000	3281	914	1000	1096	39.3701	1000	25400.0

FIGURE 1-7. ICAO TERMINAL FORECAST (TAF)

International Terminal Forecasts (TAF's) are in an alphanumeric code. They are issued two or four times daily for 24-hour periods beginning at 0000Z, 0600Z, 1200Z and 1800Z.

The TAF is a series of groups made up of digits and letters. An individual group is identified by its position in the sequence, by its alphanumeric coding, by its length, or by a numeric indicator.

The following is a St. Louis forecast in TAF code:

KSTL 1212 33025/35 0800 71SN 9//005 INTER 1215 0000 39BLSN 9//000 GRADU 1516 33020 4800 38BLSN 7SC030 TEMPO 1620 85SNSH GRADU 2122 33015 9999 WX NIL 3SC030 RAPID 00 VRB05 9999 SKC

The forecast is broken down into the elements lettered "a" to "k" to aid in the discussion.

KSTL	**1212**	**33025/35**	**0800**	**71SN**	**9//005**
a.	b.	c.	d.	e.	f.
INTER	1215	0000	39BLSN		9//000
		g.			
GRADU	1516	33020	4800	38BLSN7SC030	
		h.			
TEMPO	1620	85SNSH			
		i.			
GRADU	2122	33015	9999		WX
			NIL 3SC030		
			j.		
RAPID	00	VRB05	9999	SKC	
		k.			
680304		590359	02134		
l.		m.	n.		

a. Station identifier. The TAF code uses ICAO 4-letter station identifiers.

b. Valid time. Valid Time of the forecast follows station identifier. "1212" means a 24-hour forecast valid from 1200Z until 1200Z the following day.

c. Wind. The wind forecast is usually a 5-digit group showing direction in 3 digits and speed in 2 digits. When the wind is expected to be 100 knots or more, the group is 6 digits with speed shown in 3 digits. When the speed is gusty or variable, peak speed is separated from average speed with a slash. For example, in the KSTL TAF, "33025/35" means wind 330, average speed 25 knots, peak speed 35 knots. A group "160115/130" means wind 160, 115 knots, peak speed 130 knots. "00000" means clam; "VRB" followed by speed indicates direction variable; i.e., "VRB10" means wind direction variable at 10 knots.

FIGURE 1-7. ICAO TERMINAL FORECAST (TAF) - Continued

d. Visibility. Visibility is forecast in meters. Table 1 converts meters to miles. "0800" is 800 meters or 1/2 mile.

e. Significant weather. Significant weather is decoded using Table II. Groups in the table are numbered sequentially. Each number is followed by an acronym suggestive of the weather; you can soon learn to read most of the acronyms without reference to the table. Examples:

"17TS," thunderstorm; "18SQ," squall' "31SA," sandstorm; "60RA," rain; "85SNSH," snow shower. "XX" between the number and acronym means "heavy." Examples: "33XXSA," heavy sandstorm; "67XXFZRA," heavy freezing rain. In the KSTL forecast, "71SN" means light snow. The TAF encodes only the single most significant type of weather unlike the U.S. domestic FT which permits encoding of multiple weather types.

f. Clouds. The cloud group is a 6-character group. The first digit is sky coverage in octas (eighths) as shown in Table III. The two letters identify cloud type as shown in the table. The last three digits are cloud height in hundreds of feet. In the KSTL TAF, "9//005" means sky obscured (9), clouds not observed (//), vertical visibility 500 feet (005). The TAF may include as many cloud groups as necessary to describe expected sky condition.

g. and i. Variation from prevailing conditions. Variation from prevailing conditions are identified by the contractions INTER and TEMPO as defined below. In the KSTL TAF, "INTER 1215 0000 39BLSN 9//000" means intermittently from 1200Z to 1500Z (1215) visibility zero meters (0000) or zero miles, blowing snow (39BLSN), sky obscured, clouds not observed, vertical visibility zero (9//000). "TEMPO 1620 85SNSH" means between 1600Z and 2000Z, temporary, or brief, snow showers. Omission of other groups imply no significant change in wind, visibility, or cloud cover.

h., j., and k. An expected change in prevailing conditions. An expected change in prevailing conditions is indicated by the contraction GRADU, RAPID, or FRONT as defined below. In the KSTL TAF, "GRADU 1516 33020 4800 38BLSN 7SC030" means a gradual change between 1500Z and 1600Z to wind 330 at 20 knots, visibility 4,800 meters or 3 miles (Table I), blowing snow, 7/8 stratocumulus (Table III) at 3,000 feet. "GRADU 2122 33015 9999 WX NIL 3SC030" means a gradual change between 2100Z and 2200Z to wind 330 at 15 knots, visibility 10 kilometers or more (more than 6 miles), no significant weather, 3/8 stratocumulus at 3,000 feet. "RADIP 00 VRB05 9999 SKC" means a rapid change about 0000Z to wind direction variable at 5 knots, visibility than 6 miles, sky clear.

Listed below are a few contractions used in the TAF. Some of the contractions are followed by time entries indicated by "tt" or "tttt" or by probability, "pp":

GRADU tttt A gradual change occurring during a period in excess of one-half hour. "tttt" are the beginning and ending times of the expected change to the nearest hour; i.e., "GRADU 1213" means the transition will occur between 1200Z and 1300Z.

FIGURE 1-7. ICAO TERMINAL FORECAST (TAF) - Continued

RAPID tt A rapid change occurring in one-half hour or less. "tt" is the time to the nearest hour of the change; i.e., "RAPID 23" means the change will occur about 2300Z.

TEMPO tttt Temporary changes from prevailing conditions lasting less than one hour. "tttt" are the earliest and latest change times during which the temporary changes are expected; i.e., "TEMPO 0107" means the temporary changes may occur between 0100Z and 0700Z.

INTER tttt Intermittent changes from prevailing conditions are expected to occur frequently and briefly. "tttt" are the earliest and latest times the brief changes are expected; i.e., "INTER 1518" means that the brief changes may occur between 1500Z and 1800Z, the changes to persist for less than one half the time period.

CAVOK Ceiling and visibility OK. No clouds below 5,000 feet or below the highest minimum sector altitude, whichever is greater, and no cumulonimbus. Visibility 6 miles or greater. No precipitation, thunderstorms, shallow fog or drifting snow.

PROB pp Probability of conditions occurring. "pp" is the probability in percent; i.e., "PROB 20" means a 20% probability of the conditions occurring.

WX NIL No significant weather or obstructions to vision.

SKC Sky clear.

l. Icing. An icing group may be included. It is a 6-digit group. The first digit is 6, identifying it as an icing group. The second digit is the type of ice accretion from Table IV. The next three digits are height of the base of the icing layer in hundreds of feet. The last digit is the thickness of the layer in thousands of feet. For example, let's decode the group "680304". "6" indicates an icing forecast; "8" indicates severe icing in cloud (Table IV); "030" means the base of the icing is at 3,000 feet; and "4" specifies a layer 4,000 feet thick.

m. Turbulence. A turbulence group also may be included. It also is 6-digit group coded the same as the icing group except a "5" identifies the group as a turbulence forecast, and type of turbulence is from Table IV. To decode the group "590359"; "5" identifies a turbulence forecast; "9": specifies frequent severe turbulence in cloud (Table IV); "035" means the base of the turbulent layer is 3,500 feet; "9" specifies that the turbulence layer is 9,000 feet thick.

When either an icing or a turbulent layer is expected to be more than 9,000 feet thick, multiple groups are used; the top specified in one group is coincident with the base in the following group. Let's assume a cloud base at 5,000 feet and the forecaster expects frequent turbulence in thunderstorms from the surface to 45,000 feet; the most hazardous turbulence is at mid-levels. This could be encoded 530005 550509 591409 592309 553209 554104. While you most likely will never see such a complex coding with this many groups, the flexible TAF code permits it.

FIGURE 1-7. ICAO TERMINAL FORECAST (TAF) - Continued

n. Temperature. A temperature code is seldom included in a terminal forecast. However, it may be included if critical to aviation. It may be used to alert the pilot to high density altitude or possible frost when on the ground. The temperature group is identified by the digit "0". The next two digits are time to the nearest hour GMT at which the temperature will occur. The last two digits are temperature in degrees Celsius. A minus temperature is preceded by the letter "M." Examples: "02137" means temperature at 2100Z is expected to be 37C, about 99F; "012M02" means temperature at 1200Z is expected to be minus 2C. A forecast may include more than one temperature group.

FIGURE 1-8. VISIBILITY CONVERSION, TAF CODE TO MILES

METERS	MILES
0000	0
0100	1/16
0200	1/8
0300	3/16
0400	1/4
0500	5/16
0600	3/8
0800	1/2
1000	5/8
1200	3/4
1400	7/8
1600	1
1800	1 1/8
2000	1 1/4
2200	1 3/8
2400	1 1/2
2600	1 5/8
2800	1 3/4
3000	1 7/8
3200	2
3600	2 1/4
4000	2 1/2
4800	3
6000	4
8000	5
9000	6
9999	more than 6

FIGURE 1-9. TAF WEATHER CODES

CODE	DECODE
04FU	SMOKE
06HZ	DUST HAZE
08PO	DUST DEVILS
10BR	MIST
11MIFG	SHALLOW FOG - Patches
12MIFG	SHALLOW FOG - Continuous
17TS	THUNDERSTORMS
18SQ	SQUALL
19FC	FUNNEL CLOUD
30SA	DUSTSTORM or SANDSTORM - Decreased during the preceding hour
31SA	DUSTSTORM or SANDSTORM - No change during the preceding hour
32SA	DUSTSTORM or SANDSTORM - Began or increased during the preceding hour
33XXSA	HEAVY DUSTSTORM or SANDSTORM - Decreased during the preceding hour
34XXSA	HEAVY DUSTSTORM or SANDSTORM - No change during the preceding hour
35XXSA	HEAVY DUSTSTORM or SANDSTORM - Began or increased during the preceding hour
36DRSN	LOW DRIFTING SNOW - Slight or moderate
37DRSN	LOW DRIFTING SNOW - Heavy
38BLSN	BLOWING SNOW - Slight or moderate
39BLSN	BLOWING SNOW - Heavy

FIGURE 1-9. TAF WEATHER CODES - Continued

CODE	DECODE
40BCFG	FOG PATCHES - Sky visible, has become thinner during the preceding hour
41BCFG	FOG PATCHES
42FG	FOG - Sky visible, has become thinner during the preceding hour
43FGFOG	Sky invisible, has become thinner during the preceding hour
44FG	Fog - Sky visible, no change during the last hour
45FGFOG	Sky invisible, no change during the preceding hour
46FGFOG	Sky visible, has begun or has become thicker during the preceding hour
47FGFOG	Sky invisible, has begun or has become thicker during the preceding hour
48FZFG	FREEZING FOG - Sky visible
49FZFG	FREEZING FOG - Sky invisible
50DZ	DRIZZLE - Intermittent, slight
51DZ	DRIZZLE - Continuous, slight
52DZ	DRIZZLE - Intermittent, moderate
53DZ	DRIZZLE - Continuous, moderate
54XXDZ	HEAVY DRIZZLE - intermittent
55XXDZ	HEAVY DRIZZLE - Continuous
56FZDZ	FREEZING DRIZZLE
57XXFZDZ	HEAVY FREEZING DRIZZLE

FIGURE 1-9. TAF WEATHER CODES - Continued

CODE	DECODE
58RA	RAIN - Drizzle and Rain, slight
59RA	RAIN - Drizzle and Rain, moderate or heavy
60RA	RAIN - Intermittent, slight
61RA	RAIN - Continuous, slight
62RA	RAIN - Intermittent, moderate
63RA	RAIN - Continuous, moderate
64XXRA	HEAVY RAIN - Intermittent, heavy
65XXRA	HEAVY RAIN - Continuous, heavy
66FZRA	FREEZING RAIN
67XXFZRA	HEAVY FREEZING RAIN
68RASN	RAIN and SNOW
69XXRASN	HEAVY RAIN and SNOW
70SN	SNOW - Intermittent, slight
71SN	SNOW - Continuous, slight
72SN	SNOW - Intermittent moderate
73SN	SNOW - Continuous moderate
74XXSN	HEAVY SNOW - Intermittent
75XXSN	HEAVY SNOW - Continuous
77SN	SNOW - Snow grains
79PE	ICE PELLETS
80RASH	SHOWERS
81XXSH	HEAVY SHOWERS - Moderate or heavy

FIGURE 1-9. TAF WEATHER CODES - Continued

CODE	DECODE
82XXSH	HEAVY SHOWERS - Violent
83RASN	SHOWERS of RAIN and SNOW mixed
84XXRASN	HEAVY SHOWERS of RAIN and SNOW - Mixed
85SNSH	SNOW SHOWERS
86XXSN	HEAVY SNOW SHOWERS
87GR	SOFT HAIL - Moderate or heavy
89GR	HAIL - Not associated with thunder, slight
90XXGR	HEAVY HAIL - Not associated with thunder, moderate or heavy
91RA	RAIN - Slight rain at time of observation, thunderstorm during preceding hour but not at time of observation
92XXRA	RAIN - Moderate or heavy rain at time of observation, thunderstorm during the preceding hour but not at the time of observation
93GR	HAIL, SLIGHT SNOW - Or rain and snow mixed with hail, at time of observation, thunderstorm during preceding hour but not at time of observation
94XXGR	HEAVY HAIL - Moderate or heavy snow, or rain and snow mixed with hail at time of observation, thunderstorm during preceding hour but not at time of observation
95TS	THUNDERSTORM - Thunderstorm, slight or moderate, without hail but with rain and/or snow
96TSGR	THUNDERSTORM with HAIL - Thunderstorm, slight or moderate, with hail

FIGURE 1-9. TAF WEATHER CODES - Continued

CODE	DECODE
97XXTS	HEAVY THUNDERSTORM - Heavy, without hail
98TSSA	THUNDERSTORM with DUSTSTORM or SANDSTORM
99XXTSGR	HEAVY THUNDERSTORM with HAIL

FIGURE 1-10. TAF CLOUD CODE

CLOUD AMOUNT	CLOUD TYPE
0 0 (CLEAR)	CI Cirrus
1 1 octa or less but not zero	CC Cirrocumulus CS Cirrostratus
2 2 octas	AC Altocumulus
3 3 octas	AS Altostratus
4 4 octas	NS Nimbostratus
5 5 octas	SC Stratocumulus
6 6 octas	ST Stratus
7 7 octas or more but less than 8	CU Cumulus CB Cumulonimbus
8 8 octas (overcast)	//Cloud not visible
9 Sky obscured, or cloud amount not estimated	due to darkness or obscuring phenomena

FIGURE 1-11. TAF ICING & TURBULENCE

Fig. Code	Amount of Ice Accretion (TAF group 6)
0	No icing
1	Light icing
2	Light icing in cloud
3	Light icing in precipitation
4	Moderate icing
5	Moderate icing in cloud
6	Moderate icing in precipitation
7	Severe icing
8	Severe icing in cloud
9	Severe icing in precipitation

Fig. Code	Amount of Ice Accretion (TAF group 5)
0	None
1	Light turbulence
2	Moderate turbulence in clear air, infrequent
3	Moderate turbulence in clear air, frequent
4	Moderate turbulence in cloud, infrequent
5	Moderate turbulence in cloud, frequent
6	Severe turbulence in clear air, infrequent
7	Severe turbulence in clear air, frequent
8	Severe turbulence in cloud, infrequent
9	Severe turbulence in cloud, frequent

FIGURE 1-12. CONVERSION OF ALTIMETER SETTING INCHES OF MERCURY - MILLIBARS

1 inch of mercury = 33.863 hectopascals = 33.863 millibars

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	MILLIBARS									
26.0	880.5	880.8	881.1	881.5	881.8	882.2	882.5	882.8	883.2	883.5
26.1	883.8	884.2	884.5	884.9	885.2	885.5	885.9	886.2	886.6	886.9
26.2	887.2	887.6	887.9	888.3	888.6	888.9	889.3	889.6	889.9	890.3
26.3	890.6	891.0	891.3	891.6	892.0	892.3	892.7	893.0	893.3	893.7
26.4	894.0	864.3	894.7	895.0	895.4	895.7	896.0	896.4	896.7	897.1
26.5	897.4	897.7	898.1	898.4	898.7	899.1	899.4	899.8	900.1	900.4
26.6	900.8	901.1	901.5	901.8	902.1	902.5	902.8	903.2	903.5	903.8
26.7	904.2	904.5	904.8	905.2	905.5	905.9	906.2	906.5	906.9	907.2
26.8	907.6	907.9	908.2	908.6	908.9	909.2	909.6	909.9	910.3	910.6
26.9	910.9	911.3	911.6	912.0	912.3	912.6	913.0	913.3	913.6	914.0
27.0	914.3	914.7	915.0	915.3	915.7	916.0	916.4	916.7	917.0	917.4
27.1	917.7	918.1	918.4	918.7	919.1	919.4	919.7	920.1	920.4	920.8
27.2	921.1	921.4	921.8	922.1	922.5	922.8	923.1	923.5	923.8	924.1
27.3	924.5	924.8	925.2	925.5	925.8	926.2	926.5	926.9	927.2	927.5
27.4	927.9	928.2	928.5	928.9	929.2	929.6	929.9	930.2	930.6	930.9
27.5	921.3	931.6	931.9	932.3	932.6	933.0	933.3	933.6	934.0	934.3
27.6	934.6	935.0	935.3	935.7	936.0	936.3	936.7	937.0	937.4	937.7
27.7	938.0	938.4	938.7	939.0	939.4	939.7	940.1	940.4	940.7	941.1
27.8	941.4	941.8	942.1	942.4	942.8	943.1	943.4	943.8	944.1	944.5
27.9	944.8	945.1	945.5	945.8	946.2	946.5	946.8	947.2	947.5	947.9

FIGURE 1-12. CONVERSION OF ALTIMETER SETTING INCHES OF MERCURY - MILLIBARS - Continued

1 inch of mercury = 33.863 hectopascals = 33.863 millibars

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	MILLIBARS									
28.0	948.2	948.5	948.9	949.2	949.5	949.9	950.2	950.6	950.9	951.2
28.1	951.6	951.9	952.3	952.6	952.9	953.3	953.6	953.9	954.3	954.6
28.2	955.0	955.3	955.6	956.0	956.3	956.7	957.0	957.3	957.7	958.0
28.3	958.3	958.7	959.0	959.4	959.7	960.0	960.4	960.7	961.1	961.4
28.4	961.7	962.1	962.4	962.8	963.1	963.4	963.8	964.1	964.4	964.8
28.5	965.1	965.5	965.8	966.1	966.5	966.8	967.2	967.5	967.8	968.2
28.6	968.5	968.8	969.2	969.5	969.9	970.2	970.5	970.9	971.2	971.6
28.7	971.9	972.2	972.6	972.9	973.2	973.6	973.9	974.3	974.6	974.9
28.8	975.3	975.6	976.0	976.3	976.6	977.0	977.3	977.7	978.0	978.3
28.9	978.7	979.0	979.3	979.7	980.0	980.4	980.7	981.0	981.4	981.7
29.0	982.1	982.4	982.7	983.1	983.4	983.7	984.1	984.4	984.8	985.1
29.1	985.4	985.8	986.1	986.5	986.8	987.1	987.5	987.8	988.2	988.5
29.2	988.8	989.2	989.5	989.8	990.2	990.5	990.9	991.2	991.5	991.9
29.3	992.2	992.6	992.9	993.2	993.6	993.9	994.2	994.6	994.9	995.3
29.4	995.6	995.9	996.3	996.6	997.0	997.3	997.6	998.0	998.3	998.6
29.5	999.0	999.3	999.7	1000.0	1000.4	1000.7	1001.0	1001.4	1001.7	1002.0
29.6	1002.4	1002.7	1003.1	1003.4	1003.7	1004.1	1004.4	1004.7	1005.1	1005.4
29.7	1005.8	1006.1	1006.4	1006.8	1007.1	1007.5	1007.8	1008.1	1008.5	1008.8
29.8	1009.1	1009.5	1009.8	1010.2	1010.5	1010.8	1011.2	1011.5	1011.9	1012.2
29.9	1012.5	1012.9	1013.2	1013.5	1013.9	1014.0	1014.6	1014.9	1015.2	1015.6
30.0	1015.9	1016.3	1016.6	1016.9	1017.3	1017.6	1018.0	1018.3	1018.6	1019.0
30.1	1019.3	1019.6	1020.0	1020.3	1020.7	1021.0	1021.3	1021.7	1022.0	1022.4

FIGURE 1-12. CONVERSION OF ALTIMETER SETTING INCHES OF MERCURY - MILLIBARS - Continued

1 inch of mercury = 33.863 hectopascals = 33.863 millibars

INCHES	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	MILLIBARS									
30.2	1022.7	1023.0	1023.4	1023.7	1024.0	1024.4	1024.7	1025.1	1025.4	1025.7
30.3	1026.1	1026.4	1026.8	1027.1	1027.4	1027.8	1028.1	1028.4	1028.8	1029.1
30.4	1029.5	1029.8	1030.4	1030.5	1030.8	1031.2	1031.5	1031.8	1032.2	1032.5
30.5	1032.9	1033.2	1033.5	1033.9	1034.2	1024.5	1034.9	1035.2	1035.6	1035.9
30.6	1036.2	1026.6	1036.9	1037.3	1037.6	1037.9	1038.3	1038.6	1038.9	1039.3
30.7	1039.6	1040.0	1040.3	1040.6	1041.0	1041.3	1041.7	1042.0	1042.3	1042.7
30.8	1043.0	1043.3	1043.7	1044.0	1044.4	1044.7	1045.0	1045.4	1045.7	1046.1
30.9	1046.4	1046.7	1047.1	1047.4	1047.8	1048.1	1048.4	1048.8	1049.1	1049.4

FIGURE 1-13. HECTOPASCALS (OR MILLIBARS) TO INCHES OF MERCURY

HECTOPASCALS or MILLIBARS to INCHES (1 hectopascal = 1 millibar = 0.02953 inches of mercury)

hPa or mb	0	1	2	3	4	5	6	7	8	9
	INCHES									
710	20.97	21.00	21.03	21.05	21.08	21.11	21.14	21.17	21.20	21.23
720	21.26	21.29	21.32	21.35	21.38	21.41	21.44	21.47	21.50	21.53
730	21.56	21.59	21.62	21.65	21.67	21.70	21.73	21.76	21.79	21.82
740	21.85	21.88	21.91	21.94	21.97	22.00	22.03	22.06	22.09	22.12
750	22.15	22.18	22.21	22.24	22.27	22.30	22.32	22.35	22.38	22.41
760	22.44	22.47	22.50	22.53	22.56	22.59	22.62	22.65	22.68	22.71
770	22.74	22.77	22.80	22.83	22.86	22.89	22.92	22.94	22.97	23.00
780	23.03	23.06	23.09	23.12	23.15	23.18	23.21	23.24	23.27	23.30
790	23.33	23.36	23.39	23.42	23.45	23.48	23.51	23.54	23.56	23.59
800	23.62	23.65	23.68	23.71	23.74	23.77	23.80	23.83	23.86	23.89
810	23.92	23.95	23.98	24.01	24.04	24.07	24.10	24.13	24.16	24.19
820	24.21	24.24	24.27	24.30	24.33	24.36	24.39	24.42	24.45	24.48
830	24.51	24.54	24.57	24.60	24.63	24.66	24.69	24.72	24.75	24.78
840	24.81	24.83	24.86	24.89	24.92	24.95	24.98	25.01	25.04	25.07
850	25.10	25.13	25.16	25.19	25.22	25.25	25.28	25.31	25.34	25.37
860	25.40	25.43	25.45	25.48	25.51	25.54	25.57	25.60	25.63	25.66
870	25.69	25.72	25.75	25.78	25.81	25.84	25.87	25.90	25.93	25.96
880	25.99	26.02	26.05	26.07	26.10	26.13	26.16	26.19	26.22	26.25
890	26.28	26.31	26.34	26.37	26.40	26.43	26.46	26.49	26.52	26.55
900	26.58	26.61	26.64	26.67	26.70	26.72	26.75	26.78	26.81	26.84
910	26.87	26.90	26.93	26.96	26.99	27.02	27.05	27.08	27.11	27.14
920	27.17	27.20	27.23	27.26	27.29	27.32	27.34	27.37	27.40	27.43
930	27.46	27.49	27.52	27.55	27.58	27.61	27.64	27.67	27.70	27.73
940	27.76	27.79	27.82	27.85	27.88	27.91	27.94	27.96	27.99	28.02
950	28.05	28.08	28.11	28.14	28.17	28.20	28.23	28.26	28.29	28.32
960	28.35	28.38	28.41	28.44	28.47	28.50	28.53	28.56	28.58	28.61
970	28.64	28.67	28.70	28.73	28.76	28.79	28.85	28.85	28.88	28.91
980	28.94	28.97	29.00	29.03	29.06	29.09	29.15	29.15	29.18	29.21
990	29.23	29.26	29.29	29.32	29.35	29.38	29.44	29.44	29.47	29.50
1000	29.53	29.56	29.59	29.62	29.65	29.68	29.74	29.74	29.77	29.80
1010	29.83	29.85	29.88	29.91	29.94	29.97	30.03	30.03	30.06	30.09
1020	30.12	30.15	30.18	30.21	30.24	30.27	30.33	30.33	30.36	30.39
1030	30.42	30.45	30.47	30.50	30.53	30.56	30.62	30.62	30.65	30.68
1040	30.71	30.74	30.77	30.80	30.83	30.86	30.92	30.92	30.95	30.98
1050	31.01	31.04	31.07	31.10	31.12	31.15	31.21	31.21	31.24	31.27

FIGURE 1-13. HECTOPASCALS (OR MILLIBARS) TO INCHES OF MERCURY - Continued

HECTOPASCALS or MILLIBARS to INCHES (1 hectopascal = 1 millibar = 0.02953 inches of mercury)

MN	0	1	2	3	4	5	6	7	8	9
	HECTOPASCALS (or MILLIBARS)									
530	706.6	707.9	709.3	710.6	711.9	713.3	714.6	715.9	717.3	718.6
540	719.9	721.3	722.6	723.9	725.3	726.6	727.9	729.3	730.6	731.9
550	733.3	734.6	735.9	737.3	738.6	739.9	741.3	742.6	743.9	745.3
560	746.6	747.9	749.3	750.6	751.9	753.3	754.6	755.9	757.3	758.6
570	759.9	761.3	762.6	763.9	765.3	766.6	767.9	769.3	770.6	771.9
580	773.3	774.6	775.9	777.3	778.6	779.9	781.3	782.6	783.9	785.3
590	786.6	787.9	789.3	790.6	791.9	793.3	794.6	795.9	797.3	798.6
600	799.9	801.3	802.6	803.9	805.3	806.6	807.9	809.3	810.6	811.9
610	813.3	814.6	815.9	817.3	818.6	819.9	821.3	822.6	823.9	825.3
620	826.6	827.9	829.3	830.6	831.9	833.3	834.6	835.9	837.3	838.6
630	839.9	841.3	842.6	843.9	845.2	846.6	847.9	849.3	850.6	851.9
640	853.3	854.6	855.9	857.3	858.6	859.9	861.3	862.6	863.9	865.3
650	866.6	867.9	869.3	870.6	871.9	873.3	874.6	875.9	877.3	878.6
660	879.9	881.3	882.6	883.9	885.3	886.6	887.9	889.3	890.6	891.9
670	893.3	894.6	895.9	897.3	898.6	899.9	901.3	902.6	903.9	905.3
680	906.6	907.9	909.3	910.6	911.9	913.3	914.6	915.9	917.3	918.6
690	919.9	921.3	922.6	923.9	925.3	926.6	927.9	929.3	930.6	931.9
700	933.3	934.6	935.9	937.3	938.6	939.9	941.3	942.6	943.9	945.3
710	946.6	947.9	949.3	950.6	951.9	953.3	954.6	955.9	957.3	958.6
720	959.9	961.3	962.6	963.9	965.3	966.6	967.9	969.3	970.6	971.9
730	973.3	974.6	975.9	977.3	978.6	979.9	981.3	982.6	983.9	985.3
740	986.6	987.9	989.3	990.6	991.9	993.3	994.6	995.9	997.3	998.6
750	999.9	1001.	1002.	1003.	1005.	1006.	1007.	1009.	1010.	1011.
760	1013.	1014.	1015.	1017.	1018.	1019.	1021.	1022.	1023.	1025.
770	1026.	1027.	1029.	1030.	1031.	1033.	1034.	1035.	1037.	1038.
780	1039.	1041.	1042.	1043.	1045.	1046.	1047.	1049.	1050.	1051.
790	1053.	1054.	1055.	1057.	1058.	1059.	1061.	1062.	1063.	1065.
800	1066.	1067.	1069.	1070.	1071.	1073.	1074.	1075.	1077.	1078.

FIGURE 1-14. JET FUEL CONVERSION

LBS - KG - U.S. GAL - LITER

TURBINE FUEL volume/weight
(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

U.S. Gal	U.S. Lbs / Gal	Lbs	Liter	Lbs / Liter	Lbs	Liter	Kg / Liter	Kg
0.15	1	6.7	0.57	1	1.8	1.25	1	0.8
0.3	2	13	1.1	2	3.6	2.5	2	1.6
0.45	3	20	1.7	3	5.4	3.8	3	2.4
0.6	4	27	2.3	4	7.2	5.0	4	3.2
0.75	5	33	2.8	5	9.0	6.2	5	4.0
0.9	6	40	3.4	6	11	7.5	6	4.8
1.05	7	47	4	7	13	8.8	7	5.6
1.2	8	53	4.5	8	14	10	8	6.4
1.35	9	60	5.1	9	16	11	9	7.2
1.5	10	67	5.7	10	18	12	10	8
3	20	130	11	20	36	25	20	16
4.5	30	200	17	30	54	38	30	24
6	40	270	23	40	72	50	40	32
7.5	50	330	28	50	90	62	50	40
9	60	400	34	60	110	75	60	48
10.5	70	470	40	70	130	88	70	56
12	80	530	45	80	140	100	80	64
13.5	90	600	51	90	160	110	90	72
15	100	670	57	100	180	120	100	80
30	200	1300	110	200	360	250	200	160
45	300	2000	170	300	540	380	300	240
60	400	2700	230	400	720	500	400	320
75	500	3300	280	500	900	620	500	400
90	600	4000	340	600	1100	750	600	480
105	700	4700	400	700	1300	880	700	560
120	800	5300	450	800	1400	1000	800	640
135	900	6000	510	900	1600	1100	900	720
150	1000	6700	570	1000	1800	1200	1000	800

FIGURE 1-15. VOLUME CONVERSION

IMP GAL - U.S. GAL - LITER

TURBINE FUEL volume/weight
(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

Imp Gal	U.S. / Imp Gal / Gal	U.S. Gal	U.S. Gal	U.S. Liter / Gal	Liter	Imp Gal	Imp Liter / Gal	Liter
.83267	1	1.2010	.26418	1	3.7853	.21997	1	4.5460
2	2	2	1	2	8	0.4	2	9
2	3	4	1	3	11	0.7	3	14
3	4	5	1	4	15	0.9	4	18
4	5	6	1	5	19	1	5	23
5	6	7	2	6	23	1	6	27
6	7	8	2	7	26	2	7	32
7	8	10	2	8	30	2	8	36
7	9	11	2	9	34	2	9	41
8	10	12	3	10	38	2	10	45
17	20	24	5	20	76	4	20	91
25	30	36	8	30	114	7	30	136
33	40	48	11	40	151	9	40	182
42	50	60	13	50	189	11	50	227
50	60	72	16	60	227	13	60	273
58	70	84	18	70	265	15	70	318
67	80	96	21	80	303	18	80	364
75	90	108	24	90	341	20	90	409
83	100	120	26	100	378	22	100	455
167	200	240	53	200	757	44	200	909
250	300	360	79	300	1136	66	300	1364
333	400	480	106	400	1514	88	400	1818
416	500	600	132	500	1893	110	500	2273
500	600	721	158	600	2271	132	600	2728
583	700	841	185	700	2650	154	700	3182
666	800	961	211	800	3028	176	800	3637
750	900	1081	238	900	3407	198	900	4091
833	1000	1201	264	1000	3785	220	1000	4546

FIGURE 1-16. LENGTH CONVERSIONS

KILOMETERS - NAUTICAL MILES

KILOMETERS to SM		KILOMETERS to NM
0.62137	1	0.53996
1.24	2	1.08
1.86	3	1.62
2.49	4	2.16
3.11	5	2.70
3.73	6	3.24
4.35	7	3.78
4.97	8	4.32
5.59	9	4.86
6.21	10	5.40
12.43	20	10.80
18.64	30	16.20
24.85	40	21.60
31.07	50	27.00
37.28	60	32.40
43.50	70	37.80
49.71	80	44.20
55.92	90	48.60
62.14	100	54.00
124.27	200	107.99
186.41	300	161.99
248.55	400	215.98
310.69	500	269.98
372.82	600	323.97
434.96	700	377.97
497.10	800	431.97
559.23	900	485.96
621.37	1000	539.96

NAUTICAL MILES to KM		NAUTICAL MILES to SM
1.8520	1	1.1508
3.70	2	2.30
5.56	3	3.45
7.41	4	4.60
9.26	5	5.75
11.11	6	6.90
12.96	7	8.06
14.82	8	9.21
16.67	9	10.36
18.52	10	11.51
37.04	20	23.02
55.56	30	34.52
74.08	40	46.03
92.60	50	57.54
111.12	60	69.05
129.64	70	80.56
148.16	80	92.06
166.68	90	103.57
185.20	100	115.08
370.40	200	230.16
555.60	300	345.23
740.80	400	460.31
926.00	500	575.39
1111.20	600	690.47
1296.40	700	805.55
1481.60	800	920.62
1666.80	900	1035.70
1852.00	1000	1150.78

LOCAL TIME CHART

PREVIOUS DAY

-9	-5	-3½	UTC	+2	-5½	+7	+9
ALASKA	NEW YORK	GANDER	LONDON	CAIRO	BOMBAY	BANGKOK	TOKYO
1500	1900	2030	0000	0200	0530	0700	0900
1600	2000	2130	0100	0300	0630	0800	1000
1700	2100	2230	0200	0400	0730	0900	1100
1800	2200	2330	0300	0500	0830	1000	1200
1900	2300	0030	0400	0600	0930	1100	1300
2000	0000	0130	0500	0700	1030	1200	1400
2100	0100	0230	0600	0800	1130	1300	1500
2200	0200	0330	0700	0900	1230	1400	1600
2300	0300	0430	0800	1000	1330	1500	1700
0000	0400	0530	0900	1100	1430	1600	1800
0100	0500	0630	1000	1200	1530	1700	1900
0200	0600	0730	1100	1300	1630	1800	2000
0300	0700	0830	1200	1400	1730	1900	2100
0400	0800	0930	1300	1500	1830	2000	2200
0500	0900	1030	1400	1600	1930	2100	2300
0600	1000	1130	1500	1700	2030	2200	0000
0700	1100	1230	1600	1800	2130	2300	0100
0800	1200	1330	1700	1900	2230	0000	0200
0900	1300	1430	1800	2000	2330	0100	0300
1000	1400	1530	1900	2100	0030	0200	0400
1100	1500	1630	2000	2200	0130	0300	0500
1200	1600	1730	2100	2300	0230	0400	0600
1300	1700	1830	2200	0000	0330	0500	0700
1400	1800	1930	2300	0100	0430	0600	0800

NEXT DAY

FIGURE 1-17. LOCAL TIME CHART

FIGURE 1-18. RADIO PROPAGATION FORECAST CHART

RADIO-SUISSE SA
TELECOMMUNICATIONS
MOBILE RADIO SERVICES
P.O. BOX
CH-3000 BERNE 14

RADIO PROPAGATION FORECAST
for HF Communications with
BERNA-RADIO

Frequencies in kHz:

WATCH FREQUENCIES: ON REQUEST:

4654.0	H24	3010.0
6643.0	H24	25500.0
8936.0	H24	
10069.0	H24	
13205.0	H24	
15046.0	H24	
18023.0	H24	
21988.0	DAY-TIME	
23285.0	DAY-TIME	

NOTAM:

OWING TO PREDICTED LOW SUNSPOT ACTIVITY, RADIO PROPAGATIONS REMAIN SHAKY. IN CASE OF UNSUCCESSFUL COMMUNICATION ATTEMPT, TRY NEXT HIGHER OR LOWER FREQUENCY.

TIME IN UTC	00	02	04	06	08	10	12	14	16	18	20	22
EUR												
Northern Europe	6	4	6	10	10	10	13	10	10	10	10	8
Central Europe	4	4	4	6	8	10	10	8	8	6	8	6
Balkan/Western and Central Med. Sea	8	6	8	10	13	15	15	13	10	13	13	8
NAT/NAM												
30° W (mid-atlantic)/Iceland	8	6	6	8	10	10	13	13	13	13	13	10
U.S. and Canada East Coast	10	6	6	10	15	15	15	15	15	15	13	13
West Coast U.S.A./Brit. Columbia	13	6	6	8	10	13	13	13	15	15	15	15
Alaska/Transpolar	10	6	8	10	10	13	13	13	13	13	13	10
CAR												
Antilles/Gulf of Mexico	10	6	6	8	8	10	15	15	15	15	15	13
Mexico/Latin America	10	8	6	8	8	10	15	15	15	15	15	13
SAM												
South Atlantic	6	6	6	10	15	15	18	15	15	18	15	10
Northern South America	10	6	6	8	10	15	15	18	18	18	15	13

FIGURE 1-18. RADIO PROPAGATION FORECAST CHART - Continued

RADIO-SUISSE SA TELECOMMUNICATIONS MOBILE RADIO SERVICES P.O. BOX CH-3000 BERNE 14	RADIO PROPAGATION FORECAST for HF Communications with BERNA-RADIO
Frequencies in kHz: WATCH FREQUENCIES: ON REQUEST: 4654.0 H24 3010.0 6643.0 H24 25500.0 8936.0 H24 10069.0 H24 13205.0 H24 15046.0 H24 18023.0 H24 21988.0 DAY-TIME 23285.0 DAY-TIME	**NOTAM:** OWING TO PREDICTED LOW SUNSPOT ACTIVITY, RADIO PROPAGATIONS REMAIN SHAKY. IN CASE OF UNSUCCESSFUL COMMUNICATION ATTEMPT, TRY NEXT HIGHER OR LOWER FREQUENCY.

TIME IN UTC	00	02	04	06	08	10	12	14	16	18	20	22
Central South America	10	8	8	10	10	18	18	18	18	18	15	13
Southern South America	10	8	8	10	8	15	18	21	18	18	18	13
AFI												
Northern Africa/Med. Coast	10	6	6	10	13	15	15	15	13	15	15	10
Sahara/Canary Islands/Azeroes	10	8	8	10	13	15	15	15	15	15	15	13
Liberia-Ghana-Nigeria-belt	6	6	6	10	13	13	15	15	15	15	13	10
Angola/Zaire/Zambia/Tanzania	6	6	6	13	15	15	15	15	18	18	13	8
South Africa	6	6	4	13	18	21	21	21	15	10	8	6
Egypt/Sudan	8	6	8	10	15	15	15	15	15	15	13	10
Ethiopia/Kenya	8	6	8	13	15	15	15	15	15	15	10	10
SW Indian Ocean/Seychelles	6	6	13	15	18	18	18	18	15	13	10	8
MID/ASIA/PAC												
Turkey/Eastern Med. Sea	8	6	8	13	13	15	15	18	18	18	15	10
Israel/Jordan/Lebanon/Iraq/Syria	6	6	8	10	13	15	15	18	18	18	10	10
Saudi-Arabia/Oman/Yemen	8	6	10	13	13	15	15	13	15	15	10	10

FIGURE 1-18. RADIO PROPAGATION FORECAST CHART - Continued

RADIO-SUISSE SA
TELECOMMUNICATIONS
MOBILE RADIO SERVICES
P.O. BOX
CH-3000 BERNE 14

RADIO PROPAGATION FORECAST
for HF Communications with
BERNA-RADIO

Frequencies in kHz:

WATCH FREQUENCIES: ON REQUEST:

4654.0	H24	3010.0
6643.0	H24	25500.0
8936.0	H24	
10069.0	H24	
13205.0	H24	
15046.0	H24	
18023.0	H24	
21988.0	DAY-TIME	
23285.0	DAY-TIME	

NOTAM:

OWING TO PREDICTED LOW SUNSPOT ACTIVITY, RADIO PROPAGATIONS REMAIN SHAKY. IN CASE OF UNSUCCESSFUL COMMUNICATION ATTEMPT, TRY NEXT HIGHER OR LOWER FREQUENCY.

TIME IN UTC	00	02	04	06	08	10	12	14	16	18	20	22
Iran/Persian Gulf	8	6	10	13	15	15	15	13	13	13	10	10
Moscow/Tashkent	8	6	10	13	13	15	15	13	13	13	13	10
Pakistan/India/Northern Indian Ocean	8	10	15	15	15	15	15	13	13	13	10	10
Indochina/Indonesia	13	10	15	18	18	18	15	18	15	10	10	8
Philippines/Japan/China/Hong Kong	10	10	13	15	15	15	15	13	13	10	10	8
Australia/New Zealand	10	13	15	18	18	13	10	10	10	10	6	10
Pacific	10	10	10	10	13	10	10	10	13	13	13	13

Period: MAY / JUNE / JULY / AUGUST 1987

FIGURE 1-19.

SPEED, TEMPERATURE, AND WEIGHT CONVERSION CONVERSIONS

METERS PER SECOND to FEET PER MINUTE (mps = 196.85 fpm)

MPS	FPM	MPS	FPM	MPS	FPM	MPS	FPM
1	197	6	1181	11	2165	16	3150
1.5	295	6.5	1279	11.5	2263	16.5	3248
2	394	7	1378	12	2362	17	3346
2.5	492	7.5	1476	12.5	2460	17.5	3444
3	591	8	1575	13	2559	18	3543
3.5	689	8.5	1673	13.5	2657	18.5	3641
4	787	9	1772	14	2756	19	3740
4.5	886	9.5	1870	14.5	2854	19.5	3838
5	984	10	1969	15	2953	20	3937
5.5	1082	10.5	2067	15.5	3051		

METERS PER SECOND to KNOTS (1 mps = 1.9438 knots)

Meters p/sec.	0	1	2	3	4	5	6	7	8	9
					Knots					
0	-	1.9	3.9	5.8	7.8	9.7	11.7	13.6	15.6	17.5
10	19.4	21.4	23.3	25.3	27.2	29.2	31.1	33.0	35.0	36.9
20	38.9	40.8	42.8	44.7	46.6	48.6	50.5	52.5	54.4	56.4
30	58.3	60.3	62.2	64.1	66.1	68.0	70.0	71.9	73.9	75.8
40	77.8	79.7	81.6	83.6	85.5	87.5	89.4	91.4	93.3	95.2
50	97.2	99.1	101.1	103.0	105.0	106.9	108.8	110.8	112.7	114.7
60	116.6	118.6	120.5	122.5	124.4	126.3	128.3	130.2	132.2	134.1
70	136.1	138.0	140.0	141.9	143.8	145.8	147.7	149.7	151.6	153.6

TEMPERATURES (CELSIUS/FAHRENHEIT)

°C	°F	°C	°F	°C	°F
-40	-40.0	-8	17.6	24	75.2
-39	-38.2	-7	19.4	25	77.0
-38	-36.4	-6	21.2	26	78.8
-37	-34.6	-5	23.0	27	80.6
-36	-32.8	-4	24.8	28	82.4
-35	-31.0	-3	26.6	29	84.2
-34	-29.2	-2	28.4	30	86.0
-33	-27.4	-1	30.2	31	87.8
-32	-25.6	0	32.0	32	89.6
-31	-23.8	1	33.8	33	91.4
-30	-22.0	2	35.6	34	93.2
-29	-20.2	3	37.4	35	95.0
-28	-18.4	4	39.2	36	96.8
-27	-16.6	5	41.0	37	98.6
-26	-14.8	6	42.8	38	100.4
-25	-13.0	7	44.6	39	102.2
-24	-11.2	8	46.4	40	104.0
-23	-9.4	9	48.2	41	105.8
-22	-7.6	10	50.0	42	107.6
-21	-5.8	11	51.8	43	109.4
-20	-4.0	12	53.6	44	111.2
-19	-2.2	13	55.4	45	113.0
-18	-0.4	14	57.2	46	114.8
-17	1.4	15	59.0	47	116.6
-16	3.2	16	60.8	48	118.4
-15	5.0	17	62.6	49	120.2
-14	6.8	18	64.4	50	122.0
-13	8.6	19	66.2	51	123.8
-12	10.4	20	68.0	52	125.6
-11	12.2	21	69.8	53	127.4
-10	14.0	22	71.6	54	129.2
-9	15.8	23	73.4	55	131.0

WEIGHT

Lbs	Kgs / Lbs	Kgs
2.2046	1	.45359
4	2	1
7	3	1
9	4	2
11	5	2
13	6	3
15	7	3
18	8	4
20	9	4
22	10	4
44	20	9
66	30	14
88	40	18
110	50	23
132	60	27
154	70	32
176	80	36
198	90	41
220	100	45
441	200	91
661	300	16
882	400	181
1102	500	227
1323	600	272
1543	700	318
1764	800	363
1984	900	408
2205	1000	454

FIGURE 1-20.

VOLUME AND WEIGHT OF AVIATION FUEL AND OIL CONVERSION

TABLES and CODES

VOLUME

Imp Gal	U.S. Gal/Imp Gal	U.S. Gal	U.S. Gal	Liter/U.S. Gal	Liter	U.S. Gal	Lbs/U.S. Gal	Liter
.83267	1	1.2010	.26418	1	3.7853	.21997	1	4.5460
2	2	2	1	2	8	.4	2	9
2	3	4	1	3	11	.7	3	14
3	4	5	1	4	15	.9	4	18
4	5	6	1	5	19	1	5	23
5	6	7	2	6	23	1	6	27
6	7	8	2	7	26	2	7	32
7	8	10	2	8	30	2	8	36
7	9	11	2	9	34	2	9	41
8	10	12	3	10	38	2	10	45
17	20	24	5	20	76	4	20	91
25	30	36	8	30	114	7	30	136
33	40	48	11	40	151	9	40	182
42	50	60	13	50	189	11	50	227
50	60	72	16	60	227	13	60	273
58	70	84	18	70	265	15	70	318
67	80	96	21	80	303	18	80	364
75	90	108	24	90	341	20	90	409
83	100	120	26	100	379	22	100	455
167	200	240	53	200	757	44	200	909
250	300	360	79	300	1136	66	300	1364
333	400	480	106	400	1514	88	400	1818
416	500	600	132	500	1893	110	500	2273
500	600	721	158	600	2271	132	600	2728
583	700	841	185	700	2650	154	700	3182
666	800	961	211	800	3028	176	800	3637
750	900	1081	238	900	3407	198	900	4091
833	1000	1201	264	1000	3785	220	1000	4546

OIL volume/weight (approximate according to Temp)

U.S. Gal	Lbs/U.S. Gal	Lbs	Liter	Lbs/Liter	Lbs	Liter	Kg / Liter	Kg
.13333	1	7.5000	.50471	1	1.9813	1.1127	1	.89871
.3	2	15	1.0	2	4	2	2	2
.4	3	22	1.5	3	6	3	3	3
.5	4	30	2.0	4	8	4	4	4
.7	5	38	2.5	5	10	6	5	5
.8	6	45	3.0	6	12	7	6	5
.9	7	52	3.5	7	14	8	7	6
1.1	8	60	4.0	8	16	9	8	7
1.2	9	68	4.5	9	18	10	9	8
1.3	10	75	5.0	10	20	11	10	9
3	20	150	10	20	40	22	20	18
4	30	225	15	30	59	33	30	27
5	40	300	20	40	79	44	40	36
7	50	375	25	50	99	56	50	45
8	60	450	30	60	119	67	60	54
9	70	525	35	70	139	78	70	63
11	80	600	40	80	158	89	80	72
12	90	675	45	90	178	100	90	81
13	100	750	50	100	198	111	100	90
27	200	1500	101	200	396	222	200	180
40	300	2250	151	300	594	334	300	270
53	400	3000	202	400	792	445	400	360
67	500	3750	252	500	991	556	500	449
80	600	4500	303	600	1189	668	600	539
93	700	5250	353	700	1387	779	700	629
107	800	6000	404	800	1585	890	800	719
120	900	6750	454	900	1783	1001	900	809
133	1000	7500	505	1000	1981	1113	1000	899

FIGURE 1-20. - Continued

VOLUME AND WEIGHT OF AVIATION FUEL AND OIL CONVERSION

TABLES and CODES

TURBINE FUEL volume/weight
(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

U.S. Gal	Lbs/U.S. Gal	Lbs	Liter	Lbs / Liter	Lbs	Liter	Kg / Liter	Kg
.15	1	6.7	0.57	1	1.8	1.25	1	.8
.3	2	13	1.1	2	3.6	2.5	2	1.6
.45	3	20	1.7	3	5.4	3.8	3	2.4
.6	4	27	2.3	4	7.2	5.0	4	3.2
.75	5	33	2.8	5	9.0	6.2	5	4.0
.9	6	40	3.4	6	11	7.5	6	4.8
1.05	7	47	4	7	13	8.8	7	5.6
1.2	8	53	4.6	8	14	10	8	6.4
1.35	9	60	5.1	9	16	11	9	7.2
1.5	10	67	5.7	10	18	12	10	8
3	20	130	11	20	36	25	20	16
4.5	30	200	17	30	54	38	30	24
6	40	270	23	40	72	50	40	32
7.5	50	330	28	50	90	62	50	40
9	60	400	34	60	110	75	60	48
10.5	70	470	40	70	130	88	70	56
12	80	530	46	80	140	100	80	64
13.5	90	600	51	90	160	110	90	72
15	100	670	57	100	180	120	100	80
30	200	1300	110	200	360	250	200	160
45	300	2000	170	300	540	380	300	240
60	400	2700	230	400	720	500	400	320
75	500	3300	280	500	900	620	500	400
90	600	4000	340	600	1100	750	600	480
105	700	4700	400	700	1300	880	700	560
120	800	5300	460	800	1400	1000	800	640
135	900	6000	510	900	1600	1100	900	720
150	1000	6700	570	1000	1800	1200	1000	800

AVIATION GAS volume/weight (approximate according to Temp)

Gal	Lbs/ Gal	Lbs	Liter	Lbs/Liter	Lbs	Liter	Kg / Liter	Kg
.167	1	6.00	.631	1	1.58	1.39	1	.719
.3	2	12	1	2	3	3	2	1
.5	3	18	2	3	5	4	3	2
.7	4	24	2	4	6	6	4	3
.8	5	30	3	5	8	7	5	4
1.0	6	36	4	6	10	8	6	4
1.2	7	42	4	7	11	10	7	5
1.3	8	48	5	8	13	11	8	6
1.5	9	54	6	9	14	12	9	6
1.7	10	60	6	10	16	14	10	7
3	20	120	13	20	32	28	20	14
5	30	180	19	30	48	42	30	22
7	40	240	25	40	63	56	40	29
8	50	300	32	50	79	70	50	36
10	60	360	38	60	95	83	60	43
12	70	420	44	70	111	97	70	50
13	80	480	50	80	127	111	80	58
15	90	540	57	90	143	125	90	65
17	100	600	63	100	158	139	100	72
33	200	1200	126	200	317	278	200	144
50	300	1800	189	300	476	417	300	216
67	400	2400	252	400	634	556	400	288
83	500	3000	315	500	793	695	500	359
100	600	3600	378	600	951	834	600	431
117	700	4200	442	700	1110	974	700	503
133	800	4800	505	800	1268	1113	800	575
150	900	5400	568	900	1427	1252	900	647
167	1000	6000	631	1000	1585	1391	1000	719

FIGURE 2-1. BOUNDARIES OF MINIMUM NAVIGATION PERFORMANCE SPECIFICATION (MNPS) AIRSPACE

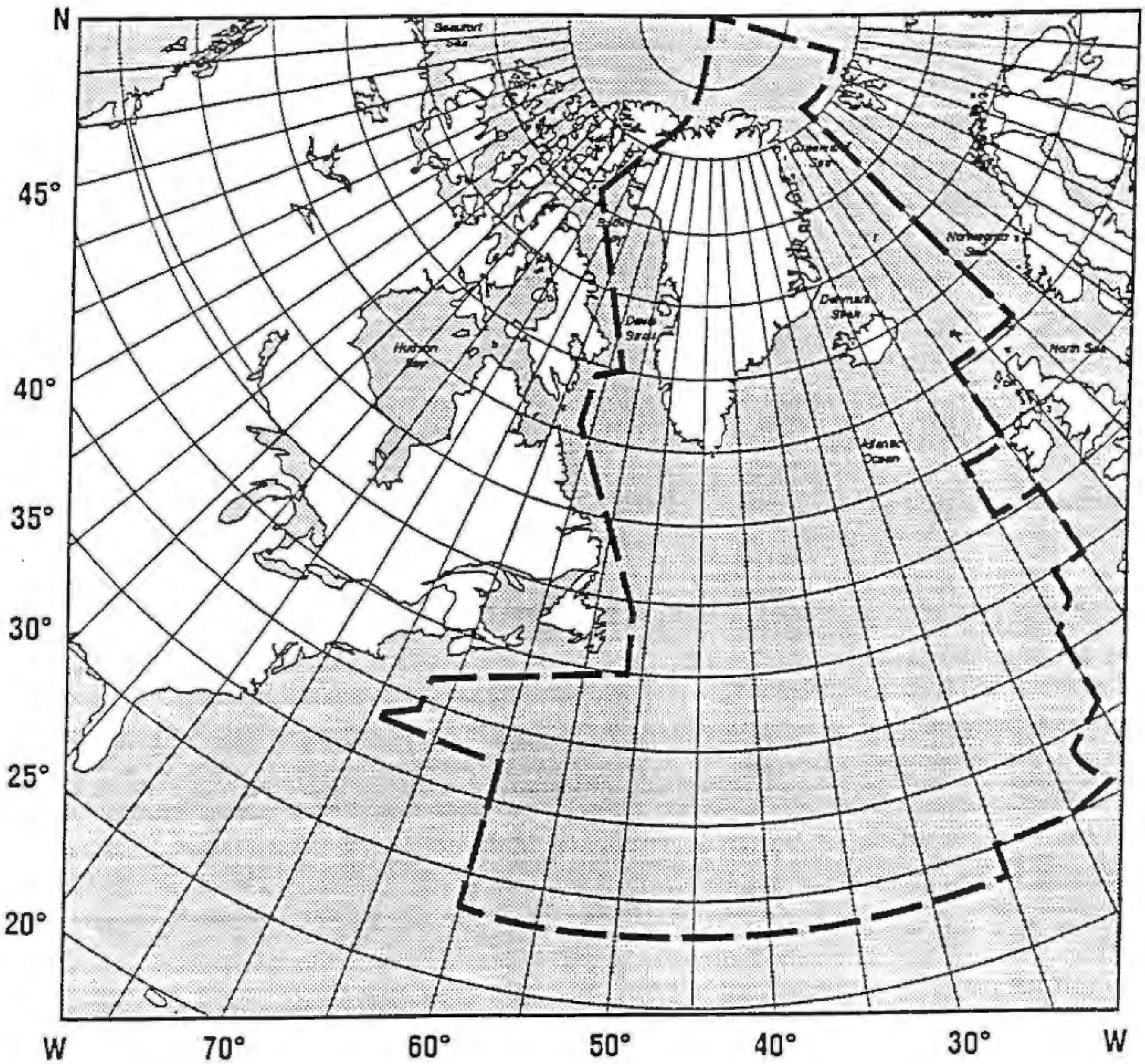


FIGURE 2-2. POLAR TRACK STRUCTURE

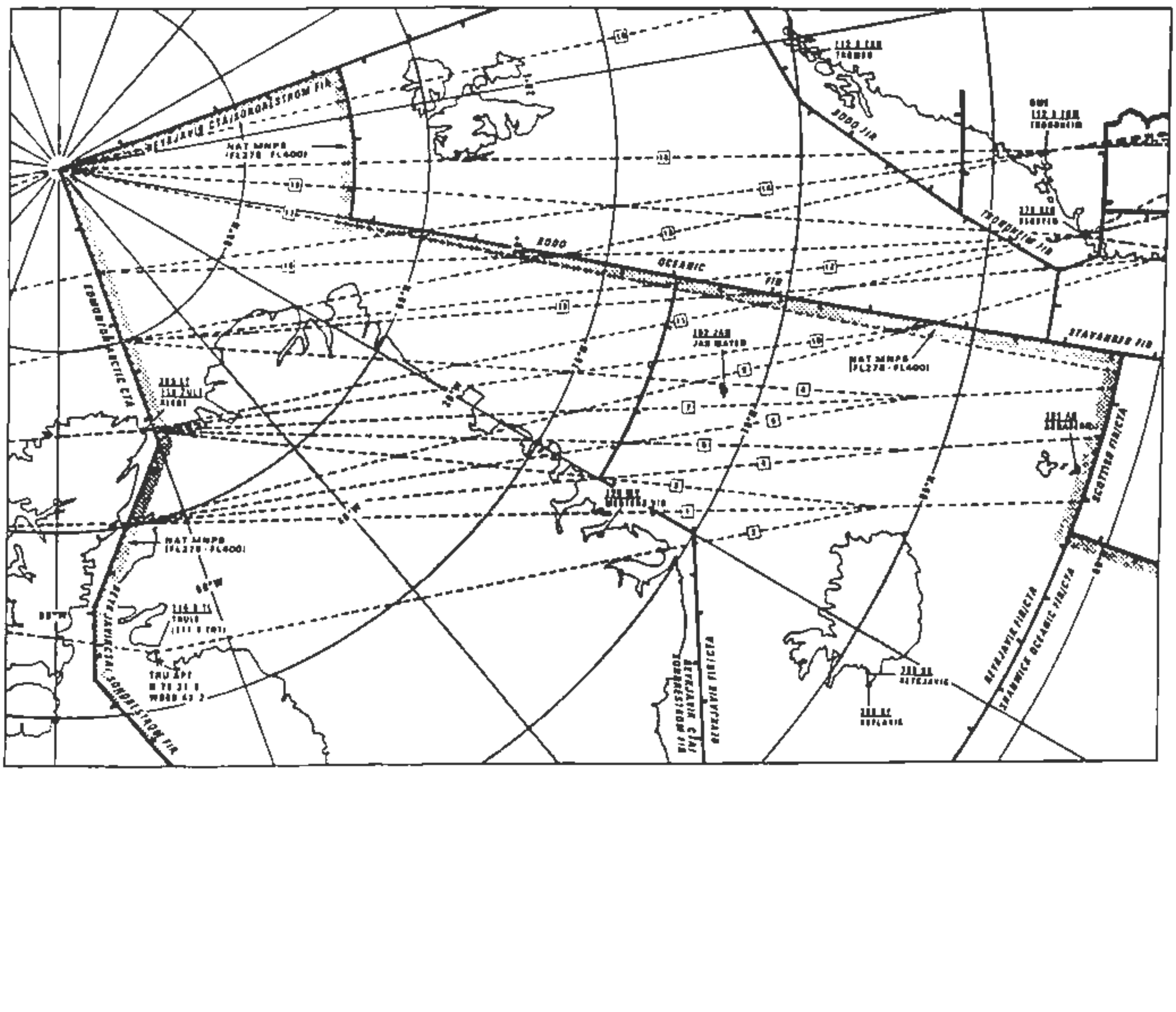


FIGURE 2-3. NORTH ATLANTIC (NAT) LORAN-C COVERAGE

Canadian East Coast Chain - 5930

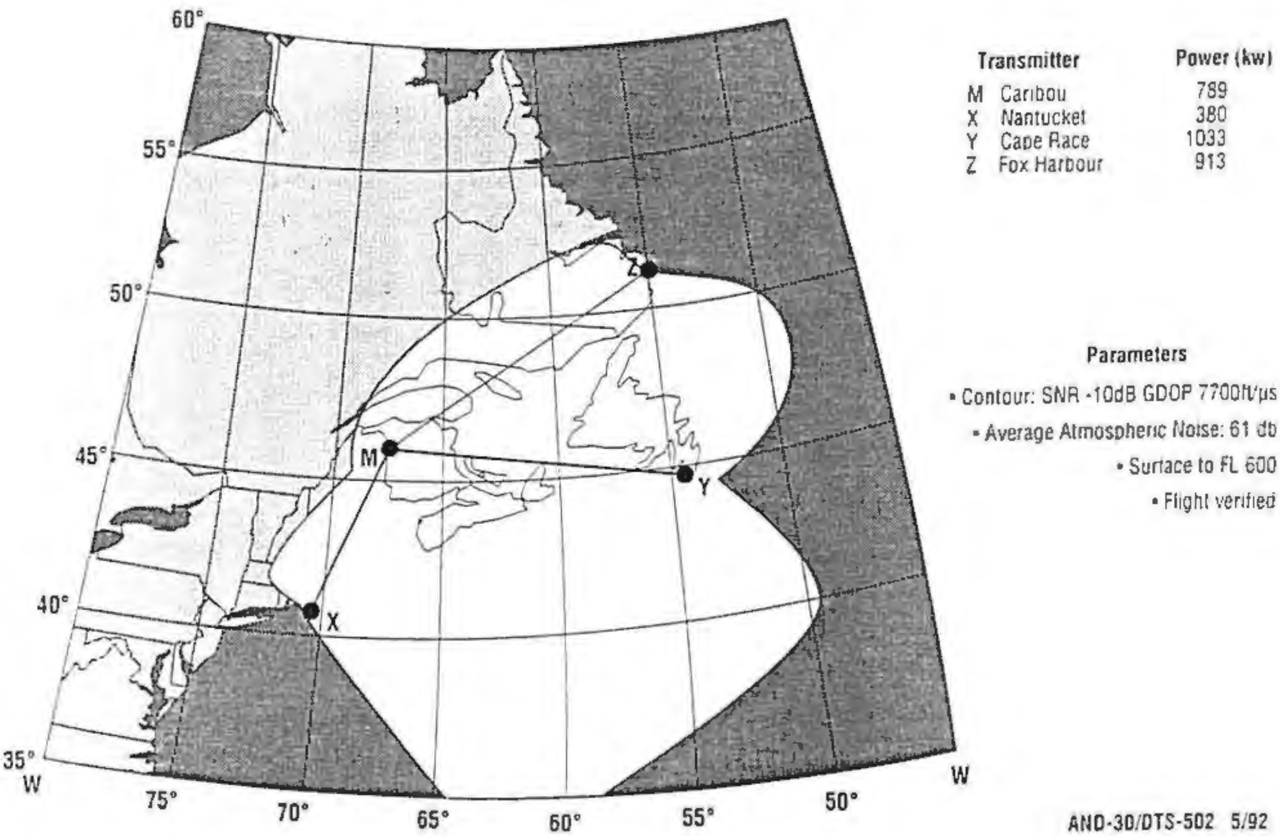
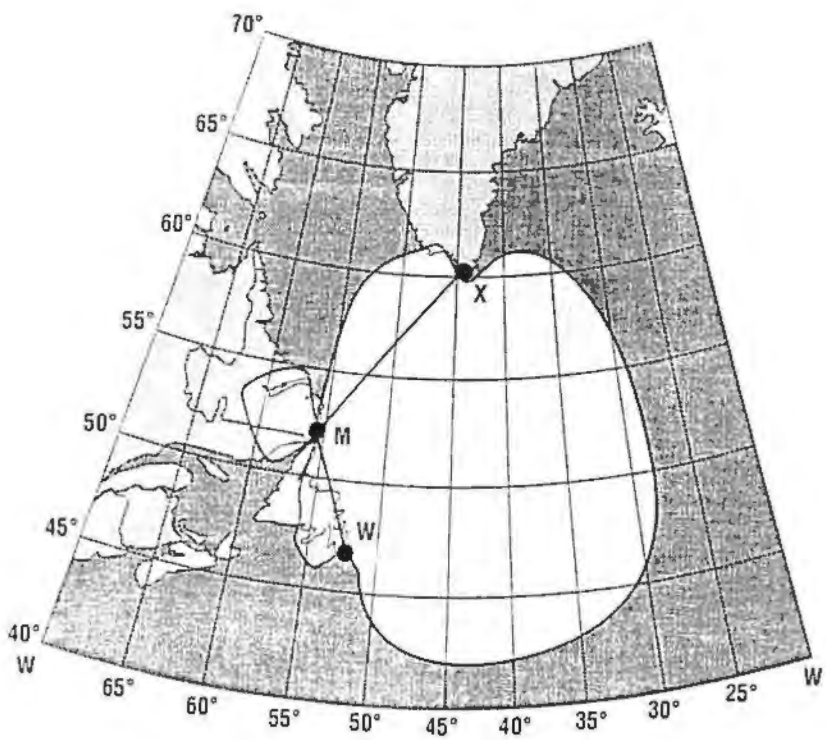


FIGURE 2-3. NORTH ATLANTIC (NAT) LORAN-C COVERAGE - Continued

Labrador Sea Chain - 7930



Transmitter	Power (kw)
M Fox Harbour	913
W Cape Race	1033
X Angissoq	762

Parameters

- Contour: SNR -10dB GDOP 7700ft/μs
- Average Atmospheric Noise: 47 db
- Surface to FL 600
- Flight verified

AND-30/DTS-502 5/92

FIGURE 2-3. NORTH ATLANTIC (NAT) LORAN-C COVERAGE - Continued

Icelandic Chain - 9980

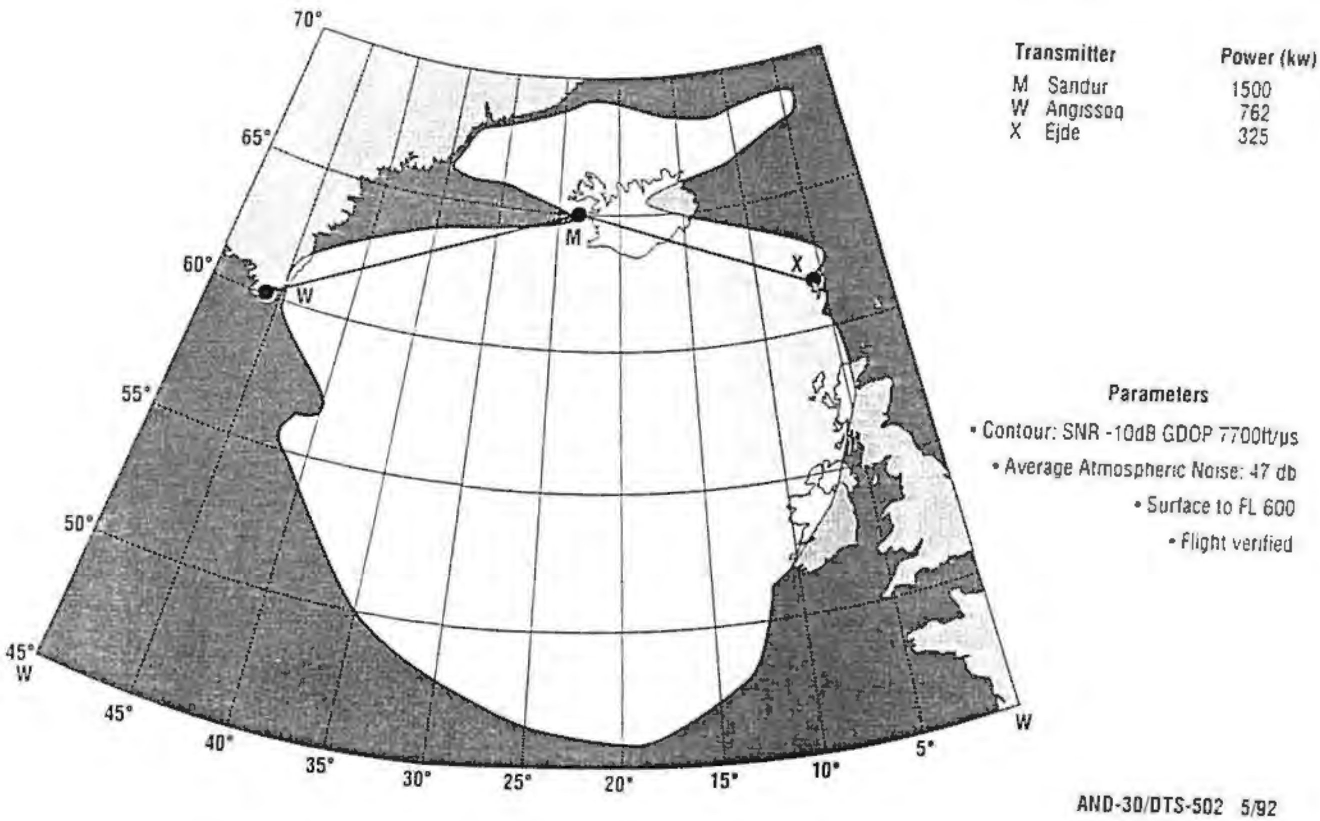
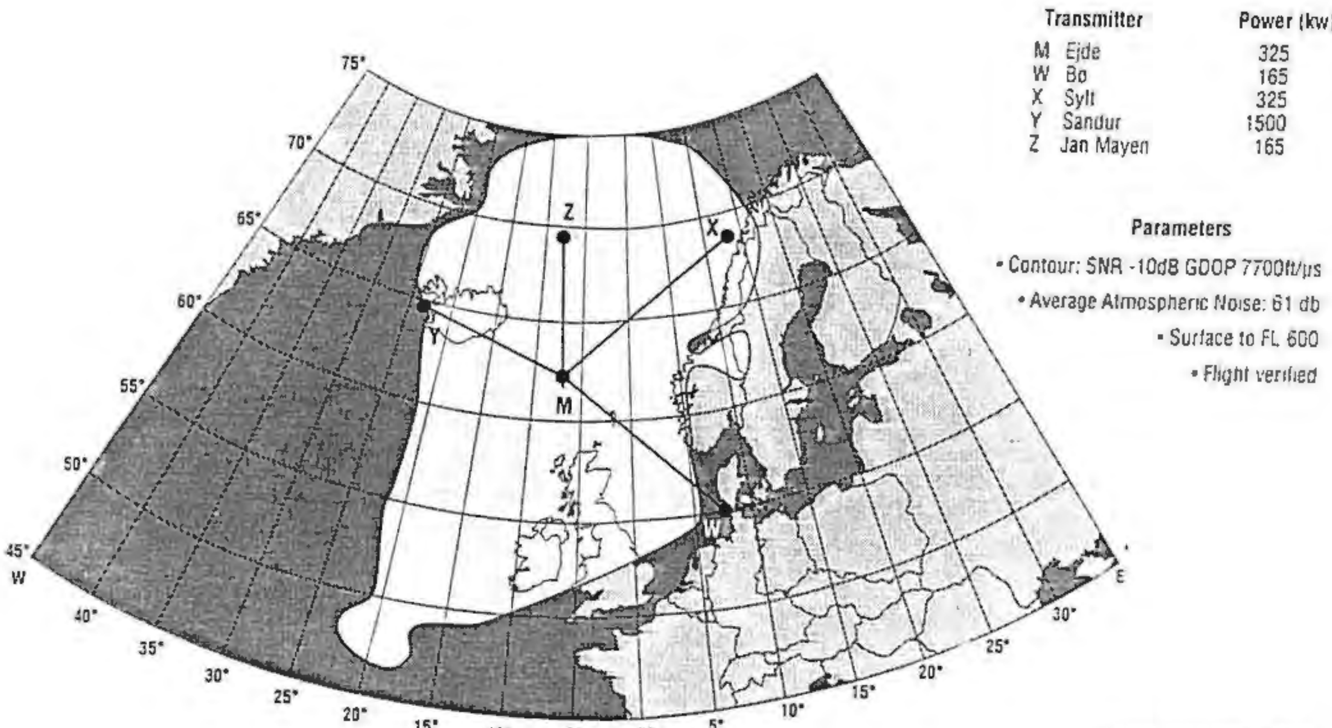


FIGURE 2-3. NORTH ATLANTIC (NAT) LORAN-C COVERAGE - Continued

Norwegian Sea Chain - 7970



AND-30/DTS-502 5/92

FIGURE 2-4. NORTH PACIFIC (NOPAC) COMPOSITE ROUTE SYSTEM

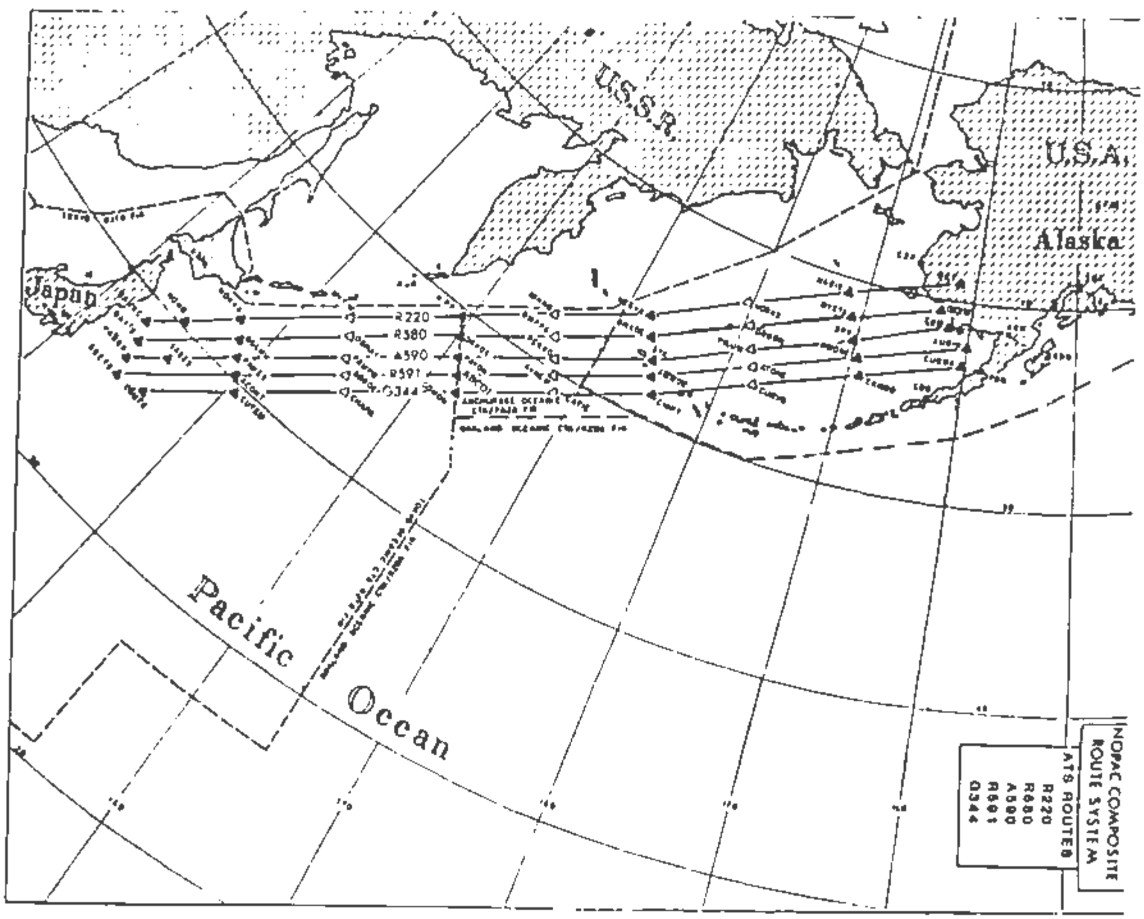


FIGURE 2-5. JAPANESE OCEANIC TRANSITION ROUTES

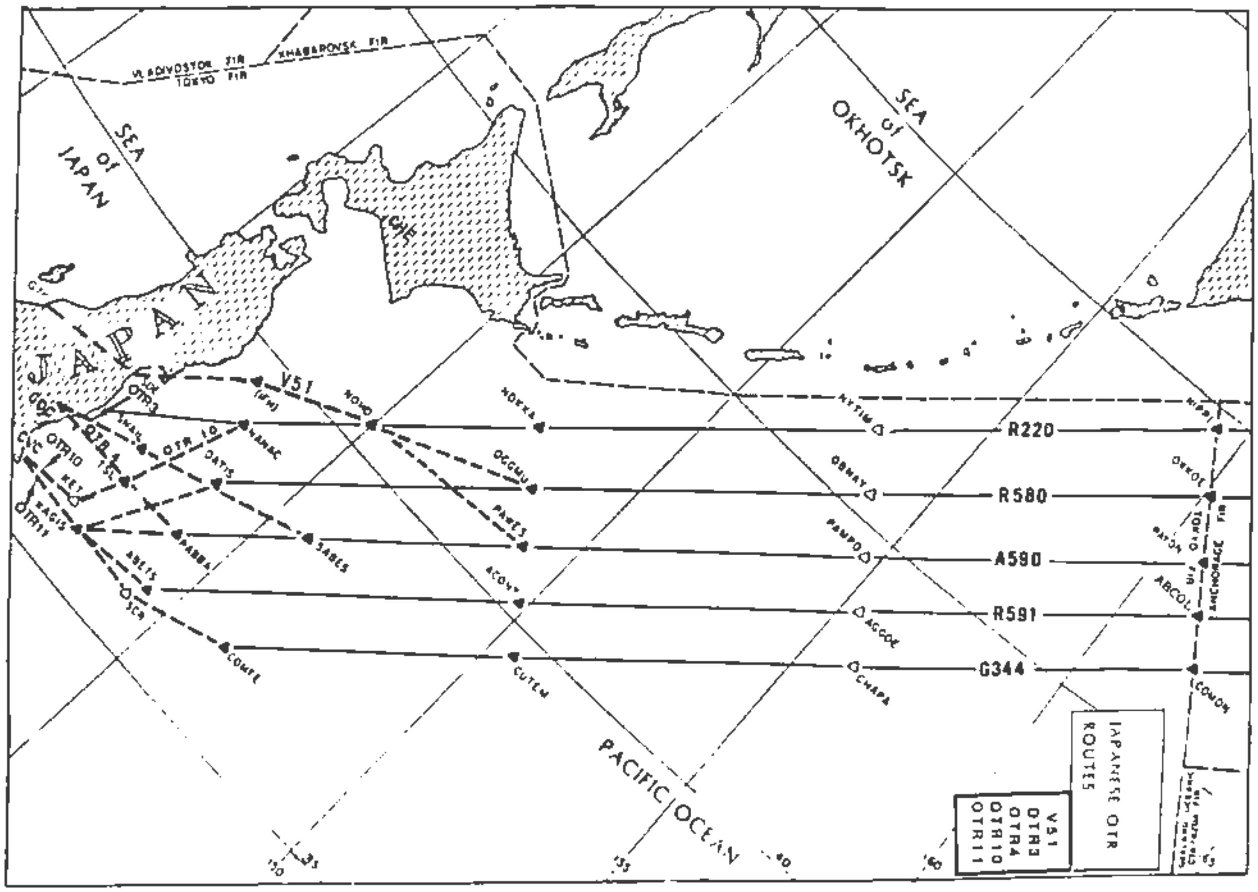


FIGURE 2-6. HAWAII-WEST COAST ROUTE SYSTEM

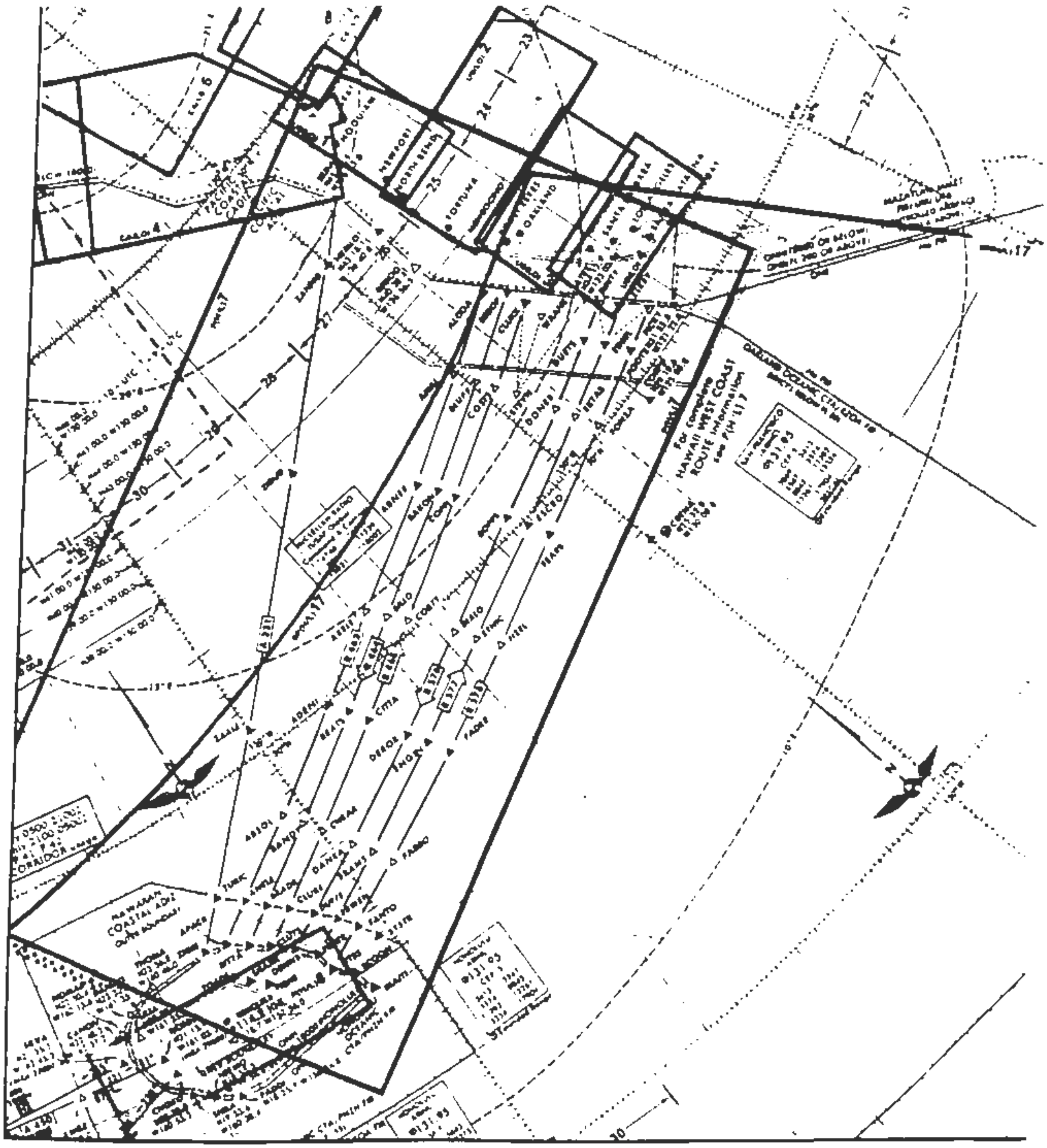


FIGURE 2-7. TOKYO-HONOLULU FLEXIBLE TRACK SYSTEM

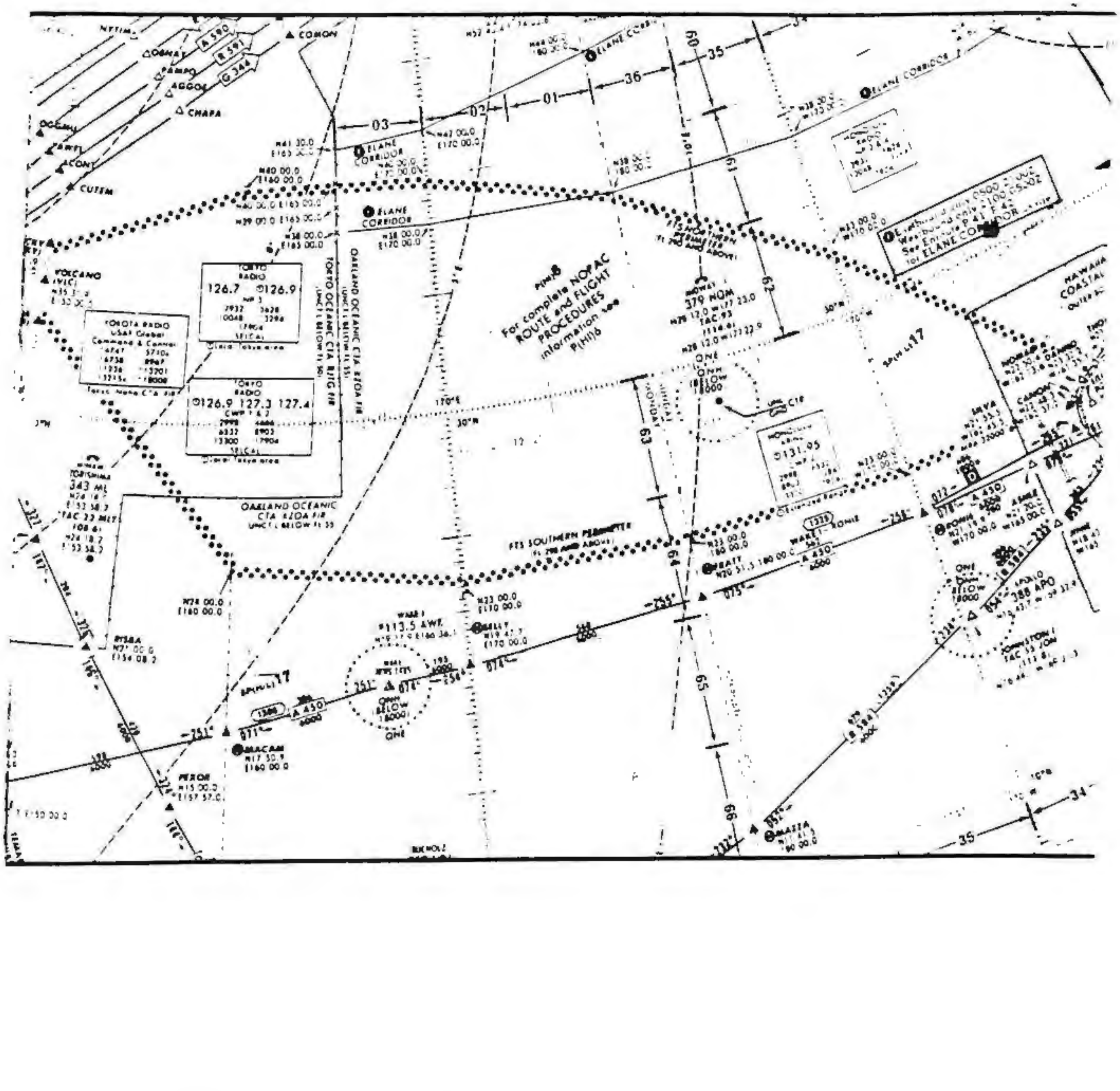


FIGURE 2-8. CENTRAL NORTH PACIFIC (CENPAC) ROUTES

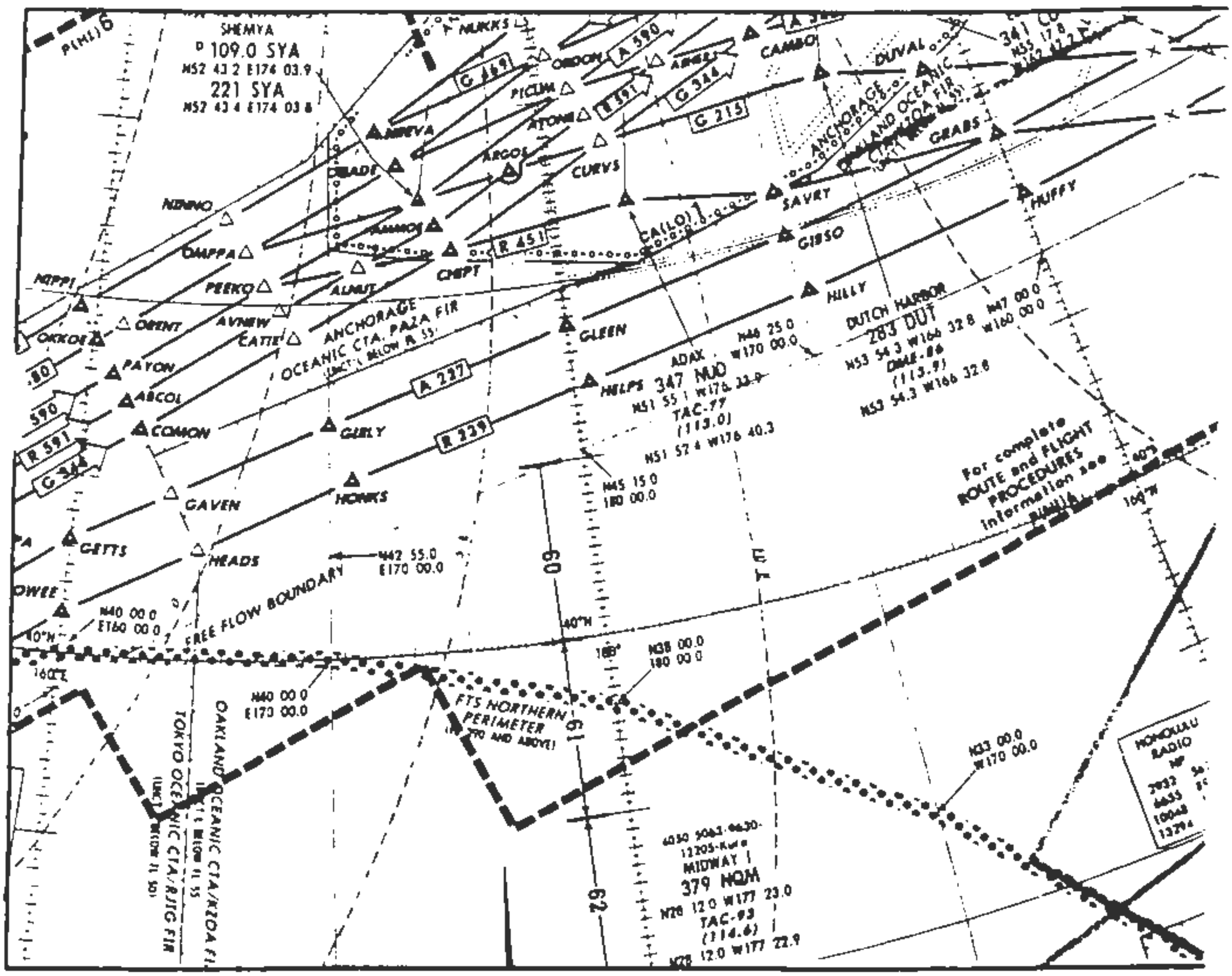


FIGURE 2-9. OCEANIC CONTROL AREA (OCA)/FLIGHT INFORMATION REGION (FIR) BOUNDARIES AND COMMONLY FLOWN ROUTES BELOW FLIGHT LEVEL (FL) 195

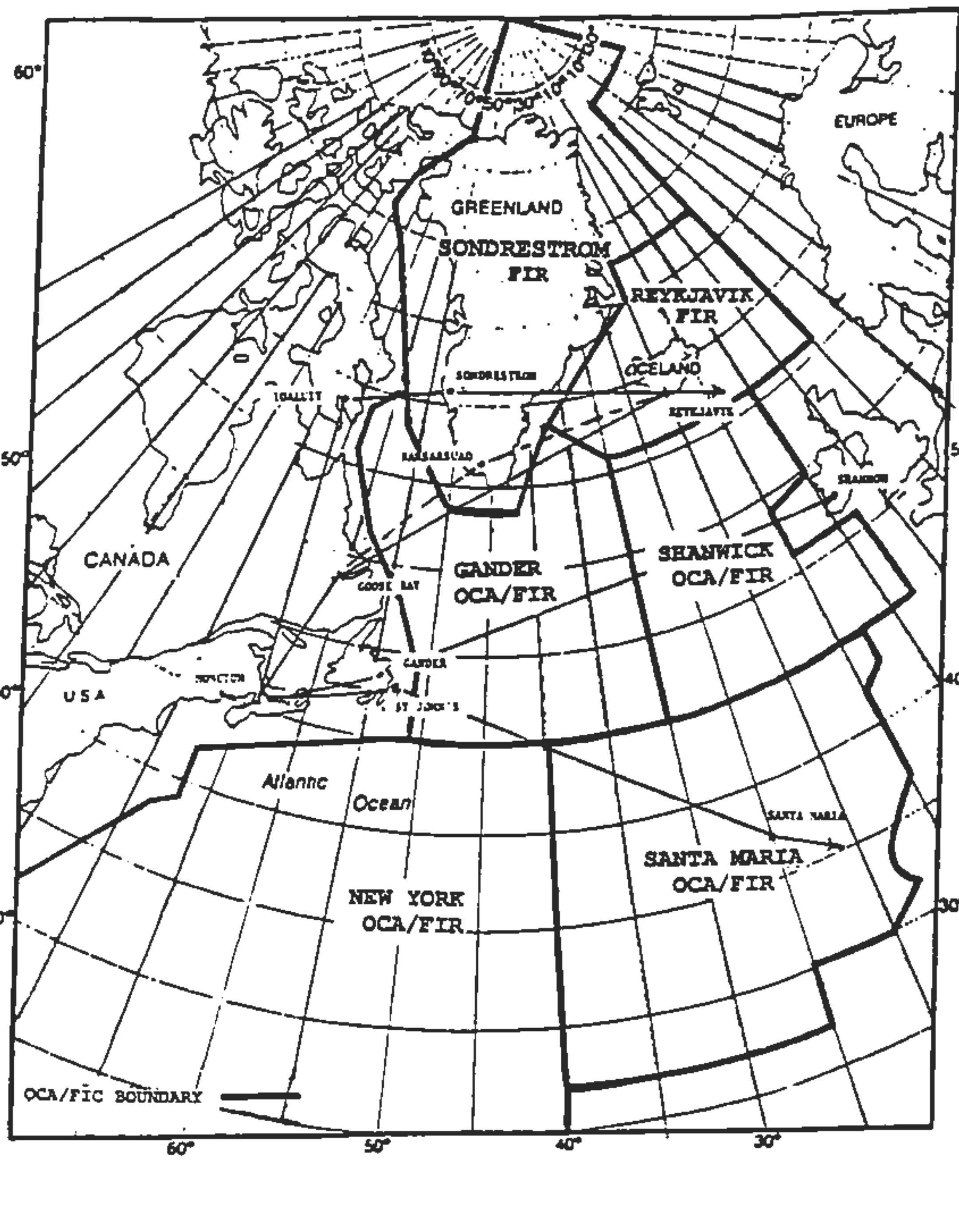
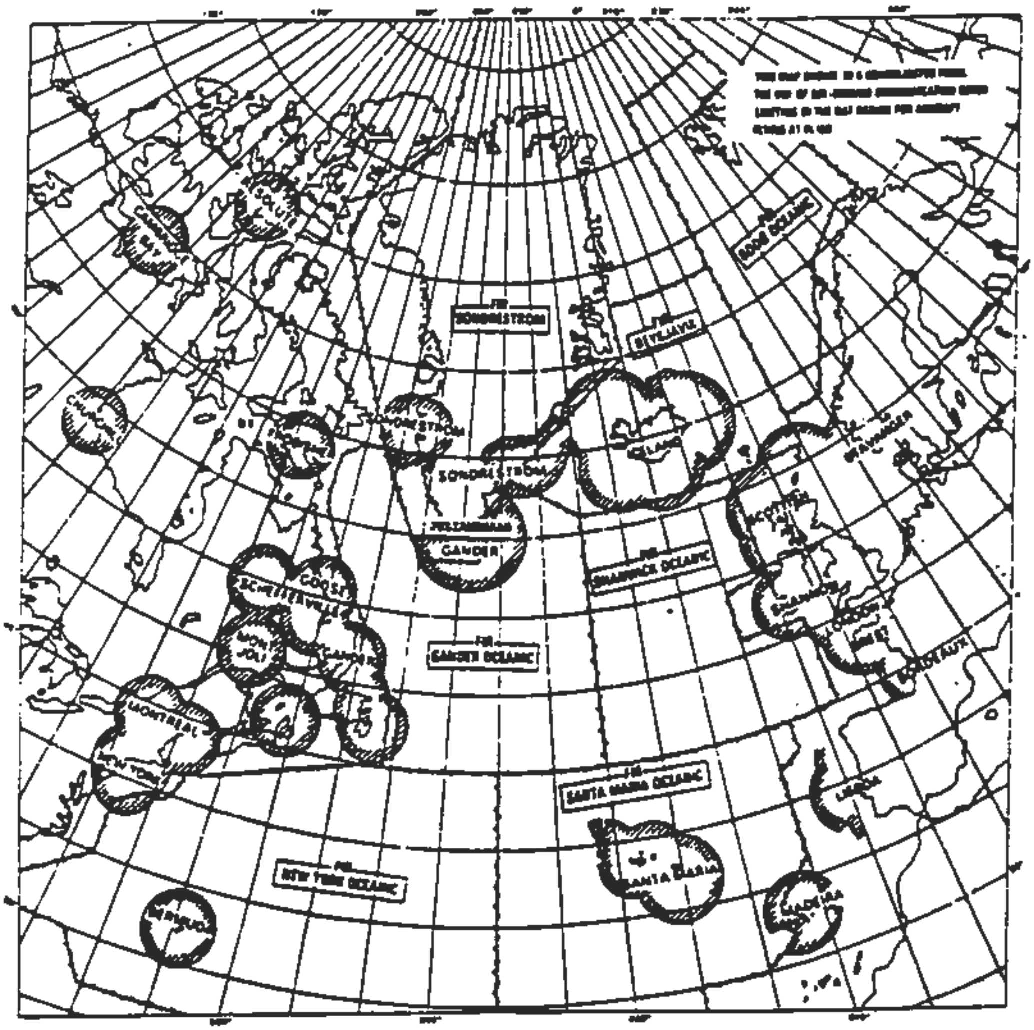


FIGURE 2-10. VERY HIGH FREQUENCY (VHF) RADIO COVERAGE IN THE NORTH ATLANTIC (NAT) REGION AT FL 100



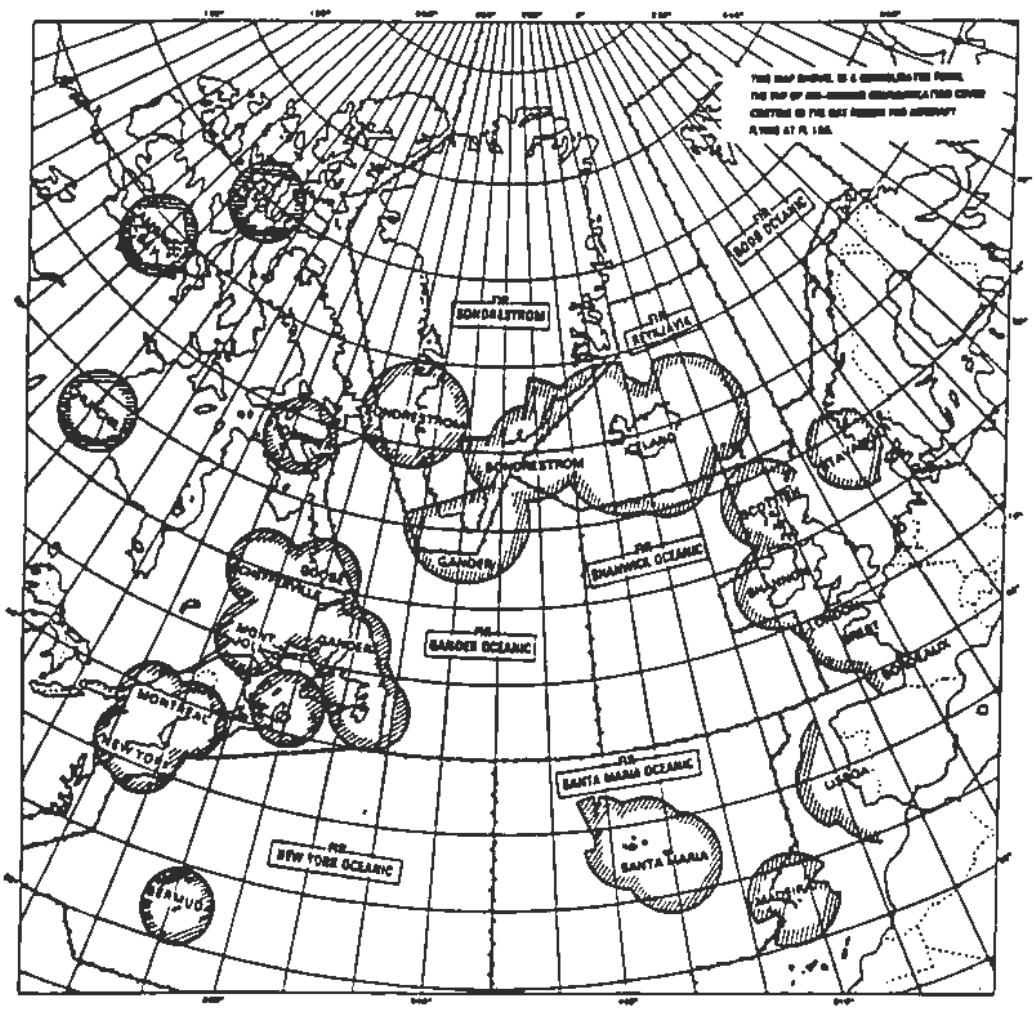
Note 1: The VHF cover depicted in the transition area between the NAT and the EUR Regions has only been shown to complete the picture of the communication cover. The VHF air-ground communication stations at Stavanger, Scottish, London, Brest, Bordeaux and Lisboa do not form part of the communication system serving the NAT Region.

Note 2: The VHF cover provided by the Qaqatoqaq and Kulusuk stations in Greenland (Sondrestrom) serves Sondrestrom FIC only (below FL 195).

Note 3: Julianehaab Radio serves Sondrestrom FIC only (below FL 195).

FIGURE 2-11. VHF RADIO COVERAGE IN THE NAT REGION AT FL 150

MAP OF THE VHF GP AIR-GROUND COMMUNICATION COVER
EXISTING IN THE NAT REGION AT FL 150



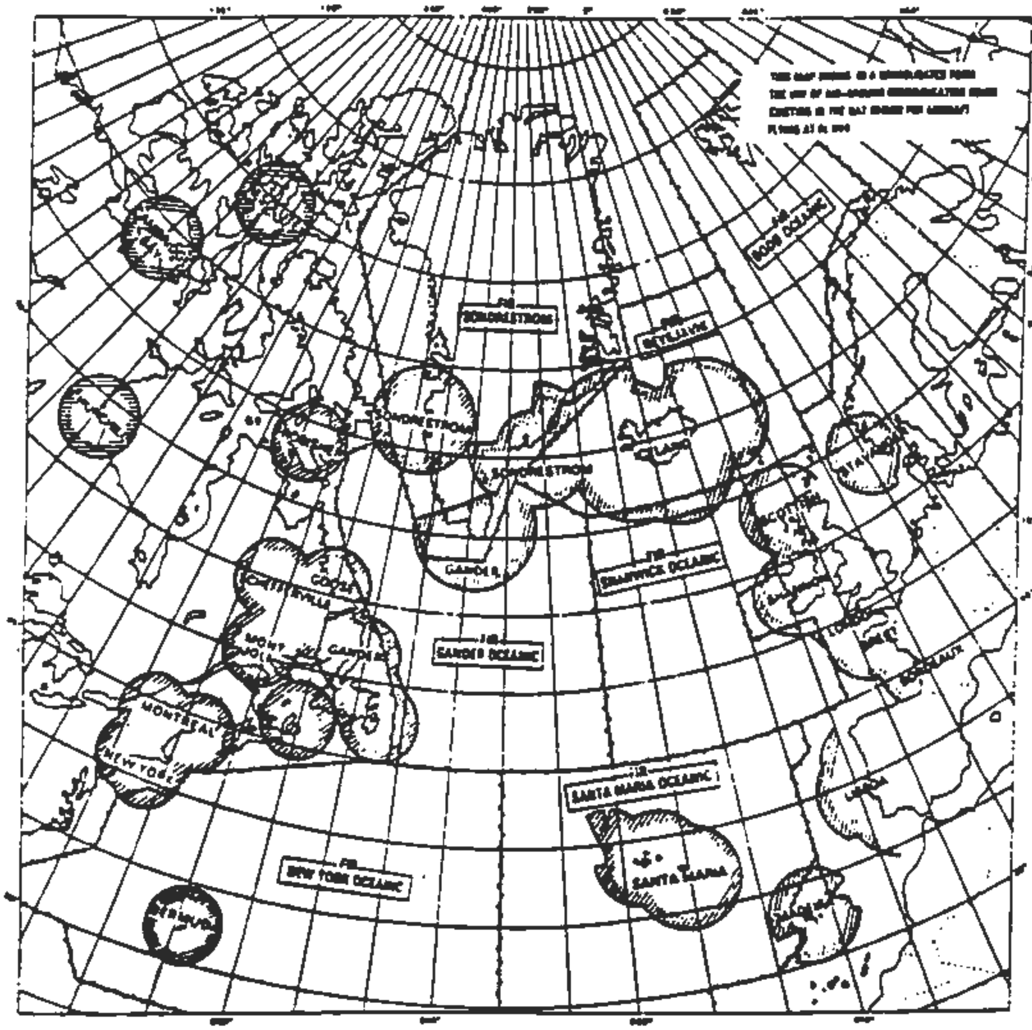
Note:

1. The VHF cover shown in the transition area between the NAT and the EUR Regions has only been shown to complete the picture of the communication cover. The VHF air-ground communication stations at Stavanger, Scottish, London, Brest, Bordeaux, and Lisboa do not form part of the communication system serving the NAT Region.

2. The VHF cover shown provided by the Qaqatoqaq and Kulusuk stations in Greenland (Sondrestrom) serves Sondrestrom FIC only (below FL195)

CAA CIDS Carto D.O. Drg No. 8181 28 / 80 28-3-88

FIGURE 2-12. VHF RADIO COVERAGE IN THE NAT REGION AT FL 200

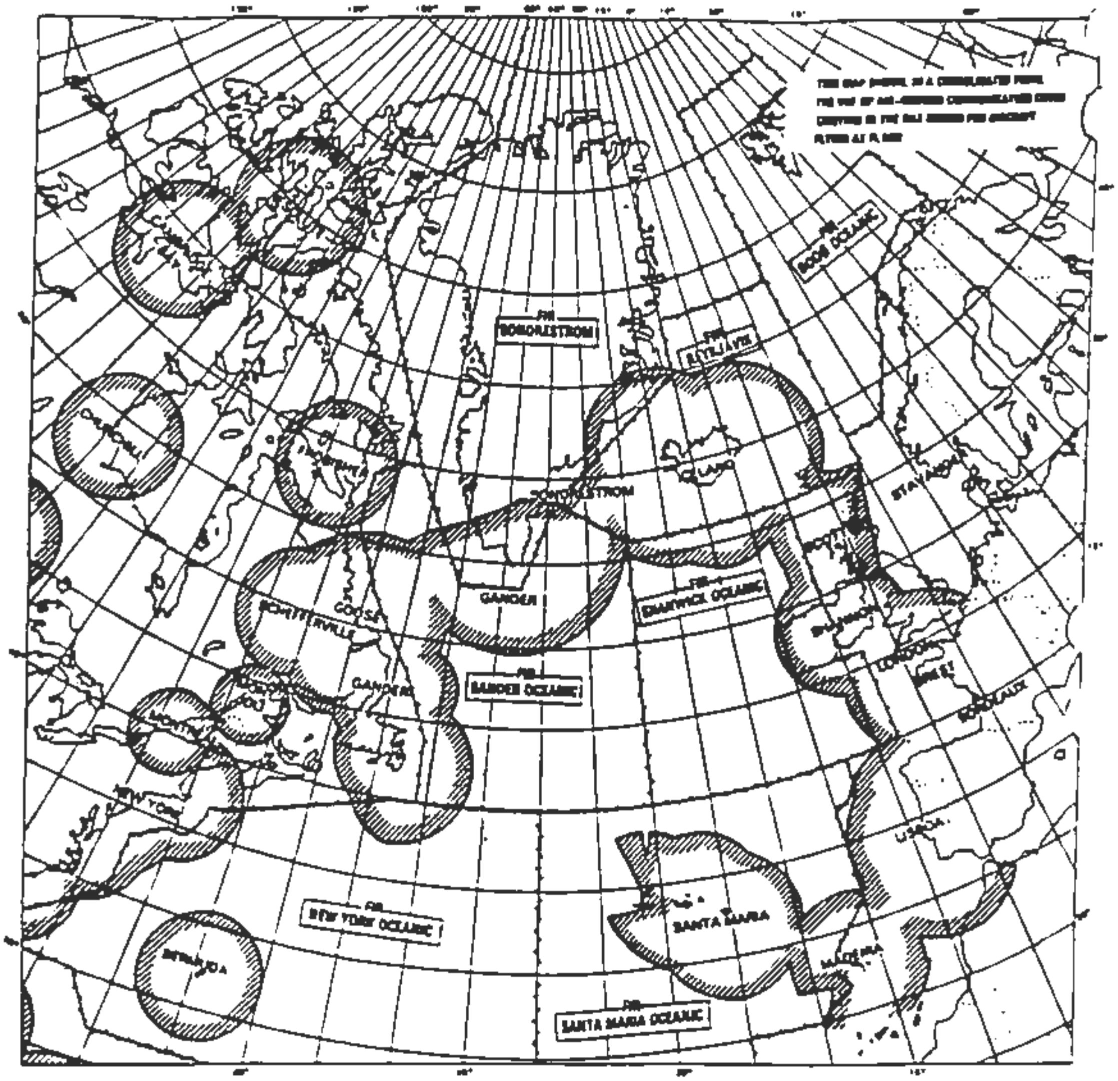


Note 1: The VHF cover depicted in the transition area between the NAT and the EUR Regions has only been shown to complete the picutre of the communication cover. The VHF air-ground communication stations at Stavanger, Scottish, London, Brest, Bordeaux and Lisboa do not form part of the communication system serving the NAT Region.

Note 2: The VHF cover provided by the Qaqatoqaq and Kulusuk stations in Greenland (Sondrestrom) serves Sondrestrom FIC only (below FL195).

FIGURE 2-13. VHF RADIO COVERAGE IN THE NAT REGION AT 300

MAP OF THE VHF OF AIR-GROUND COMMUNICATION COVER
EXISTING IN THE NAT REGION AT FL300



Note: The VHF cover shown in the transition area between the NAT and the EUR Regions has only been shown to complete the picture of the communication cover. The VHF air-ground communication stations at Stavanger, Scottish, London, Brest, Bordeaux and Lisboa do not form part of the communication system serving the NAT Region.

FIGURE 2-14. U.S. LORAN-C CHAINS

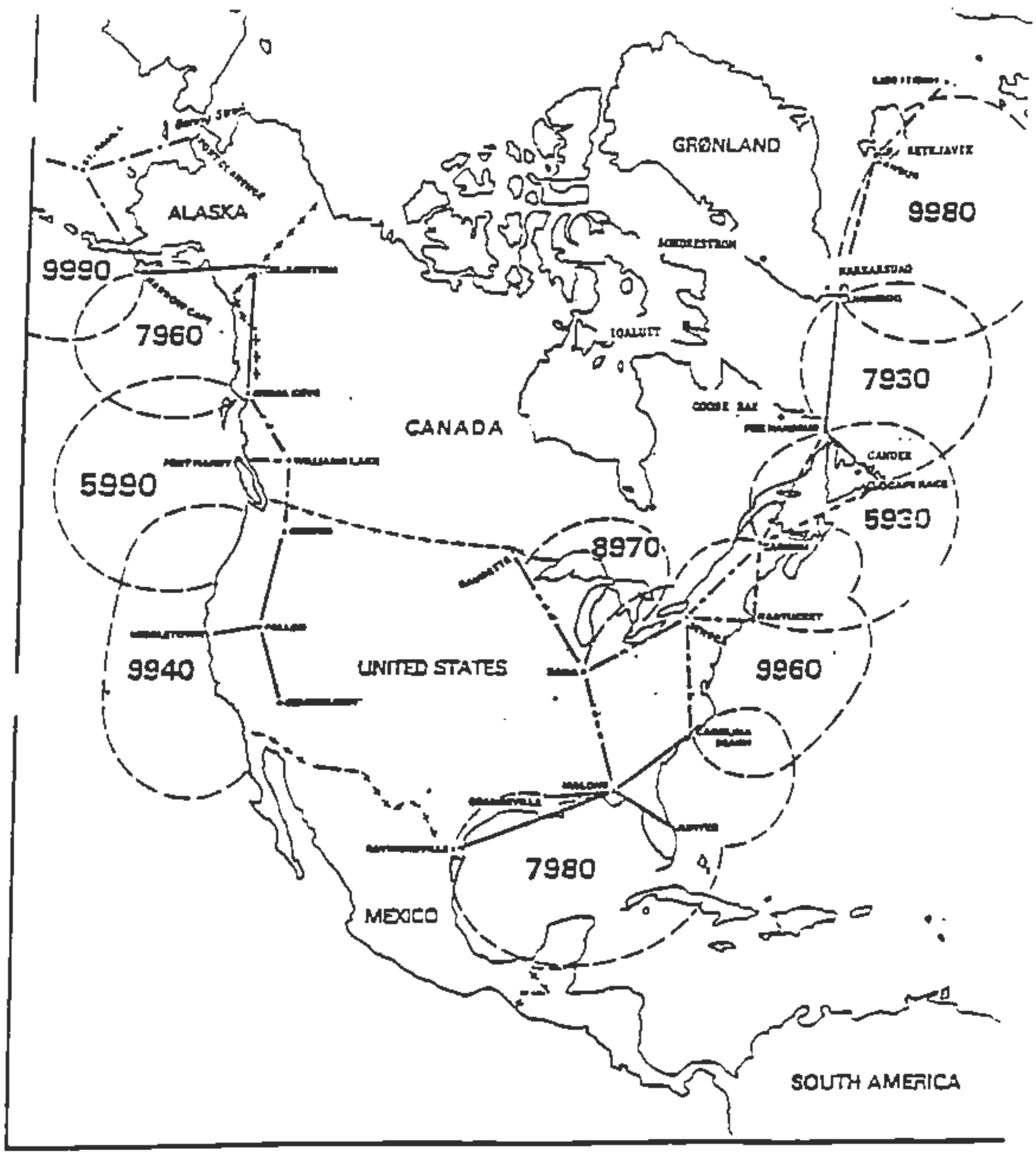


FIGURE 2-15. OTHER ROUTES AND STRUCTURES WITHIN AND ABOVE NAT MNPS AIRSPACE

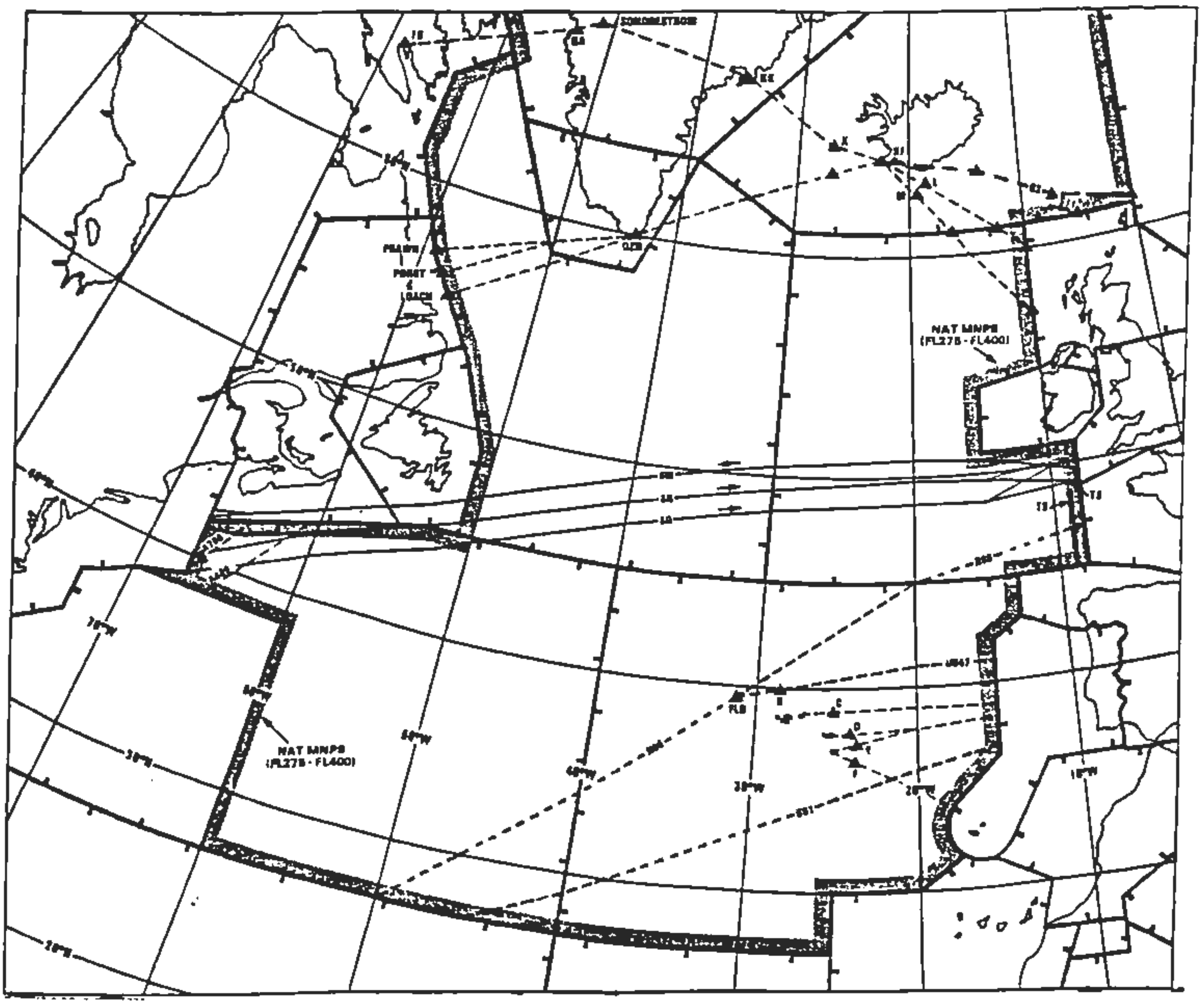


FIGURE 2-16. EXAMPLE OF DAYTIME WESTBOUND ORGANIZED TRACK SYSTEM

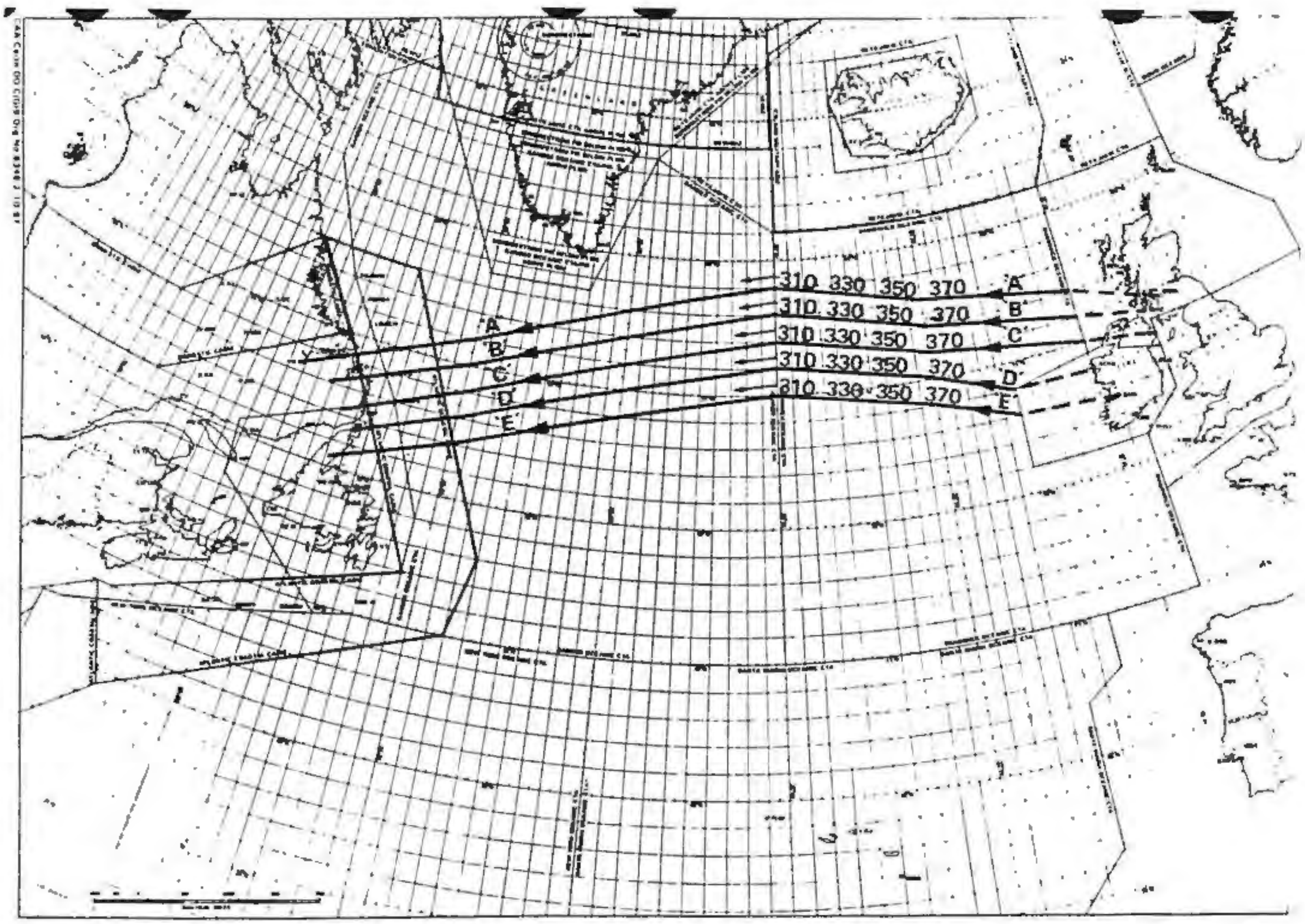
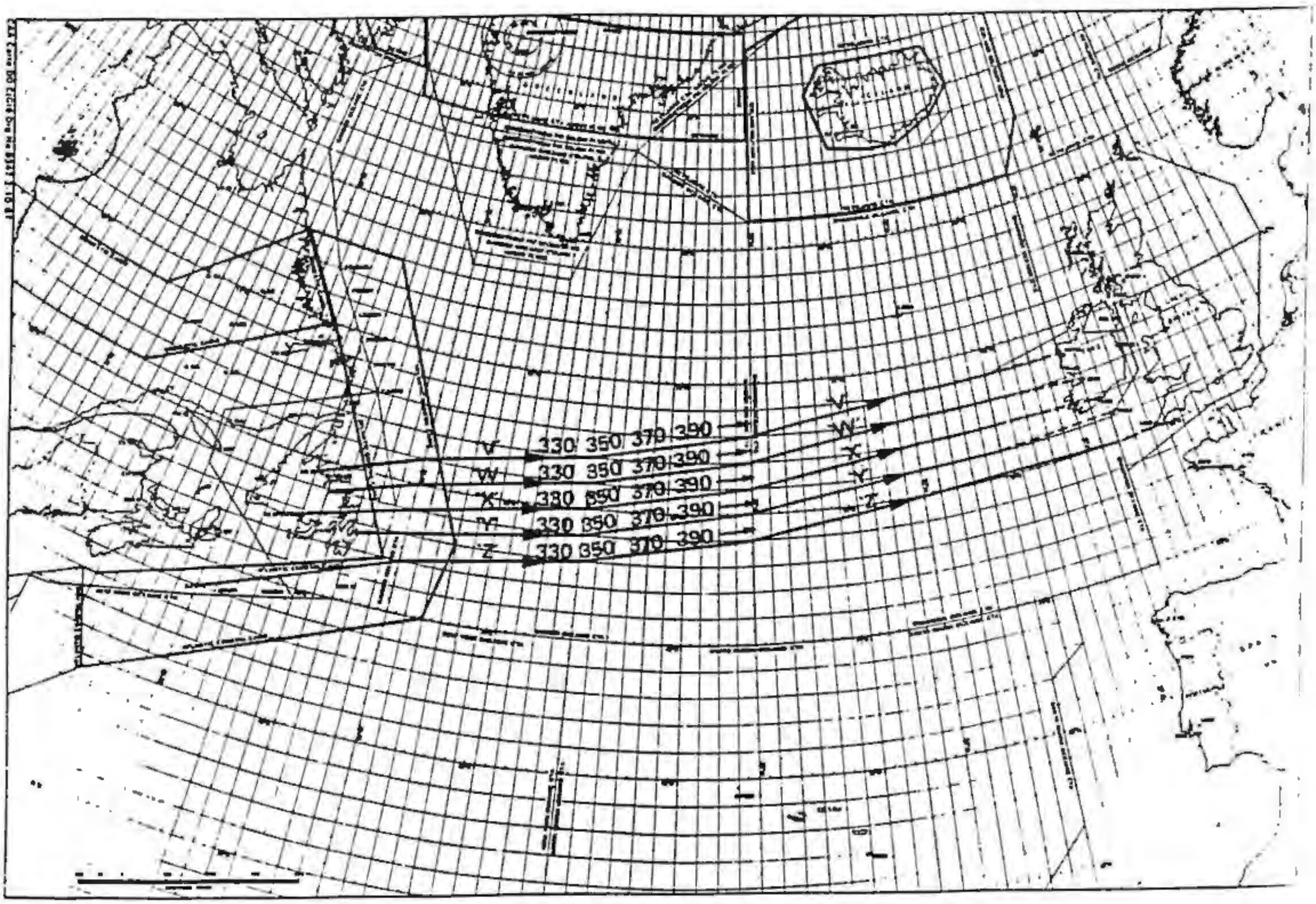


FIGURE 2-17. EXAMPLE OF NIGHTTIME EASTBOUND ORGANIZED TRACK SYSTEM



APPENDIX 3. BIBLIOGRAPHY

TITLE	SOURCE
1. Operations of Civil Aircraft of U.S. Registry Outside of the U.S. FAR § 91.703	Code of Federal Regulations (CFR) Supt. of Documents, U.S. Government Printing Office (GPO) Washington, DC 20402
2. Operations Within North Atlantic MNPS Airspace FAR § 91.705	CFR
3. Survival Equipment for Overwater Operations FAR § 91.509	CFR
4. Radio Equipment for Overwater Operations FAR § 91.511	CFR
5. Flight Navigator and Specialized Navigation Equipment FAR § 121.389	CFR
6. Crewmember Certificate: International Flight Navigator FAR § 121.721	CFR
7. Doppler Radar and Inertial Navigation Systems FAR Part 121 Appendix G	CFR
8. Emergency Equipment: Extended Overwater Operations FAR § 125.209	CFR
9. Flight Navigator and Long-Range Navigation Equipment FAR § 125.267	CFR
10. Crewmembers Certificate: International Operations: Application and Issuance FAR § 135.43	CFR
11. Radio and Navigational Equipment: Extended Overwater or IFR Operations FAR § 135.165	CFR

BIBLIOGRAPHY-CONTINUED

12. Emergency Equipment: Extended Overwater Operations FAR § 135.167	CFR
13. Flight Operations in Oceanic Airspace AC 90-76B	Advisory Circular (AC) Supt. of Documents, U.S. GPO
14. Recommended Practices and Procedures for the Use of Electronic Long-Range Navigation Equipment AC 90-79	AC
15. General Aviation Procedures for Flight in North Atlantic Minimum Navigation Performance Specifications Airspace AC 91-49	AC
16. Operational Approval of Airborne Long-Range Navigation Systems for Flight Within the North Atlantic Minimum Navigation Performance Specifications Airspace AC 120-33	AC
17. Emphasis on Long-Range Navigation Procedures as They Relate to Collision Avoidance ACOB 8-87-2	Air Carrier Operations Bulletin (ACOB) FAA - AFS-552 P.O. Box 20034 Washington, DC 20041
18. Canada Aeronautical Information Publication (AIP)	AIP Transport Canada Aeronautical Information Services Publication and Distribution (AANDHD) Ottawa, Canada K1A 0N8
19. Canada Flight Supplement (CFS)	CFS Transport Canada Canada Map Office Dept. of Energy, Mines and Resources 615 Booth Street Ottawa, Canada K1A 0E9

BIBLIOGRAPHY-CONTINUED

20. Transport Canada International General Aviation (IGA) Aircraft Transatlantic Flight Requirements Pamphlet	IGA Pamphlet Aviation Licensing Branch P.O. Box 42 Moncton, New Brunswick Canada E1C8K6
21. Rules of the Air (ICAO Annex 2)	International Civil Aviation Organization ATT: Document Sales Unit 1000 Sherbrooke Street West, Suite 400 Montreal, Quebec Canada H3A 2R2
22. Operation of Aircraft	ICAO Annex 6
23. Air Traffic Services	ICAO Annex 11
24. Search and Rescue	ICAO Annex 12
25. North Atlantic MNPS Operations Manual	Utilization and Storage Section M-443.2 U.S. Dept. of Trans. 400 7th Street SW. Washington, DC 20590
26. U. S. Airman's Information Manual (AIM)	AIM Supt. of Documents, U.S. GPO
27. U. S. International Flight Information Manual (IFIM)	IFIM Supt. of Documents, U.S. GPO
28. U. S. Aeronautical Information Publication (AIP)	AIP Supt. of Documents, U.S. GPO
29. Culturgrams	Brigham Young University David M. Kennedy Center for International Studies Publication Services 280 HRCB Provo, Utah 84602
30. Technical Standards Orders	Department of Transportation Personal Property Operations Branch Utilization and Storage Section M-443.2 Washington, DC 20590

FAA Action: Oceanic Operations; Advisory Circular No. 91-70

U.S. Department of Transportation

Federal Aviation Administration

Advisory Circular

Subject: **OCEANIC OPERATIONS** Date: **09/06/94** Initiated by: **AFS-550** AC No: **91-70**

1. PURPOSE. This advisory circular (AC) contains information and guidance to be used by operators and pilots planning oceanic flights.

2. RELATED READING MATERIAL. Order 8400.10, "Air Transportation Operations Inspector's Handbook," Order 8700.1, "General Aviation Operations Inspector's Handbook," and documents listed in Appendix 3, Bibliography section, of this AC. The orders may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

3. BACKGROUND. Presently there are several issues that are significant to the United States and civil aviation authorities of other countries relative to oceanic flight operations. The majority of these issues involve the large amount of air traffic over the North Atlantic (NAT) between Europe and the United States. Most air carriers plan eastbound flight departures in the evenings so that morning arrival in Europe will permit a full day's business or touring. Air carriers plan westbound flight departures for just the reverse reason, leaving in the morning so passengers arrive in the United States at a convenient local time. The westbound flights do not create a problem in air traffic congestion due to the breadth of the eastern coast of the United States. However, eastbound flights arriving in Europe from North America converge on the relatively small geographic area of the United Kingdom and have to be filtered onto extremely crowded European routes (ER). Because of this situation, traffic control across the NAT is strictly regulated by International Civil Aviation Organization (ICAO) rules adopted following agreement between member states. Flights in the airspace designated as **Minimum Navigation Performance Specifications** (MNPS) airspace and/or (future) **Reduced Vertical Separation Minimum** (RVSM) airspace require aircraft to obtain a Letter of Authorization (LOA) to fly in this airspace. In the past, these letters were issued by FAA Flight Standards District Offices (FSDO) in a manner and form determined by each office. There was no suspense date or numbering system required on the letters. This situation caused a great deal of international concern because letters stayed with aircraft for an indefinite period of time and were impossible to track. Pressure by ICAO member states has caused the FAA to reevaluate the process of issuing these letters, and to standardize the format and procedures for issuance.

Another area of concern in the NAT, as well as other areas, is that of general aviation oceanic navigation performance experienced by nonturbine light aircraft. Search and rescue missions conducted by ICAO member states for U.S.-registered aircraft that have strayed off course have imposed a severe strain on those states. This situation has demanded action on the part of the U.S. Government. This situation had also had a negative impact on international relations between the United States and other ICAO member states. U.S.-registered aircraft making oceanic flights and departing from the United States are not required to have an LOA and/ or an inspection unless they are to penetrate MNPS airspace. These aircraft are required, however, to submit to an inspection of both the aircraft and the flightcrew if departing from or overflying Canada.

Flights in the Northern Pacific (NOPAC) en route to Asia do not have to contend with the same traffic density as NAT operations. Although navigation in the NOPAC once involved serious political implications if a navigation error occurred, this is no longer the case. However, the length of the overwater routes makes it imperative that aircraft flying in the Pacific have well-trained flightcrews, high quality communication equipment, high quality long-range navigation equipment, and more than adequate fuel supplies on board. The same requirements apply to U.S. west coast - Hawaii routes and Hawaii - Tokyo routes.

Flights in the Caribbean and the Gulf of Mexico do not involve long distances over water, but they often encounter severe tropical weather, exceed the service volume of navigation facilities, and encounter the sensitivity of national defense agencies to the southern borders of the United States.

4. **DISCUSSION.** In response to the concerns discussed above, the FAA has done the following:

- Published this AC as a single source document for flightcrews planning oceanic flight.
- Standardized LOA's for flights into MNPS airspace.
- Established a tracking system and statistical database of overseas navigation error reports (ONER), oceanic altitude deviation reports (OADR), reports of erosion of longitudinal separation, and LOA verification requests.
- Standardized the LOA format and issuance procedures for FAA inspectors through guidance in the FAA's inspector handbooks.

This document is designed to be comprehensive; however, not all chapters are applicable to all operations. The publications cycle of this AC is such that it is impossible for up-to-the-minute details of all political, geographic, navigational, and communications information to be included. It is therefore recommended that operators use this document only for general guidance and to verify specifics by consulting the most recent Aeronautical Information Publication (AIP), international Notice to Airmen (NOTAM), and information from the U.S. Department of State.

5. **OVERVIEW.** To facilitate the use of this AC, without requiring the reading of unnecessary chapters, the following summaries are presented:

- Chapter 1 should be read by those interested in the legal foundations for oceanic regulatory control.
- Chapter 2 should be read by all operators with emphasis on those sections pertinent to their operations, as this is an overview of all oceanic operations.
- Chapter 3 should be read by all operators planning NAT flights, regardless of the nature of the operation. It is imperative that anyone flying in the NAT have a detailed knowledge of the special airspace in this oceanic area.
- Chapter 4 should be read by all operators planning NOPAC flights.
- Chapter 5 should be read by all operators planning flights in the Pacific outside the NOPAC area.
- Chapters 6 and 7 contain details on Caribbean and Gulf of Mexico operations.
- Chapter 8 provides detailed navigation information. Not all sections will pertain to all operators. It is recommended that this chapter be scanned by all operators, and that the information pertinent to their operations be read in detail.
- Chapter 9 discusses helicopter oceanic operations.
- Chapter 10 is important to all oceanic operations. ICAO requirements for flightcrew training and foreign nation's individual requirements (Canada, for example) demand varying degrees of training for flightcrews. It is recommended that all flightcrews receive the level of training required for their operation.
- Chapter 11 includes specific guidance for Federal Aviation Regulations (FAR) Part 91 operations.

• Chapter 12 describes the polar track system and includes some food for thought from Admiral Byrd.

• Chapter 13 - Caution should be exercised when planning flights to the former Soviet Union. The ever-changing political situation of the destination countries necessitates close scrutiny of AIP's, international NOTAM's, and contact with the Department of State prior to planning operations in those areas.

• The four appendixes are included to provide operators with copies of necessary documents, charts, references, and definitions that may be difficult to obtain from other sources.

The FAA's efforts will be meaningless without the cooperation of flightcrews and operators involved with oceanic operations. Therefore, individuals planning this type of operation should avail themselves of the contents of this AC and of the resource materials listed in the appendixes. It is only through the cooperative efforts of flightcrews, operators, industry groups, and the FAA that safe operations can be conducted in oceanic airspace.

In the spirit of partnership between government and industry, the following associations, agencies and corporations provided input and assistance that aided in the development of this document.

Aircraft Owners and Pilots Association
ARINC, Inc.
Aviation Rules Advisory Committee
Bristol-Meyers Squibb Company
Citibank Flight Department
Delta Air Lines
Dresser Air Transport
Emerson Electric
Flight Safety International, Inc.
459th Wing Air Force Reserve, Andrews AFB
Helicopter Safety Advisory Conference
Jeppesen Sanderson, Inc.
National Business Aircraft Association
NBAA International Operators Committee
Northwest Airlines
Simuflite
United Kingdom Civil Aviation Authority
U.S. Mission to ICAO
Wayfarer Ketch Corporation

David R. Harrington
Acting Director, Flight Standards Service

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APPENDIX 1
SAMPLES OF FORMS AND TABLES USED IN OCEANIC OPERATIONS

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CHAPTER 1. UNITED STATES AVIATION AND THE INTERNATIONAL CIVIL AVIATION ORGANIZATION

1. BACKGROUND.

An understanding of oceanic operations demands a knowledge of the International Civil Aviation Organization (ICAO) and the U.S. involvement in this organization. This background is needed to understand the relationship between U.S. policy and international policy.

World War II had a major impact on the technical development of aircraft, telescoping one quarter century of peacetime development into 6 years. There were many political and technical problems to be resolved to support a world at peace. Safety and regularity in air transportation necessitated airports, installation of navigational aids (navaids), and weather reporting systems. Standardization of methods for providing international services was vital to preclude unsafe conditions caused by misunderstanding or inexperience. Establishment of standards for air navigation, air traffic control (ATC), personnel licensing, airport design, and for many other important issues related to air safety required international action. Questions concerning the commercial and legal rights of developing airlines to fly into and through the territories of another country led the United States to conduct exploratory discussions with other allied nations during early 1944. On the basis of these talks, invitations were sent to allied and neutral states to meet in Chicago in November 1944. The outcome of this Chicago Convention was a treaty requiring ratification by 26 of the 52 states that met. By ratifying the treaty, contracting states agreed to pursue certain stated objectives, assume certain obligations, and establish the international organization that became known as ICAO.

As a charter member of ICAO, the United States has fully supported the organization's goals from its inception, being especially concerned with technical matters. Through ICAO, the United States works to achieve the highest practical uniform air regulations, standards and procedures for aircraft, personnel, airways, and aviation services throughout the world. At the same time, the United States depends upon ICAO to ensure that navigation facilities, airports, weather, and radio services provided by other nations meet international standards.

Through active support and participation in ICAO, the Federal Aviation Administration (FAA) strives to improve worldwide safety standards and procedures to make international flying more efficient and economical. The FAA also provides technical assistance to other nations when needed. As of April 1994, the FAA had 295 agreements with 86 foreign countries to provide technical assistance in areas such as flight inspection, training, air traffic development, loan of equipment and navaids, and supply support. The specific terms of these arrangements are detailed in memorandums of agreement. These memorandums include descriptions of the services, special conditions, financial provisions, liability information, effective dates, termination dates, and other information required for particular situations. Agreements involving international activities are negotiated and signed by the Director of International Aviation on behalf of the FAA.

2. ICAO AND THE ICAO ANNEXES.

a. ICAO Objectives. The objectives of ICAO are to develop the principles and techniques of international air navigation and to foster the continued development of international air transportation through the following means:

- Promoting the safe and orderly growth of civil aviation throughout the world.
- Fostering the technical arts of aircraft design and operation for peaceful purposes.
- Encouraging the development of airways, airports, and air navigation facilities for international civil aviation.

• Meeting the needs of the world's people for safe, regular, efficient, and economical air transportation.

• Preventing economic waste caused by unreasonable competition.

• Ensuring that the rights of contracting states are fully respected and that every contracting state has an equal opportunity to operate international airlines.

• Avoiding discrimination among contracting states.

• Promote the development of all aspects of international civil aeronautics

*b. **Privileges and Obligations of Member States.*** Ratifying the Convention obligated member states to abide by "certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner, and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically." Ninety-six articles, created and accepted at the Chicago Convention, established the privileges and obligations of the member states. Some of these articles are summarized as follows:

(1) Contracting states recognize that each state has complete and exclusive sovereignty over the airspace above its territory (Article 1).

(2) The Convention, including the articles and annexes, applies only to civil aircraft. Each member state will require its state aircraft to operate with "due regard" for the safety of navigation of civil aircraft (Article 3).

(3) International air navigation laws and regulations of a contracting state pertaining to the operation and navigation of such aircraft while within its territory shall apply to the aircraft of all contracting states without distinction to nationality. These laws and regulations shall be complied with by such aircraft while entering, within, or departing from the territory of that state (Article 11).

(4) Each contracting state adopts measures to ensure that every aircraft maneuvering over or within its territory, and every aircraft carrying a nationality marking, wherever it operates, shall comply with the rules and regulations of that country relating to the flight and maneuver of aircraft. This article also requires that, in operations over the high seas, the rules in force shall be those established under this Convention. Each contracting state undertakes to ensure the prosecution of all persons violating the applicable regulations (Article 12).

(5) Each contracting state undertakes not to discriminate in the availability of, or charges for, airports and other air navigation facilities (Article 15).

(6) Each contracting state undertakes to provide airports, radio services, meteorological services, and other air navigation facilities in its territory to facilitate international air navigation in accordance with ICAO standards and practices (Article 22).

(7) Each contracting state undertakes to adopt and put into operation appropriate standard systems of communication, codes, markings, signals, lighting, and other operational practices and rules recommended or established by ICAO (Article 28).

(8) Each contracting state recognizes the validity of Certificates of Airworthiness and Licenses of Competency issued by other contracting states, when issued under conditions that comply with ICAO standards (Article 33).

(9) Each contracting state collaborates in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft, personnel, airways, and auxiliary services when uniformity will facilitate and improve air navigation (Article 37).

(10) Each contracting state undertakes to immediately notify ICAO of any differences between national regulations and any ICAO standards (Article 38).

*c. **Organizational Structure.*** ICAO is recognized by the United Nations (U.N.) as a specialized agency for international civil aviation. An agreement between these organizations ensures an efficient working relationship and a mutual recognition of their respective roles. ICAO is not subordinate to, and does not receive any line-of-command authority from, the United Nations.

*(1) **Assembly.*** The Assembly is the sovereign body of ICAO. It meets every 3 years for a detailed review of the organization's technical, economic, legal, and technical assistance programs, offers guidance and provides direction concerning the future work of other ICAO bodies. Each nation has one vote in the assembly and, unless the convention provides otherwise, a majority rules. In 1994 there were 183 ICAO member nations, and therefore 183 assembly votes.

*(2) **Council.*** The Council, composed of elected representatives from 33 member states, is the permanent governing body of ICAO. The Council is responsible to the Assembly for processing ICAO's technical, economic, legal and technical assistance work programs. The Council investigates situations that might create obstacles to international air navigation, and takes action as necessary to protect global air safety and order. When required, it also serves as an arbiter between member states on aviation matters.

*(3) **Air Navigation Commission.*** The Air Navigation Commission (ANC) is composed of 15 individuals, each an expert in at least one technical field of aviation. The ANC is primarily concerned with the development of ICAO Standards and Recommended Practices (SARP) in 17 of the 18 Annexes to the Convention, that is, all annexes except Annex 17, Security.

*(4) **Air Transport Committee.*** The Air Transport Committee's prime concern is economic matters relating to airports, route facilities, and air carrier tariffs. This information is used to promote fair and equal opportunities for all international carriers.

*(5) **Joint Support Committee.*** The Joint Support Committee provides for financial arrangements for certain air facilities or services when member states have inadequate resources. Most funding comes from direct user charges to air carriers. This committee studies air service problems and makes suitable arrangements between user and provider states.

*(6) **Legal Committee.*** The Legal Committee interprets questions on the Chicago Convention and public and private law. Some of its main concerns are hijackings and other acts of air terrorism, air carrier liability, and jurisdiction over offenses committed on international flights.

*(7) **Unlawful Interference with International Civil Aviation.*** The Committee on Unlawful Interference with International Civil Aviation and its facilities assist and advise the council on all activities relating to aviation security. One of the Committee's major functions is the development and revision of ICAO SARP in Annex 17 to the Convention.

*(8) **Secretariat.*** The ICAO Secretariat, headed by a Secretary General, is comprised of staff members who provide both technical and administrative support for the triennial Assemblies, the Council, and the Council's seven subordinate bodies, such as the Air Navigation Commission.

*d. **ICAO Publications.***

*(1) **The ICAO Journal.*** This document is published 12 times annually and contains a digest of ICAO meetings, activities for the previous period, and articles, etcetera. Semiannually, it contains a table showing the status of all ICAO publications involving air navigation.

*(2) **Final Reports of Meetings.*** The final reports of divisional, regional, and panel meetings include the proceedings and recommendations of each meeting. These recommendations are not effective until reviewed

by the Air Navigation Commission or another appropriate committee and approved by the Council. Approved recommendations are separately referred as appropriate to the affected states for implementation.

(3) ***Annexes to the Convention.*** The 18 ICAO Annexes to the Convention contain the international SARP that have been adopted by the Council. Paragraph 2e contains a list of these 18 Annexes with a brief description of their subject matter.

(4) ***Procedures for Air Navigation Services (PANS).*** Normally developed by the Air Navigation Commission and based on recommendations of divisional or panel meetings, Procedures for Air Navigation Services (PANS) are intended to amplify in more detail SARP in ICAO Annexes in certain fields. To date, PANS exist for aircraft operations (PANS-OPS), rules of the air and air traffic services (PANS-RAC), and ICAO abbreviations and codes (PANS-ABC).

(5) ***Regional Supplementary Procedures.*** Certain procedures apply only in specific regions and are published as Supplementary Procedures. A Supplementary Procedure can explain and amplify, but cannot conflict with international standards. For convenience, all regional Supplementary Procedures have been included in a single document and similar procedures applicable to two or more regions are grouped together.

(6) ***Manuals.*** Like PANS, these technical publications are intended to facilitate states' implementation of SARP by providing more detailed guidance and information, for example, Airport Planning Manual and Manual of Procedures for Operations Certification and Inspection.

(7) ***ICAO Circulars.*** ICAO Circulars are issued by the Secretary General to make specialized information available to contracting states. This information is not adopted or approved by the Council. Circulars include studies of statistics, summaries of treaties or agreements, analyses of technical documents, and studies of technical subjects.

More complete descriptions of these and other ICAO publications are contained in annual editions of the "Catalogue of ICAO Publications and Audio Visual Aids." This catalogue and other ICAO publications are available by contacting ICAO at the following address:

Document Sales Unit
International Civil Aviation Organization
1000 Sherbrooke Street West, Suite 400
Montreal, Quebec
Canada H3A, 2R2
Tel: (514) 285-8219
Fax: (514) 288-4772

e. International SARP. Since ICAO was created, a main technical feature of the organization has been operational standardization of safe, regular, and efficient air services. This has resulted in high levels of reliability in the many areas that collectively shape international civil aviation, particularly with respect to aircraft, the aircraft crews, and the ground-based facilities and services. Standardization has been achieved through the creation, adoption, and amendment of Annexes to the Convention on International Civil Aviation, identified as international SARP. Standards are directives which ICAO members agree to follow. If a member has a standard different from an ICAO standard, that member must notify ICAO of the difference. Recommended practices are desirable practices but not essential. The basic criterion for deciding whether a particular issue should be a standard is an affirmative answer to the question, "Is uniform application by all contracting states essential?" The applicability of a standard may be subject to certain conditions relating to such areas as terrain, traffic density, stages of flight, and climate. A standard should, however, be applied equally by any contracting state when those specified conditions are encountered, unless the contracting state notifies ICAO of a difference and publishes this difference in its Aeronautical Information Publication (AIP).

ICAO Annexes contain the standards and recommended practices that have been adopted through international agreement. The 18 annexes are described as follows:

(1) Annex 1, Personnel Licensing, provides information on licensing of flightcrews, air traffic controllers, and aircraft maintenance personnel, including medical standards for flightcrews and air traffic controllers.

(2) Annex 2, Rules of the Air, contains rules relating to conducting visual and instrument flight.

(3) Annex 3, Meteorological Service for International Air Navigation, provides for meteorological services for international air navigation and reporting of meteorological observations from aircraft.

(4) Annex 4, Aeronautical Charts, contains specifications for aeronautical charts used in international aviation.

(5) Annex 5, Measurement Units Used in Air and Ground Operations, lists dimensional systems to be used in air and ground operations.

(6) Annex 6, Operation of Aircraft, enumerates specifications to ensure a level of safety above a prescribed minimum in similar operations throughout the world. The three parts of this Annex include the following:

- Part I - International Commercial Air Transport - Airplanes
- Part II - International General Aviation - Airplanes
- Part III - International Operations - Helicopters

(7) Annex 7, Aircraft Nationality and Registration Marks, specifies requirements for registration and identification of aircraft.

(8) Annex 8, Airworthiness of Aircraft, specifies uniform procedures for certification and inspection of aircraft.

(9) Annex 9, Facilitation, provides for the standardization and simplification of border-crossing formalities.

(10) Annex 10, Aeronautical Telecommunications, Volume 1, provides for standardizing communications equipment and systems. Volume 2 standardizes communications procedures.

(11) Annex 11, Air Traffic Services, includes information on establishing and operating ATC, flight information, and alerting services.

(12) Annex 12, Search and Rescue, provides information on organization and operation of facilities and services necessary for search and rescue (SAR).

(13) Annex 13, Aircraft Accident Investigation, provides for uniformity in notifying, investigating, and reporting on aircraft accidents.

(14) Annex 14, Aerodromes, contains specifications for the design and equipment of aerodromes.

NOTE: Most countries outside of North America designate "airports" as "aerodromes."

(15) Annex 15, Aeronautical Information Services, includes methods for collecting and disseminating aeronautical information required for flight operations.

(16) Annex 16, Environmental Protection, Volume 1, contains specifications for aircraft noise certification, noise monitoring, and noise exposure units for land-use planning. Volume 2 contains specifications for aircraft engine emissions.

(17) Annex 17, Security-Safeguarding International Civil Aviation Against Acts of Unlawful Interference, specifies methods for safeguarding international civil aviation against unlawful acts of interference.

(18) Annex 18, The Safe Transport of Dangerous Goods by Air, contains specifications for labeling, packing, and shipping dangerous cargo.

3. ICAO REGIONAL PLANS AND AERONAUTICAL INFORMATION PUBLICATIONS.

a. Regional Planning. Although ICAO is involved with civil aviation on a worldwide scale, there are many subjects it considers on a regional basis. Regional air navigation meetings are held periodically to consider the requirements of air operations in specified areas. Facilities, services, and the formulation of supplementary procedures necessary to support increases in traffic density, new air routes, and the introduction of new types of aircraft are among the topics considered. These meetings identify the numerous facilities and services to be provided by states in the nine ICAO regions. After review of the meeting recommendations by the Air Navigation Commission and approval by the Council, the recommendations are reflected in Air Navigation Plan publications which cover the nine ICAO regions.

b. Air Navigation Plans. Air Navigation Plans provide details of facilities, services, and procedures required for international air navigation within specified areas. Each Air Navigation Plan also contains recommendations for providing air navigation facilities and services within a specific area. Affected governments can be assured that, if the recommended facilities and services are furnished in accordance with the plan, the facilities will become part of an integrated air navigation system adequate for the foreseeable future. The plans are amended periodically to reflect changes in requirements and in the implementation status of the facilities and services.

c. Aeronautical Information Publications (AIP). Each state is responsible for developing an AIP that satisfies international requirements for the exchange of aeronautical information essential to air navigation. Each AIP contains information on air traffic, airports, navaids, special use airspace, weather, and other data vital to flightcrews coming into or flying through the airspace of a particular state. Each AIP should provide information that is adequate, accurate, timely, and designed for in-flight use. AIP's contain lists of significant differences between the national regulations and practices of the state and ICAO standards, recommended practices, and procedures. Notices to Airmen (NOTAM) are issued when information is temporary or cannot be made available quickly enough by an AIP amendment.

4. U.S. PUBLIC LAW, INTERNATIONAL AGREEMENTS, AND STANDARDS RELATED TO AIR NAVIGATION.

a. The Federal Aviation Act of 1958, as Amended (The FA Act). The FAA authorities and responsibilities related to air navigation and navigation systems, practices, and procedures originate in the FA Act. Two important sections of the Act are Sections 307 and 601. Section 307 of the FA Act states that "The Secretary of Transportation is authorized and directed to develop plans for and formulate policy with respect to the use of the navigable airspace; and assign by rule, regulation, or order the use of the navigable airspace under such terms, conditions, and limitations (operational procedures and navigation performance requirements) as he may deem necessary in order to ensure the safety of aircraft and the efficient utilization of such airspace." Section 601 of the FA Act empowers the Secretary to "promote safety of flight of civil aircraft in air commerce by prescribing and revising from time to time ... minimum standards governing the ... performance of aircraft ... and appliances (navigation performance and navigation systems) as may be required in the interest of safety ... reasonable rules and regulations, or minimum standards, governing other practices, methods, and procedure ... necessary to provide adequately for national security and safety in air commerce."

NOTE: On July 4th, 1994, the FA Act was recodified to "United States Code 49."

b. Protection of Persons and Property. The need to ensure protection of persons and property, both during flight and on the ground, is fundamental to the Federal Aviation Regulations (FAR). Many of the design and performance requirements in aircraft certification rules are established to provide this protection. This protection is also extensively addressed in the operating and equipment rules related to air navigation. It is important that the regulations provide this protection equally to persons and property both during flight and on the ground. Approvals of routes and areas of en route operation must take into account the need to protect persons and property on the ground as well as during flight.

*c. **Equipment Redundancy.*** Each airplane must have enough navigation equipment installed and operational to ensure that, if one item of equipment fails at any time during the flight, the remaining equipment will be sufficient to enable navigation to the degree of accuracy required for ATC. Additionally, failure of any single unit required for communication or navigation purposes or both, must not result in the loss of another required unit.

d. Relationship Between the FAR, ICAO SARP, and National Regulations. The FA Act is the authority for the FAR. The FAR represent the regulatory implementation of the responsibilities assigned by the FA Act and the implementation of the principles derived from the ICAO Convention. The relationship between the FAR, ICAO SARP, and foreign national regulations are discussed in the following subparagraphs.

(1) FAR Part 91 regulates the operation of aircraft other than moored balloons, kites, unmanned rockets, and unmanned free balloons that are governed by FAR Part 101, and ultralight vehicles operated in accordance with FAR Part 103. The following are examples of Part 91 regulations applicable outside the United States.

(a) FAR 91.703(a)(1) and (a)(2) requires each person operating a U.S.-registered aircraft to comply with ICAO Annex 2 when over the high seas and to comply with the regulations of a foreign country when operating within that country's airspace.

(b) FAR 91.703(a)(3) requires compliance with FAR 91.703 when not in conflict with the regulations of a foreign nation or Annex 2 of the Convention on International Civil Aviation.

(c) FAR 91.703 (a)(4), FAR 91.705 and FAR 91 Appendix C specify regulatory requirements and minimum standards for operation in North Atlantic (NAT) Minimum Navigation Performance Specifications (MNPS) airspace.

(2) For operators conducting operations under FAR Part 135, FAR 135.3 (a) requires compliance with the applicable rules of that chapter while operating within the United States. FAR 135.3 (b) specifies that while operating outside of the United States, operators must comply with the following:

(a) Annex 2, Rules of the Air, to the Convention on International Civil Aviation

(b) Rules of a foreign country when operating within that country

(c) All the regulations of FAR Parts 61, 91, and 135 that are more restrictive than Annex 2 or regulations of a foreign country when compliance with these U.S. regulations would not violate requirements of Annex 2 or the foreign country.

(3) For operators conducting operations under FAR Part 121, FAR 121.1 requires compliance with that part while operating within or outside the United States. FAR 121.11 specifies that these operators, when operating within a foreign country, must comply with the air traffic rules of the country concerned and any local airport rules which may be in force. FAR 121.11 also requires that all rules of FAR Part 121 that are more restrictive than a foreign country's rules must be followed, if it can be done without violating the rules of that country. Additionally, air carriers operating under FAR Part 121 must comply with Annex 2 when over the high seas according to FAR 91.1.

CHAPTER 2. OCEANIC OPERATIONS FOR ALL AIRCRAFT IN ALL GEOGRAPHIC AREAS

1. INTRODUCTION.

It is imperative for all pilots planning an oceanic flight to become familiar with the appropriate Federal Aviation Regulations (FAR) and the information contained in Notices to Airmen (NOTAM), International Flight Information Manual (IFIM), Aeronautical Information Publication (AIP), International Civil Aviation Organization (ICAO) Annexes, and regulations of the foreign countries over which they intend to fly. In addition, customs procedures, cultural considerations, entry and overflight procedures, and immunization requirements must be considered. Pertinent FAR for various flight configurations are listed in this Advisory Circular (AC). Other referenced documents are listed in Appendix 3, with information on their contents and publishers.

a. Legal Basis for International Operations. During oceanic flights, pilots must adhere to the U.S. regulations, ICAO regulations, and the regulations of the nations that they overfly or in which they land. This requirement is based upon the Convention on International Civil Aviation, commonly known as the Chicago Convention. The General Principles and Application of the Convention were signed by the United States on December 7, 1944, ratified on August 9, 1946, and became effective on April 4, 1947 (see Chapter 1). This document defined numerous aspects of international operations. Flight regulations for oceanic operations are specifically covered in Annex 2, "Rules of the Air." FAR 91.703 ensures that the Rules of the Air are binding to operators of U.S.-registered aircraft operating outside of the United States, and it is the FAA's responsibility to ensure that pilots of U.S.-registered aircraft comply with these regulations.

b. Information Sources. Member states follow ICAO guidelines by publishing statistical aeronautical information in the AIP for a flight information region (FIR). The AIP is the state's official publication that defines and describes the airspace, aeronautical facilities and services, and national rules and practices pertaining to air traffic. AIP's are available through the aviation departments of the publishing country. AIP's for each FIR to be flown over should be consulted during the planning of any international flight. Some ICAO member states jointly produce and publish AIP information in a single volume. Others do not publish AIP information in book form, but issue AIP information through NOTAM's. It is imperative that pilots and/or flight departments consult NOTAM's to determine if changes to published data have occurred. International NOTAM information is available from the U.S. International NOTAM office or through local flight service stations (FSS).

c. Precautions. Operators are advised to ensure full compliance with each country's requirements in advance. This ensures that all flights into, from, or over foreign territories comply with that territory's regulations. Particular attention should be given to the permissibility of night flights and operations between sunset and sunrise. The hours during which customs, immigration, and other services are operational should also be considered. Information on a country's normal work week may be obtained from the U.S. Embassy. All countries require some form of advance notification of arrival. If a number of days or hours advance notice is not specified, notification should be sent far enough in advance to permit processing and response. Pilots should carry a copy of the advance notification as well as confirmation that the notification was sent. This is particularly important for countries that do not normally return request approvals. Operators should ensure that all required entry documents are available for presentation upon arrival. Multiple copies may be needed of documents such as ownership papers, general declarations, passenger and cargo manifests, licenses, crewmember certificates, logbooks, and radio licenses. Availability, types, and duration of visas, tourist cards, and other entry documents should be determined before departure. Some countries require that a traveller have a visa for the next country of entry before departure, as well as proof of required immunizations for that country. This information can be obtained from the U.S. Embassy. Aircraft that will remain within the territorial limits of a country for an extended period of time may become subject to import regulations and may be impounded. Operators should determine in advance the number of days that an aircraft may remain in any country where the aircraft will land.

2. FEDERAL AVIATION REGULATIONS PERTINENT TO INTERNATIONAL OPERATIONS.

This section lists specific FAR that are pertinent to international operations. This listing is a compilation of FAR that have particular importance in international operations. Crews are advised to reference these FAR prior to planning an oceanic or international flight. This listing of FAR is for guidance only, and does not eliminate or provide relief from other FAR that are not listed. Pilots transporting aircraft internationally should also be aware of the contents of Chapter III, "Nationality for Aircraft," in the agreements of the Chicago Convention.

FAR PART 45 - IDENTIFICATION AND REGISTRATION MARKING

SUBJECT	FAR
Nationality and Registration Marks - General	§ 45.21
Display of Registration Marks - General	§ 45.23
Size of Registration Marks	§ 45.29
Marking of Export Aircraft	§ 45.31

FAR PART 47 - AIRCRAFT REGISTRATION

SUBJECT	FAR
Registration required	§ 47.3
Applicants for Aircraft Registration	§ 47.5
*Certification of U.S. Citizenship	§ 47.7
*Voting trust	§ 47.8
*Corporation not U.S. citizen	§ 47.9
Evidence of Ownership	§ 47.11
Effective Date of Aircraft Registration	§ 47.39
Invalid registration	§ 47.43
Cancellation of Certificate for Export	§ 47.47

* These regulations are especially noteworthy in regard to international operations. They each contain citizenship requirements relative to the legality of an aircraft registration and will be checked by inspectors upon application for any required Letter of Authorization (LOA).

FAR PART 91 - GENERAL OPERATION AND FLIGHT RULES

SUBJECT	FAR
Survival Equipment for Overwater Operations	§ 91.509
Radio Equipment for Overwater Operations	§ 91.511
Operation of Civil Aircraft of U.S. Registry Outside of the United States	§ 91.703
Operations Within the North Atlantic Minimum Navigation Performance Specifications Airspace	§ 91.705
Flights Between Mexico or Canada and the United States	§ 91.707
Operations to Cuba	§ 91.709

FAR PART 135 - AIR TAXI OPERATIONS AND COMMERCIAL OPERATORS

SUBJECT	FAR
Crewmember Certificate, International Operations: Application and Issue	§ 135.43
Aircraft Proving Tests	§ 135.145
Radio and Navigation Equipment: Extended Overwater or IFR Operations	§ 135.165
Emergency Equipment: Extended Overwater Operations	§ 135.167
Performance Requirements: Land Aircraft Operated Overwater	§ 135.183

FAR PART 121 - COMMERCIAL OPERATORS

SUBJECT	FAR
Rules Applicable to Operations in a Foreign Country	§ 121.11
En Route Navigation Facilities	§ 121.121
Emergency Equipment for Extended Overwater Operations	§ 121.339
Radio Equipment for Extended Overwater Operations and Certain Other Operations	§ 121.351
Emergency Equipment for Operations Over Uninhabited Terrain Areas	§ 121.353
Doppler Radar and Inertial Navigation Systems	Appendix G

FAR PART 125 - CERTIFICATION AND OPERATION OF AIRPLANES HAVING A SEATING CAPACITY OF 20 OR MORE PASSENGERS OR A MAXIMUM PAYLOAD CAPACITY OF 6,000 POUNDS OR MORE

SUBJECT	FAR
Emergency Equipment: Extended Overwater Operations	§ 125.209
Flight Release Overwater	§ 125.363

3. PLANNING.

Adequate planning is the key to a successful international flight, whether it be an airline or a single-engine light aircraft. The lead time required for planning varies with the experience and training background of the crew and the amount of assistance available from a company dispatcher or a planning agency. Planning can never start too early and should always be done within 30 days lead time if at all possible. Experienced crews flying the same route on a regular basis can reduce planning time significantly, but a new crew or a crew flying a new route should adhere to the 30 days rule of thumb.

Many crews utilize flight planning agencies for flight planning. While most agencies do an excellent job, planning agencies only provide the information that is requested, and they are not responsible for errors. The pilot-in-command (PIC) is ultimately responsible for the operation of the aircraft. Although an error may be caused by a planning agency, the PIC is still the responsible party. Some crews prefer to do their own planning, or do so for economic reasons. The following information is provided to assist in planning an oceanic operation.

a. ***Preflight Considerations.*** Pilots planning international flights should complete the following tasks:

(1) Research the IFIM.

(2) Arrange handling if the flight will be landing in several countries. This is extremely important if there are multiple passengers on the aircraft.

(3) Arrange hotel and ground transportation ahead of time. It is prudent to ensure that the correct grade of fuel is available at the planned arrival points.

(4) Prepare flight plan/logs and ICAO flight plans (see Appendix 1).

(5) Obtain and complete the required documents:

- general declarations.
- passenger/cargo manifests.
- passengers passports, visas (if required), and health cards.
- crew lists with certificate information, medical data and passport number. Ensure that the crew has all of the paperwork required of the passengers plus their pilot and medical certificates.

(6) Contact Customs as required.

(7) Complete the checklist and carefully review each of the items to ensure that all items are complete. A sample checklist is included at the end of this Chapter.

b. Itinerary Preparation. Preparing the itinerary is one of the most important aspects of an international flight. Experienced international pilots have often observed that the most difficult, but important, part of an international flight takes place before the aircraft departs. This paragraph presents some questions that a preflight planner must consider:

(1) What is the destination of the flight?

- Is an alternate destination available within range of the aircraft?
- Is lodging available at the destination?
- Is the appropriate grade of fuel available?
- Is a landing permit required at the destination?
- Is a visa required at the destination? Is cabotage allowed?
- Does a State Department warning exist for health, security, or other precautions?
- Are maintenance services available at the destination airport? Should spare parts be carried?

(2) En route airports - use the same guidelines as for the destination airport.

(3) Distance between stops - how was navigation distance determined?

- International Air Traffic Association (IATA) Distance Manual.
- globe.
- chart measurement.
- long-range navigation system.
- computer flight planning service.
- other.

(4) Equal time point (ETP) considerations:

- pressurization ETP where an altitude change is mandated.
- loss of engine ETP in a multiengined aircraft.
- combined problem (pressurization and loss of engine).

(5) Ground time at airports:

- passenger requirements.
- turnaround capacity.
- crew rest requirements, if applicable.
- next stop arrival time.

(6) Time considerations:

- local time.
- UTC (Zulu) or Greenwich time.
- local time at departure airport.

*c. **The International Notice to Airmen (IN).*** The IN is a biweekly compilation of significant international information and special notices which could affect a pilot's decision to enter or use certain areas of foreign or international airspace. Of crucial importance to those seeking to enter potentially dangerous areas of the world, this publication complements and expands upon data contained in the IFIM. The distribution of U.S. international NOTAM's to foreign international NOTAM offices (NOF) and the receipt and distribution of foreign international NOTAM's are accomplished by the U.S. International NOTAM Office (U.S. NOF), a part of the National Flight Data Center (NFDC) in Washington, DC.

NOF's exchange Class I NOTAM's with the other NOF's via the Aeronautical Fixed Telecommunication Network (AFTN). Class I NOTAM's are distributed via telecommunication; Class II NOTAM's are delivered via the U.S. Postal Service. NOTAM's from foreign NOF's are received via AFTN at the FAA National Communication Center in Kansas City, Missouri and relayed to the U.S. NOF in Washington, DC. The U.S. NOF receives all incoming Class I NOTAM's for processing and automatic distribution to U.S. aviation users.

The U.S. NOF reviews all Class I NOTAM's received to ensure their completeness, for conversion into English plain-text, and for distribution to aviation users in the conterminous United States, Alaska, Hawaii, and Puerto Rico. Upon distribution, all Class I NOTAM's are simultaneously entered into a computerized International NOTAM file at the National Communication Center in Kansas City according to both NOTAM number and location. Computer storage of Class I international NOTAM information allows the NOTAM's to be made available for instant recall by all FSS's and AFTN subscribers through the request-reply feature of the Service B and AFTN telecommunication networks.

Only current Class I NOTAM's are available by request-reply on Service B and AFTN. The Kansas City computerized NOTAM file may be queried for a list of all NOTAM's by geographic location or for a single NOTAM number (airspace NOTAM's are filed under the issuing NOF).

The United States does not exchange Class I international NOTAM's with all foreign international NOF's. A complete tabulation of international NOTAM exchanges among international NOF's and the areas of responsibility for each NOF is contained in Appendix 1 of this AC.

*d. **International Flight Plans.*** Flight plans are required for all flights into international and foreign airspace. The standard flight plan form is FAA Form 7233-4, "International Flight Plans," available at most U.S. Flight Service Stations. (A blank copy of this form is contained in Appendix 1). The FAA complies with the ICAO Format, except that it does not accept cruising speed/level in metric terms. (See Appendix 1 of this circular for conversion of U.S. measurements to metric measurements.) Flight plans must be transmitted to, and should be received by, air traffic control (ATC) authorities in each ATC region to be entered at least 2 hours prior to entry, unless otherwise required by an en route or destination country. When filing flight plans in countries outside the United States, it is extremely important that inquiries be made by the pilot as to the method used for subsequent transmission of flight plan information to en route and destination points and of the approximate total elapsed time applicable to such transmissions.

The flight plan provides advance notice of foreign airspace penetration and facilitates effective ATC procedures. For some countries, the flight plan is the only advance notice required; other countries use the flight plan as a check against previously granted permission to enter national airspace. Acceptance of a flight plan and issuance of a flight clearance by a foreign ATC unit does not constitute official approval for airspace penetration if prior permission for airspace penetration is required by civil aviation authorities and such permission has not been previously secured. Airspace violations that occur in such instances are pursued, and in-flight interception may result.

In the case of flights outside of U.S. airspace, it is particularly important for pilots to leave a complete itinerary and flight schedule with a responsible person. That person should be kept apprised of the flight's progress and instructed to contact an FSS or the nearest U.S. Foreign Service Post (embassy and consular office) if serious doubt arises as to the safety of the flight. Whenever an aircraft of U.S. registry or any aircraft with U.S. citizens aboard is reported to be in distress or missing during flight in or over foreign territory or foreign territorial waters, all available information should be passed to the nearest U.S. Foreign Service Post as well as the search and rescue (SAR) facilities and services in that area.

e. Operation Reservations for High Density Traffic Airports (HDTA). The Federal Aviation Administration (FAA), by FAR Part 93, Subpart K, as amended, has designated the John F. Kennedy, LaGuardia, Chicago O'Hare, Washington National and Newark Airports as high density airports and has prescribed air traffic rules and requirements for operating aircraft to and from these airports. (The quota for Newark Airport has been suspended indefinitely.) Reservations for Kennedy are required between 3 p.m. and 7:59 p.m. local time. Reservations at O'Hare are required between 6:45 a.m. and 9:15 p.m. local time. Reservations for LaGuardia and Washington National are required between 6 a.m. and 11:59 p.m. local time. Helicopter operations are excluded from the requirements for a reservation.

Operators planning on arriving or departing from any of the above airports during the reservation required time should reference Advisory Circular 90-43 and FAR Part 93, Subpart K, as amended. The filing of an instrument flight rules (IFR) or a visual flight rules (VFR) Flight Plan and/or an ATC clearance does not satisfy the reservation requirements. Reservations can be made, changed, canceled or confirmed on The Automated Voice Reservation System (AVARS). The AVARS is available 24 hours a day, can be called toll-free, and provides a reservation number that guarantees a slot. A touch-tone telephone is required to access the AVARS. A computer-synthesized voice will prompt all required inputs. To make a reservation though AVARS use one of the following numbers:

Within the continental U.S. dial 1-800-FAA-1212
Outside the continental U.S. dial (617) 576-9549

f. Civilian Use of U.S. Military Fields. U.S. Army, Air Force, Navy, Marine, and Coast Guard fields are open to civilian use in emergencies or with prior permission. The commanding officer authorizes civilian use of Army facilities. For use of Air Force installations, prior permission should be requested under the provisions of Air Force Regulation 55-20 at least 30 days prior to the first intended landing. This request should be made to U.S. Air Force (USAF) Headquarters, or may be made to the commander of the installation who has the authority to approve landing rights for certain categories of civil aircraft. For use of more than one Air Force installation, requests should be forwarded directly to: Headquarters USAF (PRPJA), Washington, DC 20330. Use of USAF installations must be specifically justified.

Prior permission for use of Navy or Marine Corps installations should be requested at least 30 days before the first intended landing. With minor exceptions, permission to use Navy and Marine Corps fields is granted only to aircraft on government business or when no suitable civil airport is available in the vicinity. An Aviation Facility License must be approved and executed by the Navy prior to any landing by civil aircraft. Requests must include an application for the Aviation Facility License (OPNAV Form 3770/1) in quadruplicate, and an official Certificate of Insurance (NAVFAC Form 7-11011/36) bearing the original signature of an official of the insurance company. Application forms may be obtained from any U.S. Navy or Marine Corps aviation facility. Applications should be forwarded to: Commander, Naval Facilities Engineering Command, Code 2041L, 200 Stovall Street, Room 10N45, Alexandria, VA 22332-2300. The telephone number is (703) 325-0475.

At Coast Guard fields, prior permission should be requested from the Commandant, U.S. Coast Guard, through the commanding officer of the field to be used. Use of Coast Guard fields is limited to persons on government business only when no suitable civil airport is in the vicinity. When instrument approaches are conducted by civil aircraft at military airports, the approaches shall be conducted in accordance with the procedures and minimums approved by the military agency having jurisdiction over the airport.

g. Cabotage. Private pilots and commercial operators should understand "cabotage," formally defined as "air transport of passengers and goods within the same national territory." The definition adopted by ICAO at the Chicago Convention is, "Each state shall have the right to refuse permission to the aircraft of other contracting states to take on its territory passengers, mail, and cargo destined for another point within its territory." Although cabotage rules are different in various countries and usually incorporate the term "for hire," some countries do not allow even nonrevenue passengers to be carried by a foreign aircraft within their boundaries. The restrictions range from no restrictions as in Italy, to not allowed, as in Pakistan. The fines for cabotage can be extremely high; therefore, pilots and flight departments should be absolutely sure of a country's cabotage rules before carrying passengers. The cabotage requirements and restrictions of individual countries are listed in the corporate aircraft restraints section for each country in the IFIM. Refer to Chapter II, Article 7 of the Chicago Convention.

h. Flight Planning Firms and Ground Handling Agents. The assistance of fixed base operators or airport service organizations may be nonexistent at overseas destinations outside of western Europe. Many countries do not have sufficient general aviation traffic to require these services or to generate any profitability. Therefore, the assistance of a ground handling agent may be essential, and most always expedites handling. A domestic or regional airline or U.S. flag (international) airline with operations at the specific foreign destination airport can frequently provide some of the necessary services, such as help with customs, immigration, public health procedures, and expediting shipment of spare parts. Aircraft maintenance may also be arranged through these agents. Flight planning firms may also be able to provide for these services. A wide range of services is offered by firms that specialize in obtaining overflight and landing permits, security information, computerized flight planning, charts, international NOTAM's, communication services, flight following, weather, ground handling of passengers, and ground handling of aircraft. It is important to remember that the responsibility for a flight rests with the pilot, not with ground handlers and/or flight planning firms.

i. Journey Logbooks. Article 34 of the Chicago Convention requires that each aircraft engaged in international aviation carry a journey logbook in which is entered particulars of the aircraft, the crew, reporting points, communications problems, and any unusual circumstances surrounding the flight (See paragraph 8 for a detailed explanation of journey logbook requirements).

j. Significant Sections of the Chicago Convention. Pilots planning international flights should know the regulations of their country, special regulations for international flight, and the Articles of the Chicago Convention. Particular attention should be given to Article 1, "Sovereignty"; Article 12, "Rules of the Air"; and Article 40, "Validity of Endorsed Certificates and Licenses." These three Articles are singled out because of their importance in regulating international flights, and should be thoroughly understood by all pilots that are flying internationally.

4. DOCUMENTATION.

a. Personal Documentation Requirements. When planning a trip to a foreign country, proper personal documentation for all participants, flightcrew and passengers alike, must be obtained. The flightcrew is required to carry at least a restricted radio telephone operator's license, even though the license is no longer required domestically. Requirements for individual countries may be found in the IFIM, the Travel Information Manual published by the International Air Transport Association (IATA), and other commercial publications. It is extremely important that flightcrews, if carrying passengers to foreign countries, make certain that passengers have all the required documents. Flights can be delayed and numerous other problems develop if all participants do not have the required documents. The responsibility for documentation varies with individual operations, but the PIC will bear the responsibility either directly or indirectly because of the effect on the flight operation. Territories subject to the jurisdiction of the United States, Canada, Bermuda and some Caribbean basin countries do not require passports. Mexico and some other countries may be visited for short periods of time using tourist cards (similar to a visa) issued by that country at the time of entry. Some ports of entry may require working visas for the flightcrew. Even when not required, it is always prudent to carry a current passport in a foreign country. Some countries require proof of nationality, and if the crew always carries their passports they will not be subjected to the difficulties of determining what form of identification is acceptable. In the case of children under the age of 18, consent of a parent, proof of citizenship, and positive identification are required. A passport or birth certificate is positive identification, but a driver's license is not acceptable.

b. Passports. A passport may be obtained by submitting an application in person to a passport agent, a clerk of any federal court, a clerk of any state court of record, a judge or clerk of any probate court, or a postal clerk designated by the Postmaster General. Under certain circumstances, a person holding an expired passport issued within the last 8 years can submit the expired passport and application by mail. Contact the nearest passport agent for more information. Telephone numbers are listed in the U.S. Government section of most telephone books.

The following documents are acceptable proof of U.S. citizenship:

(1) A passport previously issued to an applicant, or one in which he/she was included, is proof of U.S. citizenship in lieu of the documentary proof described in the following paragraphs.

(2) A person born in the United States may present his/her birth certificate. To be acceptable, the certificate must show the birth record was filed shortly after birth. The certificate must bear the registrar's signature and the raised, impressed, or multicolored seal of the registrar's office. Uncertified copies of birth certificates are not acceptable. If such primary evidence is not obtainable, a notice from the registrar stating that no birth record exists may be used. The notice shall be accompanied by the best obtainable secondary evidence such as a baptismal certificate, a certificate of circumcision, a hospital birth record, affidavits of persons having personal knowledge of the facts of the birth, or other documentary evidence such as early census, school, or family bible records, newspaper files and insurance papers. Secondary evidence should be documented as close as possible to the date of birth. All documents used as evidence of U.S. citizenship by birth must include the place and date of the applicant's birth and bear the seal of the office, if customary, and signature of the person before whom such documents were executed or by whom they were issued.

(3) A person who claims U.S. citizenship by naturalization may use their Certificate of Naturalization.

(4) If U.S. citizenship was acquired through naturalization of a parent or parents, or by birth abroad to a U.S. citizen, the Certificate of Citizenship issued by the Immigration and Naturalization Service may be used. If such a certificate is not available, citizenship may be supported by a parent's Certificate of Naturalization, the applicant's foreign birth certificate, and evidence of admission to the United States for permanent residence. If citizenship was acquired through the naturalization of a sole parent, the other having been an alien, the applicant may present the divorce decree showing the naturalized parent has custody, or the death certificate of the alien parent, when appropriate.

(5) A Consular Report of Birth (Form FS-240) or Certificate of Birth (Form DS-1350 or Form FS-545) issued by the Department of State may be used if citizenship was acquired through birth abroad to a U.S. citizen. If neither of these are available, the foreign birth certificate, evidence of the U.S. citizenship of the parent, and an affidavit from the parent showing the periods and places of residence in the United States and abroad (specifying precise periods abroad in U.S. Armed Forces, in other U.S. Government employ-

ment with qualifying international organizations, or as a dependent of such persons) before certificate of birth of the applicant may be used.

*c. **Lost or Damaged Passports.*** The holder of a passport has a serious responsibility to guard that passport from loss or damage. Altered or damaged passports shall not be used for travel. Such passports shall be surrendered to a passport agent, clerk of the court, or other U.S. Government official. Any new passport issued to replace a lost valid passport will be limited to 3 months. The address and notification data appearing on the inside front cover of the passport may be changed by the passport bearer. The passport need not be submitted to a government official for such changes. All other entries or changes, however, must be made by an authorized official. The loss of a valid passport is a serious matter, and should be reported in writing immediately to: Passport Office, Department of State, Washington, DC 20524, or to the nearest U.S. consular office when abroad.

*d. **Visas.*** Visas are endorsements of a passport issued by an embassy or consulate of a country to be visited. These grant permission for the individual named on the passport to enter and exit that country. Some countries issue visas that grant multiple entries, while others authorize only a single entry. Various types of visas are issued, depending upon the nature of the visit and the intended length of stay. A valid passport must be submitted when applying for a visa of any type. A visa may be obtained from foreign embassies or consulates located in the United States. Visas are not always obtainable at the foreign airport of entry, and verification of visa issuance must be made in advance of departure. A visa service can help travelers obtain this document. The names of such organizations are listed in the telephone classified directory. The photographs accompanying visa applications should be full view and should not be larger than 3 x 3 inches nor smaller than 2.3 x 2.5 inches on white background.

*e. **Aircraft Document Requirements.*** The FAR require the airworthiness certificate, the aircraft registration certificate (a temporary registration certificate or "pink slip" is not acceptable for international travel), a Federal Communication Commission (FCC) license (commonly referred to as "radio station license") and the operator's manual with weight and balance information to be carried on board the aircraft during international flights. The radio station license has additional significance abroad, and its necessity should not be taken lightly. The airframe logbooks, the engine logbooks, and the insurance certificates will also be needed. In the case of Mexico, the insurance certificates will need to be purchased from a Mexican firm. In operations of corporate aircraft, the company's aviation underwriter should be contacted for additional details. Some countries will require a LOA on the operating country's letterhead before the aircraft can be operated in those countries. In operations of private aircraft, if the owner is the pilot or is on board the aircraft, there are usually no difficulties. However, if the aircraft owner is not on board the aircraft, many countries require a letter from the owner that authorizes international flight in that specific country before they will allow operations within their country. Operations in North Atlantic (NAT) airspace require an Minimum Navigation Performance Specifications (MNPS) airspace LOA or operation specifications approval. Details of NAT operations are covered in Chapter 4 of this AC.

Export licenses from the U.S. Department of Commerce are necessary for certain navigation systems and/or aircraft if the operations will include certain bloc countries. When aircraft have been manufactured abroad and are U.S.-registered, a copy of the import duty receipt should be retained in the aircraft's file. This receipt, which proves that the aircraft was legally imported into the United States, may be required for return to the United States. Aircraft entry requirements are delineated in the IFIM and numerous commercial publications. As previously stated, the flightcrew must also ensure that current and special notices relating to entry and overflight requirements are followed. In most cases outside North America and western Europe, prior permission to land in or overfly a country must be obtained directly from that country's civil aviation authority.

The American Embassy in a destination country may be of assistance in some instances and a required point of contact in others. Entry to most countries must be made through specific airports of entry that are agreed to by ICAO members and listed in the ICAO Regional Air Navigation Plan, the country's AIP, the IFIM, and other commercial publications. Depending upon the country, it may take 4 hours to 6 weeks to obtain overflight and landing permits. The requirements vary from country to country. Some countries will not allow overflights without a landing, usually to collect airspace user fees. Therefore, action to obtain landing and overflight permits must be one of the first steps in planning any flight outside of the United States. The following list of documents should be included as aircraft documentation. These documents should be on board any aircraft flying internationally. Items marked with a double asterisk (**) are specified in the Articles of the Chicago Convention. A checklist that includes required documents is included at the end of this Chapter.

(1) Airworthiness certificate. **

(2) Aircraft registration (no pink slips are allowed on international fights). **

(3) Radio station license. **

(4) Minimum equipment list (MEL) if operator plans on operating under this option.

(5) Aircraft flight manual with weight and balance information.

(6) MNPS LOA if planning on operating in MNPS airspace.

(7) Metric conversion tables (see Appendix 1) with preconverted aircraft size and weights.

(8) Copies of aircraft and engine logbooks.

(9) Certificates of insurance (original signature required), U.S. military and foreign as required (some foreign countries such as Mexico require that insurance be purchased from the country in which the travel is to take place).

(10) Export licenses for aircraft navigation equipment (U.S. requirement). Check with the U.S. Department of Commerce.

(11) Import papers for aircraft of foreign manufacture.

(12) Copies of overflight and landing permissions.

(13) Authorization letters from the operating company or the aircraft owner (original signature required).

(14) Journey logbook. **

(15) A passenger manifest containing complete names of passengers and places of embarkation and destinations of each. **

(16) If cargo is carried, a manifest and detailed declaration of the cargo. **

5. EQUIPMENT.

a. ICAO Requirements. Annex 6 (Part 1 - International Commercial Air Transport - Aeroplanes and Part 2 - International General Aviation - Aeroplanes) to the Convention on International Civil Aviation details ICAO rules with respect to required equipment. A listing of these requirements is included herein for immediate reference. This equipment is an ICAO requirement, and does not supersede the equipment requirements of the state of registry.

(1) Accessible and adequate medical supplies appropriate to the aircraft's passenger carrying capacity.

(2) Portable fire extinguisher of a type that, when discharged, will not cause dangerous contamination of the air within the airplane. At least one extinguisher shall be located in the pilot's compartment and in each passenger compartment that is not readily accessible to the flightcrew.

(3) A seat or berth for each person over the age specified by the state of the operator.

(4) A seatbelt for each seat and restraining belts for each berth.

(5) A seatbelt and a safety harness for each flightcrew seat. The safety harness shall incorporate a device that will automatically restrain the occupant's torso in the event of rapid deceleration.

(6) A means of ensuring that the following information and instructions are conveyed to passengers:

- when seatbelts are to be fastened;
- when and how oxygen equipment is to be used if the carriage of oxygen is required;
- restrictions on smoking;
- location and use of lifejackets or equivalent individual flotation devices when their carriage is required; and
- location and method of opening emergency exists.

(7) An operations manual or those parts of the manual that pertain to flight operations.

(8) The airplane flight manual or other document(s) containing performance data required for the application of operating limitations, and any other information necessary for the operation of the airplane within the terms of its certificate of airworthiness.

(9) Current and suitable charts to cover the route of the proposed flight and any route along which it is reasonable to expect that the flight may be diverted.

(10) Flight recorders (data recorder and cockpit voice recorder) as specified below.

b. Oceanic Use of Traffic Alert and Collision Avoidance Systems (TCAS). Under the FAR, TCAS is required equipment for various domestic commercial operations. There is no requirement for the use of TCAS in oceanic airspace, although it is prudent for operators who have TCAS installed to take advantage of that equipment during oceanic operations. Although TCAS indications cannot be verified in nonradar environments, it does perform an alerting function that provides the crew with an exceptional aid to the "see and avoid" concept. Therefore, it is advisable that crews use TCAS equipment during oceanic operations whenever possible even though the equipment is not required by regulation.

c. Flight Recorders. A Type I flight data recorder records the parameters required to accurately determine the flight path, speed, altitude, engine power, configuration and operation. Types II and IIA flight data recorders record the parameters required to determine the airplane flight path, speed, altitude, engine power, and configuration of lift and drag devices. All flight data recorders shall be capable of retaining the information recorded during at least the last 25 hours of their operation, except for Type IIA flight data recorders which shall be capable of retaining the information recorded during at least the last 30 minutes of operation.

d. Flight Recorder Requirements. The following requirements apply to airplanes for which the individual certificate of airworthiness was first issued on or after January 1, 1989.

- All airplanes with a maximum certificated takeoff mass of over 27,000 kilograms (kg) (59,525 pounds) shall be equipped with a Type I flight data recorder.
- All airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds), up to and including 27,000 kg (59,525 pounds), shall be equipped with a Type II flight data recorder.

The following requirements apply to airplanes for which the individual certificate of airworthiness was first issued on or after January 1, 1987, but before January 1, 1989:

• All turbine engine airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds) shall be equipped with a flight data recorder that records time, altitude, airspeed, normal acceleration, and heading.

• All turbine engine airplanes with a maximum certificated takeoff mass of over 27,000 kg (59,525 pounds) for which the prototype was certificated by the appropriate national authority after September 30, 1969, shall be equipped with a Type II flight data recorder.

The following requirement applies to airplanes for which the individual certificate of airworthiness was first issued before January 1, 1987:

• All turbine engine airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds) shall be equipped with a flight data recorder that records time, altitude, airspeed, normal acceleration, and heading.

e. Cockpit Voice Recorders. The following requirement applies to airplanes for which the individual certificate of airworthiness was first issued on or after January 1, 1987:

• All turbine engine airplanes with a maximum certificated takeoff mass of over 5,700 kg (12,566 pounds) shall be equipped with a cockpit voice recorder, the objective of which is the recording of the aural environment on the flightdeck during flight time.

The following requirement applies to airplanes for which the individual certificate of airworthiness was first issued before January 1, 1987:

• All turbine engine airplanes with a maximum certificated takeoff mass of over 27,000 kg (59,525 pounds) for which the prototype was certificated by the appropriate national authority after September 30, 1969, shall be equipped with a cockpit voice recorder to record the aural environment on the flightdeck during flight time. A cockpit voice recorder shall be capable of retaining the information recorded during at least the last 30 minutes of operation.

f. Equipment Required for All Airplanes on Overwater Flights.

(1) Seaplanes, including amphibians operated as seaplanes:

• One lifejacket, or equivalent individual flotation device, for each person on board, stowed in a position easily accessible from the seat or berth.

• Equipment for making the sound signals prescribed in the International Regulations for Preventing Collisions at Sea, where applicable.

• One sea anchor (drogue).

(2) Landplanes:

• Criterion 1 - One power unit inoperative - If the critical power unit becomes inoperative during flight, the airplane must be able to continue the flight to an airport where the airplane can clear all obstacles in the approach path by a safe margin and land with the assurance that it can come to a safe stop.

• Criterion 2 - Two power units inoperative - In the case of airplanes having three or more power units, on any part of a route where the location of en route airports and the total duration of the flight are such that the probability of a second power unit becoming inoperative must be allowed for if the general level of safety implied by ICAO standards is to be maintained, the airplane shall be able, in the event of any two power units becoming inoperative, to continue the flight to an en route alternate airport and land.

- When flying over water and at a distance of more than 50 nautical miles (NM) (93 km) from shore, the aircraft shall carry one lifejacket or equivalent flotation device for each person on board, stowed in a position easily accessible from the seat or berth of the person for whose use it is provided.

- The following equipment must be carried on aircraft operated according to Criterion 1 or Criterion 2, above, when flying a route over water and at a distance of more time than 120 minutes at cruising speed or 400 NM (740 km), whichever is less, from a suitable emergency landing site. This equipment must also be carried on an aircraft flying over water at a distance of 30 minutes or 100 NM (185 km) from a suitable emergency landing site.

- Liferafts in sufficient numbers to carry all persons on board, stowed for their ready use in an emergency, and provided with lifesaving equipment and pyrotechnic signalling devices appropriate to the flight.

- At least two sets of survival radio equipment, stowed for ready use in an emergency, that operate on very high frequency (VHF) and in accordance with the provisions of ICAO communications procedures. The equipment shall be portable, water resistant, self-buoyant, and have an independent power supply. The equipment must be capable of being operated away from the airplane by unskilled persons.

In addition to the specific equipment for overwater operations, Annex 8 to the Convention on International Civil Aviation details ICAO rules with respect to the airworthiness of aircraft. Chapter 8 of Annex 8 details ICAO rules relative to "Instruments and Equipment."

Commercial operators should note that FAR 121.343, 121.353, and 121.359 may or may not be more stringent than the ICAO regulations. In either case, the more stringent regulations apply to U.S.-registered aircraft. Operators of large and turbine-powered, multiengine aircraft must note that FAR 91.509 and 91.511 may also be more or less stringent than ICAO requirements, but the more restrictive regulations apply to U.S.-registered aircraft.

g. Weight and Balance Control for FAR Part 121 and 135 Operations. AC 120-27, "Aircraft Weight and Balance Control," includes a method and procedures for developing a weight and balance control system. It provides guidance to certificate holders who are required to have an approved weight and balance program by FAR Part 121 or who elect to have an approved program under FAR Part 135. The significance of this AC to international operators is that emergency equipment for international operations is included in the empty weight of the aircraft.

h. Navigation Equipment. FAR 91.1(b) states in part that each person operating an aircraft in the airspace overlying the waters between 3 and 12 NM from the U.S. coast shall comply with FAR 91.703. FAR 91.703 requires that civil aircraft comply with ICAO Annex 2 when operating over the high seas (beyond 3 NM under FAR 91.1(b)). Annex 2 requires that "Aircraft shall be equipped with suitable instruments and with navigation equipment appropriate to the route being flown." In addition, ICAO Annex 6, Part II stipulates that an airplane operated in international airspace be provided with navigation equipment which will enable it to proceed in accordance with the flight plan and with the requirements of the air traffic services (ATS). ICAO Annex 6, Part I contains standards and recommended practices adopted as the minimum standards for all airplanes engaged in air carrier operations. Part II contains the standards and practices for general aviation international air navigation. These Parts require that those airplanes operated under IFR at night, or on a VFR controlled flight (such as in control area (CTA)/FIR oceanic airspace) have installed and approved radio communication equipment capable of conducting two-way communications at any time during the flight with such aeronautical stations and on such frequencies as may be prescribed by the appropriate authority for the airspace where the flight is conducted. Additional ICAO regulations for aircraft radio equipment can be found in Article 30 of the Chicago Convention.

i. Specific Equipment Requirements. Specific operations such as flight regulated by FAR Parts 121, 125, and 135 require that aircraft have the equipment required by these Parts in addition to any ICAO requirements. A long-range navigation device is a navigation device approved for use in Class II airspace. (Refer to Chapter 8, of this AC for information on long-range navigation.) Pertinent regulations should be reviewed before beginning any international operation.

j. Legal Interpretation of the Statement, "Appropriate to the Facility to be Used." Concerns and questions have arisen related to interpretation of the statement "appropriate to the facility to be used." Effective October 31, 1990, AGC-200, the legal branch of the FAA, rendered "Legal Interpretation # 90-31." Although the interpretation is written with regard to a FAR Part 135 operation, it is important for all operators to be aware of the interpretation. The interpretation is reproduced in part as follows:

> "Regarding the language of "appropriate to the facility to be used," by an interpretation dated July 16, 1969, concerning Section 135.159(a)(5), which is the predecessor to Section 135.165 (a)(5), the Federal Aviation Administration (FAA) determined that the intent of that section is to require Part 135 operators conducting flights under instrument flight rules (IFR) or extended overwater flight operations to provide a complete secondary (backup) navigation system. The interpretation further stated that the test of compliance requires a check of the available ground facilities en route and at the airport of intended use. The interpretation gave the example that if the aircraft can be safely navigated over the same route independently using a VOR and independently using an ADF, the navigation equipment would be considered appropriate to the facilities being used, but if at any place along the route either navigation receiver is incapable of receiving at least one ground facility, the intent of that section would not be met."

k. Survival Equipment. Although the frequency of water landings requiring aircraft occupants to depend on overwater equipment for survival is rare, the possibility does exist. Information concerning overwater survival equipment is included in this AC. Additional information is contained in Technical Standards Orders (TSO) C13, C69, C70, C85, and C91. Recommended equipment should meet the applicable TSO. The equipment includes the following items:

(1) Life preserver for each occupant

(2) Rafts or slide/rafts with appropriate buoyancy and sufficient capacity for all aircraft occupants. The rafts should be equipped with the following items:

(a) Lines, including an inflation/mooring line with a snaphook, rescue or lifeline, and a heaving or trailing line.

(b) Sea anchors.

(c) Raft repair equipment such as repair clamps, rubber plugs, and leak stoppers.

(d) Inflation devices including hand pumps and cylinders (carbon dioxide bottles).

(e) Safety/inflation relief valves.

(f) Canopy and equipment for erecting the canopy.

(g) Position lights.

(h) Hook-type knife, sheathed and secured by retaining line.

(i) Placards that give the location of raft equipment and that are consistent with placard requirements.

(j) Propelling devices such as oars or glove paddles.

(k) Water catchment devices including bailing buckets, reincatchment equipment, cups, and sponges.

(l) Signalling devices (refer to Section 10 of this Chapter), including the following:

- at least one approved pyrotechnic signalling device.
- one signalling mirror.
- one spotlight or flashlight, spare bulb, and at least two "D" cell batteries or equivalent.
- one police whistle.
- one dye marker.
- radio beacon with water-activated battery.
- radio reflector.

(m) One magnetic compass.

(n) A 2-day supply of rations supplying at least 1,000 calories a day for each person.

(o) One desalination kit for every two persons the raft is rated to carry, or two pints of water for each person the raft is rated to carry.

(p) One fishing kit.

(q) One book on survival appropriate for any area.

(r) A survival kit, appropriately equipped. Some items that could be included in the kit are as follows:

- triangular cloths.
- bandages.
- eye ointments.
- water disinfection tablets.
- sun protection balsam.
- heat retention foils.
- burning glass.
- seasickness tablets.
- ammonia inhalants.
- packets with plaster.

6. AIR TRAFFIC CONTROL.

This section contains information on flight operations in oceanic airspace and rescinds AC 90-76B, "Flight Operation in Oceanic Airspace." Detailed ICAO procedures for specific geographical areas may be found in the ICAO "Regional Supplementary Procedures," Document 7030-4 through Amendment 178 dated March 6, 1992, and in the following chapters in this AC. Navigation performance is monitored by the United States for all aircraft entering and/or departing international airspace under U.S. jurisdiction. All deviations of 20 NM or more are reported and investigated.

a. ***Oceanic Position Reporting.*** The United States provides ATS in oceanic airspace as follows:

(1) Atlantic Ocean: New York, Miami and San Juan FIR's.

(2) Gulf of Mexico: Miami and Houston FIR's.

(3) Pacific Ocean: Oakland and Anchorage FIR's.

FAR 91.1 states, in part, that "each person operating a aircraft in the airspace overlying the waters between 3 and 12 miles from the coast of the United States shall comply with FAR 91.703," which states, in part, that "Each person operating a civil aircraft of U.S. registry outside the United States shall - When over the high seas, comply with Annex 2 (Rules of the Air) to the Convention on International Civil Aviation and with FAR 91.117(c), 91.130, and 91.131."

FAR 91.705 states, in part, that "No person may operate a civil aircraft of U.S. registry in NAT airspace designated as MNPS airspace unless - The aircraft has approved navigation performance capabilities which complies with the requirements of Appendix C to this part." FAR 99.3 states, in part, that "the Air Defense Identification Zone (ADIZ) is an area of airspace over land or water in which the ready identification, location, and control of all civil aircraft is required in the interest of national security." FAR 99.11 states, in part, "unless otherwise authorized by ATC, no person may operate an aircraft into, within, or across an ADIZ unless that person has filed a flight plan with an appropriate aeronautical facility."

b. Flight Planning. A flight plan is required for all flights that cross international borders. Operations in oceanic airspace on a VFR flight plan are permitted only between sunrise and sunset and only in the following airspace:

(1) Miami, Houston, and San Juan oceanic control areas (OCA), at or below flight level (FL) 180;

(2) the New York OCA, at or below FL 050, except in the airspace east of 60 degrees west at or below FL 190; and

(3) the Oakland and Anchorage OCA's, at or below FL 050.

Operations in offshore airspace (the airspace between the U.S. 12-mile limit and the OCA/FIR boundary) on a VFR flight plan are permitted only between sunrise and sunset and only at or below FL 200. Even though flights may be legally conducted using VFR, experience indicates that instrument meteorological conditions (IMC) will be encountered at some point in a transoceanic flight. Consequently, it is recommended that the pilot be instrument rated, that the aircraft meet the equipment requirements for IFR flight, and that an IFR flight plan be filed.

c. Navigation/Communication Equipment. In most cases, aircraft operating over the high seas will not have adequate VHF radio and/or ICAO standard navigation aid (navaid) (VOR, VOR/DME, and NDB) coverage. High frequency (HF) communication capabilities, provided by Aeronautical Radio, Inc. (ARINC), are available throughout most of U.S.-controlled oceanic airspace. Notwithstanding the fact that pilots must comply with all FAR applicable to their flight, all aircraft operating over the high seas must be equipped with suitable instruments and navigation equipment appropriate to the route to be flown (FAR 91.703, ICAO Annex 2, 5.1.1, and Section 7 of this Chapter). Reference should also be made to the legal interpretation in Section 5 of this Chapter. The aircraft must also be equipped with a functioning two-way radio to maintain a continuous listening watch on the appropriate radio frequency of, and establish two-way radio communication with, the appropriate ATC unit (ICAO Annex 2 Ø 3.6.5.1). It should be noted that it is not acceptable to depend on radio relay operations to satisfy this requirement.

d. Position Reporting. Position reports shall be made to the ATS unit serving the airspace where the aircraft is operated. In addition, when so prescribed by the appropriate AIP or requested by ATC, the last position report before passing from one FIR or CTA to an adjacent FIR or CTA shall be made to the ATS about to be entered. If a position report is not received at the expected time, subsequent control shall not be based on the assumption that the estimated time is accurate. Immediate action shall be taken to obtain the report if it is likely to have any bearing on the control of other aircraft. Position reports shall be made when over, or as soon as passing, each designated compulsory reporting point. Additional reports over other points may be requested by the appropriate ATS unit when required for ATS purposes. On routes not defined by designated significant points, reports shall be made as soon as possible after the first half hour of flight and at hourly intervals thereafter. Additional reports at shorter intervals of time may be requested by the appropriate ATC unit when required for ATS purposes. In cases where adequate flight progress data is available from other sources such as ground radar, and in other situations where the omission of routine reports from selected flights is found to be acceptable, flights may be exempted from the requirement to make position reports at each designated compulsory reporting point or interval. However, account should be taken of the requirement for making, recording, and reporting of routine aircraft observations (see "Reporting of Operational and Meteorological Information" below).

Oceanic position procedures call for aircraft reporting of all designated reporting points when following a designated oceanic route. Otherwise, positions shall be reported at designated lines of latitude and longitude. Flights whose tracks are predominantly east and west shall report over each 5 or 10 degrees meridian of longitude. Flights whose tracks are predominantly north and south shall report over each 5 or 10 degree parallels of latitude. Reports over each 10 degrees parallel/meridian are to be made if the speed of the aircraft is such that 10 degrees will be traversed within 1 hour 20 minutes or less, and over each 5 degrees if the aircraft is slower. Position reports should be transmitted at the time of crossing the designated reporting point or designated reporting line, or as soon thereafter as possible. Flights operating within international airspace should make position reports, either directly or for relay (NOTE: Relay should not be done over the emergency frequency 121.5 except in an actual emergency when no other means of reporting is possible), in the following format:

Aircraft Position - For flights reporting coordinates rather than specified named reporting points, east-west oriented flights report latitude in degrees and minutes, longitude in degrees only. North-south oriented flights should report latitude in degrees only and longitude in degrees and minutes.

Time Over Position in Four Digits

Flight Level (FL) - Pilots should note that a FL request on a filed flight plan does not constitute authority to change FL en route without a specific clearance, even though the ATC clearance originally issued may specify "Cleared as filed" or "cleared via flight-planned route." These terms refer to routing requested and not to altitude requests contained in the flight plan.

Next Fix and Estimate over Next Fix in Four Digits

Name of Subsequent Fix

e. ATC Service. ATC separation is provided to all flights in oceanic controlled airspace by Air Route Control Centers (ARTCC) and San Juan Combined Center Approach Control (CERAP). These facilities issue clearances and instructions providing separation vertically and horizontally (laterally and longitudinally). The horizontal distances between aircraft being separated generally exceed those applied over land. The following separation variations are unique to oceanic ATC:

(1) Composite separation is a combination of vertical and lateral separation. Composite separation is currently used on the North Pacific (NOPAC) routes between Alaska and Japan and the Central East Pacific (CEP) routes between the U.S. west coast and Hawaii.

(2) MNPS airspace is specially designated airspace in the NAT. All aircraft must have FAA approval (see Chapter 3 of this AC) for flights within MNPS airspace. Within the designated area, lateral and longitudinal separation is significantly reduced.

(3) Controllers may apply reduced longitudinal minimums in oceanic airspace between turbojet aircraft cleared to maintain a specific mach speed. For example, in some cases initial longitudinal minimums

applied between aircraft may be reduced from 20 minutes to 5 minutes depending on the speed of the aircraft when mach technique is used.

(4) ICAO Documents 7030, "Regional Supplementary Procedures" and 8168, "Aircraft Operations Volume I," state that transponders shall be operated as follows:

(a) when the aircraft carries serviceable Mode C equipment, the pilot shall continuously operate in this mode, unless otherwise directed by ATC;

(b) in NAT airspace, unless otherwise directed by ATC, pilots shall retain the previously assigned transponder code for a period of 30 minutes after entry into the airspace, then operate on code 2000;

(c) in oceanic airspace other than the NAT, pilots shall operate the transponder and select modes and codes as directed by the ATC unit with which the pilot is in contact; or

(d) in the absence of any ATC directions, pilots shall operate the transponder on Mode A Code 2000.

f. ***Warning Areas.*** Warning areas are established in international airspace to contain operations hazardous to nonparticipating aircraft. Some of the these areas may be jointly used by the FAA and the military. The FAA will issue IFR clearances through these areas whenever hazardous operations are not taking place. Charts should be carefully reviewed for those area while flight planning, taking note of the area operating times and restrictions.

g. ***Altimeter Settings.*** Operations in international airspace demand that pilots are aware of, and understand the use of, the three types of altimeter settings.

(1) **QFE** (airport altitude) is an altimeter setting used in some nations that causes the altimeter to read zero feet when on the ground.

(2) **QNE** (en route) is the altimeter setting used at or above the transition altitude (FL 180 in the United States). The altimeter setting is always 29.92 for a QNE altitude. CAUTION - transition levels differ from country to country, and pilots should be particularly alert when making a climb or descent in a foreign area.

(3) **QNH** is the altimeter setting with which most general aviation pilots are familiar when operating in the United States. This setting causes the altimeter to read field elevation when on the ground and is determined by setting the altimeter to the local altimeter setting.

NOTE: Most overseas airports give altimeter settings in hectopascals (hPa)(millibars); therefore, it is imperative that pilots are able to convert inches of mercury to hectopascals or hectopascals to inches of mercury. A conversion chart is provided in Appendix 1 of this AC for convenience in performing this task.

For flights in the vicinity of airports, the vertical position of aircraft shall be expressed in terms of QNH at or below the transition altitude and in terms of QNE at or above the transition level. While passing through the transition layer, vertical position shall be expressed in terms of FL's when ascending and in terms of altitudes when descending. After approach clearance has been issued and the descent to land has commenced, the vertical position of an aircraft above the transition level may be expressed by reference to QNH, provided that level flight above the transition altitude is not indicated or anticipated. When an aircraft that has been given a clearance as number one to land is completing its approach using QFE, the vertical position of the aircraft shall be expressed in terms of height above the airport elevation during that portion of its flight for which QFE may be used, except it shall be expressed in terms of height above runway threshold elevation under the following conditions:

• for instrument runways, if the threshold is 2 meters (approximately 7 feet) or more below the airport elevation.

• for precision approach runways.

For flights en route, if a transition altitude has not been established for that area through a regional air navigation agreement, the vertical position of aircraft shall be expressed in the following terms:

• FL's at or above the lowest useable FL.

• altitudes below the lowest usable FL.

h. Reporting of Operational and Meteorological Information. When operational and/or routine meteorological information is to be reported by an aircraft en route at points or times when position reports are required, the position report shall be given in the form of an air report (AIREP). Special aircraft observations shall be reported as special AIREP's as soon after the observations have been made as is practical. The format of messages and the terminology or data conventions shall be used by the flightcrew when transmitting AIREP's.

i. National Security. National security in the control of air traffic is governed by FAR Part 99. All aircraft entering domestic U.S. airspace must provide for identification prior to entry. To facilitate early identification of all aircraft in the vicinity of U.S./international airspace, ADIZ have been established. Operational requirements for aircraft entering or flying within an ADIZ are as follows:

(1) Flight plan - Except as specified below, an IFR or defense VFR (DVFR) flight plan must be on file with the appropriate aeronautical facility for all operations that enter an ADIZ, and for operations that will enter or exit the United States and that will operate into, within, or across the contiguous U.S. ADIZ regardless of true airspeed (TAS). The flight plan must be filed before departure except for operations associated with the Alaskan ADIZ when the departure airport has no facility for filing a flight plan. In this case, the flight plan may be filed immediately after takeoff or when within range of the aeronautical facility.

(2) An operating two-way radio is required for the majority of operations associated with an ADIZ. Consult FAR 99.1 for exceptions.

(3) Unless otherwise authorized by ATC, each aircraft flying into, within, or across the contiguous United States must be equipped with an operable radar beacon transponder having altitude reporting capability (Mode C). The transponder must be turned on and set to reply on the appropriate code or as assigned by ATC.

(4) Position reporting.

• For IFR flight - normal IFR position reporting.

• For DVFR flight - the estimated time of ADIZ penetration must be filed with the aeronautical facility at least 15 minutes prior to penetration. For flight in the Alaskan ADIZ, report prior to penetration.

• Foreign registry aircraft - for inbound flight by aircraft of foreign registry, the pilot must report to the aeronautical facility at least 1 hour prior to ADIZ penetration.

j. Aircraft Position Tolerances. Over land, the aircraft position tolerance is within plus or minus 5 minutes from the estimated time over a reporting point or penetration point, and within 10 NM from the centerline of an intended track over an estimated reporting/penetration point. Over water, the tolerance is plus or minus 5 minutes from the estimated time over a reporting/penetration point and within 20 NM from the centerline of the intended track over an estimated reporting/penetration point, including the Aleutian Islands.

Except when applicable under FAR 99.7, FAR Part 99 does not apply to the following aircraft operations:

- within the 48 contiguous states, the District of Columbia, Alaska, and within 10 miles from the point of departure.

- over any island, or within 3 NM of the coastline of any island, in the Hawaii ADIZ.

- associated with any ADIZ other than the contiguous U.S. ADIZ, when the aircraft has a TAS of less than 180 knots.

Authorization to deviate from the requirements of FAR Part 99 may be granted by an ARTCC, on a local basis, for some operations associated with an ADIZ. An air filed VFR flight plan makes an aircraft subject to interception for positive identification when entering an ADIZ. Pilots are urged to file the required DVFR flight plan in person or by telephone prior to departure.

k. Special Security Instructions. During air defense emergency conditions, additional special security instructions may be issued in accordance with the Security Control of Air Traffic and Air Navigation Aids (SCATANA) Plan. Under the provisions of the SCATANA Plan, the military directs the actions of aircraft in regard to landing, grounding, diversion or dispersal, and control of air navaids in the defense of the United States. Upon implementation of all or a portion of SCATANA, ATC facilities will broadcast instructions from the military over available ATC frequencies. Depending upon these instructions, VFR flights may be directed to land at the nearest available airport and IFR flights may be expected to proceed as directed by ATC. Pilots on the ground may be required to file a flight plan and obtain an approval through the FAA prior to conducting a flight operation. In view of the preceding, pilots should guard an ATC or FSS frequency at all times during flight operations.

l. International Interception Procedures. There are occasions when interceptor pilots are required to transmit instructions to pilots of intercepted aircraft. When radio communications are not available, visual signals (listed below) are used. Interceptor pilots will approach the aircraft from astern, employing the interception pattern for identification of transport aircraft. A distance of at least 500 feet shall be maintained between the aircraft. Intercepted aircraft, regardless of ATC clearance, shall follow the instructions of the intercepting aircraft and shall attempt to notify the appropriate ATC. Additionally, the intercepted aircraft shall attempt radio contact with the interceptor aircraft on 121.5 MHz, giving aircraft identify, flight purpose, and position.

m. Intercept Pattern for Identification of Transport Aircraft.

(1) Phase 1. The Intercepting aircraft approaches the target aircraft from astern. The element leader reduces the throttle and extends dive breaks. The wingman continues to the opposite side of the target aircraft from the leader and climbs to 4,000 above the target's altitude to maintain surveillance. If weather does not permit this altitude for surveillance, the wingman assumes a position on either side of the target that will permit observation of the leader and target aircraft at a distance of 3,000 feet from the target aircraft. The wingman retains position during surveillance by S-turns rather than reducing speed with dive breaks. The leader should be 1,000 feet abreast of the target aircraft at the aircraft's altitude. After speed and position are stabilized, proceed with Phase 2.

(2) Phase 2. The wingman continues surveillance. The leader begins closing on target until no closer than absolutely necessary to identify. The wingman copies identification for mission report. The leader uses every precaution to avoid startling target crew and passengers, keeping in mind that fighter aircraft maneuvers may startle nonfighter crew/passengers. Upon target identification, the leader and the wingman withdraw from target vicinity as described in Phase 3.

(3) Phase 3. The leader breaks away from the target in a shallow dive to increase speed. The wingman stays well clear of the target and joins the leader.

INTERNATIONAL INTERCEPTION SIGNALS

INTERCEPTING SIGNAL	MEANING	INTERCEPTED AIRCRAFT RESPONSE	MEANING
Day: Rocking wings from a position in front and normally to the left of the intercepted aircraft. After response, slow level turn, normally to the left, onto course.* *Night:* Same as above with flashing navigational/landing lights	You have been intercepted	*Day, fixed wing:* Rock wings, follow *Rotorcraft:* Rocking tip path plane, follow *Night, fixed wing:* Same as day plus flashing lights *Rotorcraft: Same as day plus flashing landing/search lights*	Understood, will comply
Day or night: Abrupt break away; climbing turn 90 degrees or more without crossing flight path	You may proceed	*Day, fixed wing:* Rock wings *Rotorcraft:* Rocking tip path plane *Night, fixed wing:* Rock wings *Rotorcraft: Flash landing or search lights*	Understood, will comply
Day: Circling airport, lowering landing gear, overflying runway in landing direction *Night:* Same as above with steady landing lights	Land at the airport	*Day, fixed wing:* Lower landing gear, follow, land *Rotorcraft:* Rock tip path plane, follow, land *Night, fixed wing:* Same as day plus steady landing lights *Rotorcraft:* Same as day plus flash landing lights	Understood, will comply
Day: Raising landing gear while overflying runway at 1,000-2,000 ft altitude; circling airport *Night:* Same as day with flashing lights	Designated airport inadequate	*Day or night:* If intercepted aircraft is to follow, intercepting aircraft raises landing gear and gives interception signals. If intercepted aircraft may land, intercepting aircraft signals "You may proceed."	Understood, will comply You may proceed

* Meteorological conditions or terrain may require the intercepting aircraft to take a position in front and to the right of the target aircraft, and to make the turn to the right.

7. OCEANIC COMMUNICATIONS.

*a. **Guard Station.*** The oceanic radio station guarding for flight operations is normally the station associated with the ATC center responsible for the FIR (e.g., Honolulu ARINC for the Anchorage FIR and Tokyo Radio for the Tokyo FIR). At the FIR boundary the responsibility for the guard changes, under normal signal conditions, to the station associated with each new FIR. The flight must ensure that it has established communications with the new guard facility. Normally, each oceanic radio station continuously listens on all assigned frequencies. If en route HF communications fail, every effort should be made by the flightcrew to relay progress reports through other aircraft. The VHF frequency 128.95 MHz is used exclusively as an air-to-air communications channel in Pacific operations, and 131.8 MHz is used for Atlantic operations. In emergencies, however, initial contact for such relays may be established on 121.5 MHz and transferred as necessary to 128.95 MHz or 131.8 MHz. In normal HF propagation conditions, appropriate overdue action procedures are taken by ATC in the absence of position reports or relays. In all cases of communication failure, the pilot should follow the oceanic clearance last received and not revert to the original flight plan (see Section 10 of this Chapter for emergency operations).

b. Use of VHF and HF for Communications. Due to the inherent line-of-sight limitations of VHF radio equipment when used for communications in international oceanic airspace, those aircraft operating on an IFR or controlled VFR flight plan beyond the communications capability of VHF are required, as per ICAO Annex 2, to maintain a continuous listening watch and communication capability on the assigned HF frequencies. Although these frequencies are designated by ATC, actual communications will be with general purpose communication facilities such as international FSS's or ARINC. These facilities are responsible for the relay of position reports and other pertinent information between the aircraft and ATC. When using these frequencies in fringe cover areas, however, care should be taken to maintain a selective calling (selcal) watch (see below) on HF, thus ensuring that if VHF contact is lost, the radio station is still able to contact the aircraft.

c. Guard of VHF Emergency Frequency. Pilots should remember that there is a need to continuously guard the VHF emergency frequency 121.5 MHz when on long overwater flights, except when communications on other VHF channels, equipment limitations, or cockpit duties prevent simultaneous guarding of two channels. Guarding of 121.5 MHz is particularly critical when operating in proximity of FIR boundaries. Pilots should not use the emergency frequency 121.5 to relay position reports and/or other information unless an actual emergency exists.

d. U.S. Aeronautical Telecommunications Services. The aeronautical voice communications stations listed on the following page are available to, and used, by the FAA ARTCC for ATC purposes. The frequencies in use depend upon the time of day or night and conditions that affect radio wave propagation. Voice communications are handled on a single channel simplex basis (aircraft and ground station use the same frequency for transmission and reception) unless otherwise noted. The stations remain on continuous watch for aircraft within their communication areas, and when practical, will transfer this watch when the aircraft reaches the limit of the communications area. The stations that are designated "FAA" are operated by the U.S. Federal Aviation Administration. Those stations designated "ARINC" are operated by Aeronautical Radio, Incorporated, 2551 Riva Road, Annapolis, MD 21401, U.S.A.; telephone number (301) 266-4000; cable address ARINC Annapolis, Maryland.

The following chart shows examples of frequency pairings in oceanic areas. Operators should be cautioned that these frequencies change, and should be verified before using.

TELECOMMUNICATIONS SERVICES

STATION/ OPERATING AGENCY	RADIO CALL	TRANSMITTING FREQUENCY	REMARKS
Honolulu / ARINC	Honolulu	2998 4666 6532 8903 11384 13300 17904	Central West Pacific
		3467 5643 8867 13261 17904	South Pacific
		3413 5574 8843 13354 17904	Central East Pacific Family 1
		5547 11282 13288 17904	Central East Pacific Family 2
		2932 5628 6655 8951 10048 11330 13273 17904	North Pacific
		131.95	Extended range VHF. Covered area includes tracks to mainland extending out from HNL to approx. 400 NM. Range on other tracks approx. 300 NM
Honolulu / FAA	Honolulu Radio	122.6 122.2 #121.5	#Emergency. Frequency 122.1 also available for receiving only
	Volmet	2863 6679 8828 13282	Broadcasts at H+00-05 and H+30-35; airport forecasts, Honolulu, Hilo, Agana, Honolulu SIGMET. Hourly report Honolulu, Hilo, Kahului, Agana, Honolulu
			Broadcasts at H+05-10 and H+30-40; hourly reports, San Francisco
Miami / FAA	Miami Radio	126.7 118.9 126.9 122.2 123.65 122.75	Local and short range
		#121.5	#Emergency
New York / FAA	New York Radio	6604 10051	Broadcasts at H+05->10: airport forecasts Detroit, Chicago, Cleveland. Hourly reports Detroit, Chicago, Cleveland, Niagara Falls, Milwaukee, Indianapolis. Broadcasts at H+05->+10 SIGMET (Oceanic-New York) airport forecasts
		*13270, *3485	* Volmet broadcasts
New York / ARINC	New York	3016 5598 8825 13306 17946	North Atlantic Family A
		2899 5616 8864 13291 17946	North Atlantic Family B
		2887 5550 6577 8846 8918 11396 13297 17907	Caribbean Family A
		129.90	Extended range
Oakland / FAA	Oakland Radio	122.5 122.2 #121.5	# Emergency
San Juan PR / FAA	San Juan Radio	122.2 126.7 123.65 255.4 114.0 113.5 108.2 108.6 109.0 110.6	Unscheduled broadcasts H+00, H+15, H+30 and H+45 for weather and military activity advisories on 110.6, 109.0, 108.6, 108.2, 113.5, 114.0. For frequencies 114.0, 113.5, 108.2, 109.0 use 122.1 to transmit to San Juan Radio. For frequency 108.6 use 123.6
		#121.5, #243.0	# Emergency
San Francisco / ARINC	San Francisco	3413 5547 8843 10057 13288 17904	Central East Pacific One
		2869 5547 6673 11282 13288 17904	Central East Pacific Two
		131.95	Extended range
		129.40	For en route communication for aircraft on Seattle/Anchorage routes

e. ***Selcal Facilities.*** Selcal equipment should be seriously considered for use in both domestic and long-range communications. It enables a ground station to contact an aircraft through a combination of audio tones and illuminated lights on the instrument panel of that aircraft, and frees the crew from continually monitoring a given HF or VHF frequency. There is one problem with selcal, however; single side band (SSB) signals are incompatible with selcal signals. Many HF SSB transceivers are designed to detect selcal transmitted in the full carrier mode even though the aircraft transceiver mode selector is in the SSB position. Transceivers not designed and built with this feature must have the selector switch in the full carrier mode to detect a selcal signal. In addition, the ground station must know the aircraft's selcal code assignment in advance.

f. ***Selcal Procedures.*** During the time that they depend on HF communications, pilots should maintain a listening watch on the assigned frequency. This is not necessary, however, if selcal is installed and used correctly. Details of correct use are as follows.

- The provisions of the selcal code are included in the ICAO flight plan
- The selcal code must be corrected if subsequently altered due to a change of aircraft or equipment
- Operation of selcal equipment must be checked with the appropriate radio station prior to selcal watch and at, or prior to, entry into oceanic airspace.
- Maintenance of a constant selcal watch.

LOCATION	OPERATOR	HF	VHF
Honolulu	ARINC	X	X
New York	ARINC	X	X
San Francisco	ARINC	X	X

g. ***Standard Air-Ground Message Types and Formats.***

(1) REQUEST CLEARANCE.

(a) To be used in conjunction with a routine position report or to request a change in mach number, FL, or route. The content and data sequence follow:

"Request Clearance"

- Flight identification.
- Present or last reported position.
- Time over last reported position (hrs. and mins.).
- Present FL.
- Next position on assigned route or obstacle clearance altitude (OCA) entry point.
- Estimated time for next position or OCA entry point.
- Next subsequent position.
- Requested mach number, FL, or route.
- Further information or clarifying remarks.

(b) To be used to request a change in mach number when a position report message is not appropriate. The content and data sequence follow:

"Request Clearance"

- Flight identification.
- Requested mach number, FL, or route.
- Further information or clarifying remarks.

(2) REVISED ESTIMATE.

(a) To be used to upgrade time estimate for next position. The content and data sequence follow:

- Flight identification.
- Next position on route.
- Revised estimate for next position (hrs. and mins.).
- Further information.

(3) ***MISCELLANEOUS MESSAGE.***

(a) To be used to convey information or make a request in plain language that does not conform with the content of other message format. No message designator is required as this will be inserted by the ground station. The content and data sequence follow:

- Flight identification.
- General information or request in plain language and format free.

h. ***Methods of Obtaining Oceanic Clearances.***

- Use of VHF clearance delivery frequencies when in coverage.
- Use of HF to the OCA through the appropriate radio station (if possible at least 30 minutes before boundary/entry estimate).
- Request via domestic or other ATC agencies.

i. ***Summary of Communication and Reporting Procedures.*** Continuous contact with the controlling agency must be maintained. This can be through VHF, HF, or selcal. The range of VHF is approximately 200 NM; HF is required beyond that distance. A family of frequencies, if more than one family is monitored, is normally assigned based on route and/or the state where the aircraft is registered. These families of frequencies are listed on en route charts.

j. ***Transponder.***

(1) NAT - maintain last assigned squawk for 30 minutes, then squawk 2000 until advised of a discreet frequency.

(2) Pacific - Between 150 and 170 East, squawk 2000.

(3) In Bermuda TCA squawk 2100.

k. ***Emergency Frequencies.***

(1) VHF: 121.5

(2) FM: 156.8

(3) UHF: 243.0

(4) HF: 2182/4125

8. NAVIGATION PROCEDURES.

a. ***Journey Logbooks.*** Navigational procedures must include the establishment of some form of a master working document for use on the flight deck. This document may be based upon the flight plan, navigation log, or other suitable document that sequentially lists the waypoints that define the routes, distances between the waypoints, and any other navigation information pertinent to the cleared route. This document is known as the journey logbook. Misuse of the journey logbook can result in serious navigational errors.

For this reason, strict procedures should be in place for use of the document. These procedures should include the following:

• Only one copy of the journey logbook should be used in the cockpit. If more than one copy is provided, one copy may be altered to reflect reclearance and other amendments to the flight plan. The unaltered copy may be used to extract navigational information that results in an unintentional deviation.

• A waypoint numbering sequence should be established from the outset of the flight. This sequence should be entered on the journey logbook and should also be used to store waypoints in the navigational computer.

• Appropriate symbology should be adopted to indicate the status of each waypoint listed on the journey logbook. For example:

(a) the waypoint number is entered against the relevant waypoint coordinates to indicate that the waypoint has been entered in the navigation computer;

(b) the number is circled to signify that entry of the coordinates in the navigation computer has been doublechecked by another crewmember;

(c) the circled number is ticked to signify that the distance information has been doublechecked; and

(d) the circled number is crossed out to signify that the aircraft has passed the waypoint.

All navigational information contained in the journey logbook must be verified against the best available primary data source. If an ATS route change is received or the ATC clearance is otherwise changed, the journey logbook must be updated to reflect the change. Old waypoints should be clearly crossed out and the new information inserted. While ATC clearances are being obtained, headsets should be worn because loudspeaker distortion has been known to result in errors. Two qualified crewmembers should monitor such clearances: one should record the information, and the other should check the receipt and read back the information. All waypoint coordinates should be read back in detail unless approved local procedures make this unnecessary. In that case, each detail must be cross-checked with the journey logbook.

*b. **Position Plotting.*** It is helpful for crews to use a plotting chart to provide themselves with a visual presentation of the intended route. Plotting the route may reveal errors or discrepancies in the navigational coordinates that can be corrected before they can cause a deviation from the ATC cleared route. As the flight progresses, plotting the position after passing each waypoint helps confirm that the flight is on course. If the position is laterally offset, the flight may be deviating unintentionally and should be investigated at once.

*c. **Relief Crewmembers.*** Flightcrews conducting very long-range operations may include a relief pilot. In such cases, it is necessary to ensure that the continuity of the operation is not interrupted, especially in regard to the handling and treatment of navigational information.

*d. **System Alignment.*** INS alignment must be completed and the equipment switched to "nav" mode prior to releasing the parking brake at the ramp. There are various ways of ensuring that there is adequate time for this operation, including the following methods:

• Have the first crewmember on the flight deck place the system in align mode as early as possible.

• At short transit stops, leave the equipment in "nav" mode provided that the system errors are not so large as to require INS realignment. The decision to realign may depend on the size of the error as well as the length and nature of the next leg.

• INS batteries usually have a limited life, and cannot be recharged onboard if allowed to run down. If the INS is left in "nav" mode during a transit stop, or if the INS has been switched on for alignment, it is imperative that an individual be responsible for monitoring ground power interruption. Some INS systems provide overheat protection in "stby" and "align," but not in other modes. During stops at tropical terminals, the mode selector should be put directly to "align" (not through "stby," which would cause realignment).

In the absence of abnormally high radio noise levels, Omega synchronization usually takes only a minute or so after being switched on. However, at certain ramp or gate positions, particularly those where metal structures interfere with Omega signals, synchronization may take longer or the inserted ramp coordinates may drift after insertion. Interference from ground vehicles may have a similar effect. Synchronization or dead reckoning (DR) warning lights usually indicate this situation. If the Omega equipment is serviceable, the problem usually disappears shortly after the equipment is switched to aircraft power or the aircraft is moved, but it is good practice to check the position ("pos") coordinates immediately before takeoff and make any necessary corrections.

*e. **Initial Insertion of Latitude and Longitude.*** Early in the course of the preflight check, the aircraft's position should be loaded into the INS and verified. This position must be checked against an authoritative reference source before insertion. Any latitude error in the initial position will introduce a systematic error that cannot be removed during flight by updating the resulting erroneous "pos" indications. Correct insertion of "pos" must be checked before the "align" mode is selected and the "pos" recorded in the journey logbook. Subsequently, silent checks of "pos" should be made independently by both pilots during an early stage of the preflight check. In the case of some INS, insertion errors exceeding one degree of latitude will activate a malfunction light. However, very few systems provide similar protection against erroneous longitudinal insertion errors. Care should be taken at all times to ensure that previously inserted coordinates are correct.

*f. **Loading of Initial Waypoints.*** The entry of waypoint data into the navigation system must be a coordinated operation by two people working in sequence and independently. One should key in the data, and the other person should recall and confirm the data against source information. It is not sufficient for one crewmember to simply observe another crewmember entering the data. Waypoint #1 should be used for the ramp position of the aircraft. At least two additional waypoints should be loaded while the aircraft is on the ramp; all waypoints may be loaded at this time. However, it is more important to ensure that the second waypoint is inserted accurately than to attempt to load all waypoint data. The second waypoint should be associated with the first significant position along the route (approximately 100 NM from departure point). Positions associated with ATC standard instrument departures (SID) should not normally be used for this purpose. During flight, at least two current waypoints beyond the sector being navigated should be maintained in the control display unit (CDU) until the destination ramp coordinates are loaded. The pilots should be responsible for loading, recalling, and checking the accuracy of the loaded waypoints. Each pilot should cross-check the other's work. In no case should this process engage the attention of both pilots simultaneously during flight. An acceptable procedure is for the pilots to independently load their own waypoints and then cross-check the waypoints. The pilot responsible for verification should work from the CDU display to the journey logbook, lessening the risk of seeing what is expected rather than the actual information. After the initial waypoints have been loaded, the route between waypoints 1 and 2 and the auto track change should be selected.

*g. **Flight Plan Check.*** The purpose of the flight plan check is to ensure complete compatibility between the journey logbook and the programming of the navigation system.

(1) "Dis/time" should be selected to verify the correct distance from the ramp position to waypoint 2. An appropriate allowance may have to be considered since the great circle distance shown on the CDU's may be less than the flight plan as a consequence of the additional mileage involved in ATC SID's. However, a significant disparity requires a recheck of "pos" and waypoint 2 coordinates.

(2) Select "remote" and track change 1-2. Check the accuracy of the indicated distance against that listed in the journey logbook.

(3) Select "dsrtk" and check that the desired track indicated on the CDU is the same as that in the journey logbook. This track check will reveal any errors in the latitude and longitude designators.

(4) Similar track and distance checks should be performed for subsequent pairs of waypoints and any discrepancies between the CDU information and the journey logbook. These checks can be coordinated between the pilots against the journey logbook.

(5) After checking each leg of the flight as described above, a note should be made on the journey logbook using the appropriate symbols.

h. Leaving the Ramp. If the aircraft is moved before the "nav" mode is initiated, the INS must be realigned. The aircraft should be relocated so that it does not block the gate or otherwise interfere with traffic while the realignment takes place. After leaving the ramp, INS groundspeeds should be checked. A check of the malfunction codes should be made while the aircraft is stopped but after it has taxied at least part of the way to the takeoff position. Any significant groundspeed indication while stationary may indicate a faulty unit. This check does not normally apply in the case of Omega, because such equipment is usually inhibited from providing speed indicators until the aircraft is airborne. Omega position indicators should be checked before takeoff if there is a possibility of error induced by signal interference.

i. In-Flight. If the initial part of the flight is conducted along airways, the airways facilities should be used as the primary navigational aids and the aircraft navigation system should be monitored to ascertain which system is giving the most accurate performance.

j. Approaching the Ocean. Before entering oceanic airspace, the aircraft's position should be checked as accurately as possible by using external navigation aids (navaids) to ascertain the aircraft navigation system to be used. This may require distance measuring equipment (DME)/DME and/or DME/VHF omnidirectional radio range (VOR) checks to determine navigation system errors through displayed and actual positions. In the event of significant discrepancies (greater than 6 NM), updating the navigation system should be considered. Updating is normally not recommended when the discrepancy is less than 6 NM. The duration of the flight before the oceanic boundary and the accuracy of the external navigation system are factors that influence any decision to update the system. If the system is updated, the proper procedures should be followed with the aid of a prepared checklist. The navigation system that performs the most accurately should be selected for autocoupling. In view of the importance of following the correct track in oceanic airspace, some operators advise that the third pilot or equivalent crewmember should check the inserted waypoints using appropriate source information.

k. Oceanic Boundary Position Report. Just prior to the oceanic boundary and prior to any waypoint, the present position coordinates should be monitored, recorded, and verified. The coordinates for the next waypoint should be monitored and verified. When the CDU alert light comes on, the crew should note and record the present position on the journey logbook. This information should be verified against the current clearance on the journey logbook. The waypoint number on the journey logbook should be annotated with the appropriate symbol to indicate that it has been verified. If the oceanic boundary position report is made over a VOR facility, the appropriate radial to the first oceanic waypoint should be selected as a further check that the navigation system is tracking according to the current clearance. If DME is available, a distance check can also be performed.

l. At an Oceanic Waypoint. Coordinates of the next two waypoints should be verified against the master document. When sending the ATC position report, the coordinates should be copied from the journey logbook or the present position and the next two forward positions can be read from the CDU. As soon as the waypoint alert light goes on, the present position coordinates of each navigation system should be checked against the current clearance to ensure that the position report coincides with the actual position of the aircraft and the ATC clearance. Over the waypoint, the pilots should verify that the aircraft is headed in the right direction and takes up the heading appropriate to the leg to the next waypoint. The coordinates of the next waypoint should be verified against the journey logbook. After the ATC position report is sent, the present position should be plotted to ensure that the tracking is correct. The crew should be particularly alert in maintaining selcal watch in the event of possible ATC follow-up to the position watch.

m. Routine Monitoring. There are a number of ways in which the autopilot may accidentally become disconnected from the command mode. Regular checks of correct engagement should be made. Although it is a common practice to display "dis/time," it is recommended that the navigation system coupled to the autopilot should display the present position coordinates throughout the flight. If the coordinates are plotted at roughly 20 minute intervals, they will confirm that the flight is on track according to the ATC clearance. Distance-to-go information should be available on the instrument panel, and the waypoint alert light provides a reminder of the proximity of the waypoint. If a position check and verification are being made at each waypoint and 10 minutes after each waypoint, additional plotting every 20 minutes may be counterproductive during routine flight. The navigation equipment not being used to steer the aircraft should display cross-track error (XTK) and track angle error (TKE). These indicators should be monitored, with XTK being displayed on the horizontal situation indicator (HSI) when feasible.

n. Use of Radar. Aircraft equipped with airborne weather radar capable of ground mapping should use the radar to observe any land masses as an aid to determining the accuracy of their navigation. Aircraft conducting NOPAC operations under U.S. civil certification are required to be equipped with functioning weather radar approved for day and night operation. The flightcrews must use the radar on a constant basis during flight to monitor navigation system accuracy.

o. Approaching Landfall. When the aircraft is approaching the first landfall navaid, it should acquire the appropriate inbound radial as soon as the flightcrew is confident that the navaid's information is accurate. The aircraft should be flown to track by means of radio navigation and fly over the facility, which becomes the primary navigational guidance after leaving the oceanic area.

p. Navigation System Accuracy Check. At the end of each flight, the accuracy of the navigational system should be determined to facilitate correction of performance. A check to determine the radial error at the ramp position may be performed as soon as the aircraft is parked. Radial errors in excess of 2 NM per hour are generally considered excessive. Records should be kept of navigation systems performance.

q. Monitoring During Distractions. Training and drills ensure that minor emergencies or interruptions of normal routine do not distract the crew to the extent that the navigation system is mishandled. If the autopilot is disconnected during flight, it must be reengaged carefully to ensure that the correct procedure is followed.

r. Avoiding Confusion Between Magnetic and True. To cover all navigation requirements, some air carriers produce flight plans that include both magnetic and true tracks. If crews are changing to a new system, there is a risk of confusion in selecting the correct values. Operators should devise drills to reduce this risk and ensure that the subject is covered during training. Crews that check or update their long-range navigation systems (LRNS) by reference to VOR located in the Canadian Northern Control Area should remember that they are not aligned with reference to magnetic north.

s. Navigation in Areas of Magnetic Unreliability. In areas of compass unreliability, basic INS operations require no special procedures. However, many operators retain an independent heading reference in case of INS failure. There are a number of ways to accomplish this. For example, Omega requires heading input from an external source. Different manufactures offer their own solutions to special problems in magnetic unreliability. Such solutions should not involve the use of charts or manual measurement of direction.

t. Deliberate Deviations. Temporary deviations from track are sometimes necessary, but prior ATC clearance should be obtained. Such deviations can cause gross navigation errors (GNE) if the autopilot is not re-engaged. Selection of the autopilot turbulence mode can disengage the autopilot from the navigation system. After using turbulence mode, the aircraft must be flown back to the desired track before the autopilot is reengaged. The following steps are useful in preventing GNE's as a result of deviations around severe weather:

(1) The autopilot turn control knob is used to turn the aircraft in the desired direction

(2) The autopilot engage switch will automatically move from "command" to "manual." The altitude mode switch will either remain in "altitude hold," or if in the "altitude select" mode, will trip to "off."

(3) The steering CDU selector is set to XTK/TKE to provide a continuous display of cross-track data.

(4) If turbulence is encountered, the "turb" setting on the speed mode selector may be used. In this case, the altitude mode switch automatically positions to "off."

(5) Both radio INS switches remain in the INS position. This provides a visual display of the navigation situation on the HSI. Even if more than 8 NM off the track, the pegged needle on the HSI is a reminder of that fact and confirms whether the aircraft is tracking towards, away from, or parallel to the desired track.

(6) The turn control knob should be used to maneuver the aircraft as necessary.

(7) When clear of the severe weather, the aircraft should be steered back to the desired track, guided by the steering CDU to zero the XTK indication.

(8) When the aircraft returns to the desired track, the autopilot engage switch is set to "command" and the altitude mode switch to "altitude hold." The navigation mode selector should still be in the INS position.

(9) The captain and first officer, or the entire crew if possible, should monitor the diversion maneuver to ensure that the aircraft has returned to the desired track and the autopilot is properly reengaged for command INS operation.

(10) After return to route has been completed, check the assigned mach number and advise ATC.

u. ATC Reclearance. Experience suggests that when ATC issues a clearance involving rerouting and new waypoints, the risk of errors increases. The procedures used to copy the ATC clearance, load and check the waypoints, verify the flight plan information, and prepare a new plotting chart should be the same as the procedures for beginning a flight. One pilot should be designated to fly the aircraft while the other pilot reprograms the navigation systems and amends the cockpit documents. In the event that a reclearance involves a direct routing, data relevant to the original route should be retained in case the aircraft is required by ATC to return to its original course.

v. Detecting Failures. INS, GPS, and Omega installations normally include comparator and/or warning devices, but the crew must still make frequent comparison checks. With three systems on board, identification of a defective system should be straightforward. During the acceleration phase of flight, Omega groundspeed indicators are likely to be less accurate than INS and should not be used in comparison checks. With only two systems on board, identifying system failures is more difficult before significant deviations occur. If a significant deviation occurs in oceanic airspace, nearby aircraft can be contacted on 128.9 MHz and information can be obtained to aid in identifying a system failure. A record of Omega and INS performance should be maintained and kept available for crews. The following are suggestions for recordkeeping:

(1) Before takeoff and while stationary, note the INS groundspeed and "pos" indicators. These may give an indication of system accuracy.

(2) The accuracy of each unit should be noted before reaching oceanic airspace, preferably while passing a convenient short-range facility. A further record should be made at the destination regarding terminal error after first canceling any in-flight updates that were made.

(3) Compass deviation checks (INS only) can be made to determine deviation values for the magnetic compass systems so that the accuracy of INS heading outputs can be checked in-flight.

w. ***Identifying Faulty Systems.***

(1) Check malfunction codes for indications of unservicability.

(2) Refer to records for indications of prior problems.

(3) Obtain a fix, possibly using the weather radar, to determine position and compare to information from the systems.

(4) Communicate with nearby aircraft on air-to-air VHF to compare information on spot wind, groundspeed, and drift. If no aircraft can be contacted, compare information from the prognostic chart to the system readout. This method should be a last resort, and preferably should be used with another method of verification.

(5) Use the heading method (INS only). Simultaneously read both INS and magnetic compass indicators. Obtain the mean to the nearest degree to get an acceptably accurate true heading value to compare to the INS readings and determine what reading is inaccurate.

x. ***When Faulty Systems Cannot be Identified.*** Situations may arise when distance or cross-track differences develop between two LRNS's, but the crew cannot identify the faulty system. If three systems are on board, the two agreeing systems can be accepted as reliable signals. If, however, only two systems are on board and they disagree, most operators believe that the best procedure in this instance is to fly the aircraft halfway between the cross-track differences as long as uncertainty exists. ATC must be informed that the flight is experiencing navigation difficulties so that appropriate clearances may be obtained.

y. ***What Constitutes a Failed System.*** Crews must be able to determine when an INS or Omega system should be considered to have failed. INS failure may be indicated by the red warning light or self-diagnostic indications, or by an error over a known position exceeding the value agreed upon by the operator and the certifying authority. Generally, if there is a difference of greater than 15 NM between the two aircraft's navigation systems, it is advisable to split the difference to determine the aircraft's position. If the disparity exceeds 25 NM, one or more of the systems should be regarded as having failed and ATC should be notified. In the case of Omega, estimates of position error are easier to determine because it is likely the system using the greater number of ground stations will be the most reliable. Omega failure may be indicated by a red warning light or by built-in test equipment (BITE) indications.

z. ***Loss of Navigation Capability.*** There are two navigational requirements for NOPAC operations. One refers to the navigation performance that should be achieved; the second to the need to carry standby equipment with comparable performance characteristics. Some aircraft carry triplex equipment so that if one system fails the requirements are still met. The following guidance is for aircraft with two systems.

(1) If one system fails before takeoff, the pilot should consider delaying departure if repair is possible, or obtaining a clearance for below FL 280, if practical.

(2) If a system fails before an oceanic boundary is reached, the pilot should consider landing at a suitable airport before the boundary, returning to the departure airport, or obtaining a reclearance below FL 280.

(3) If a system fails while the aircraft is in oceanic airspace, the pilot should continue the flight according to the ATC clearance already obtained while keeping in mind that the reliability of the navigational information is significantly reduced. The pilot should assess the reliability of the remaining system and contact

ATC with a proposed course of action. ATC clearance must be obtained before any deviation to the existing clearance is made.

(4) While continuing flight in oceanic airspace with a failed system, the pilot should monitor the following:

- the operation of the remaining system;
- check the main and standby compass reading against available information; and
- check the performance record for the remaining system. If there is doubt about the reliability of the remaining system, the pilot should attempt visual sighting of other aircraft contrails for a track indication, call the appropriate ATC facility to get information on the location of adjacent aircraft, and establish air-to-air communication with nearby aircraft on 128.95 MHz.

(5) If the remaining system fails or indicates degradation of performance, the pilot should notify ATC, obtain all possible information from other aircraft, keep visual watch for other aircraft, use all possible outside lights, and use any necessary contingency procedures.

9. OPERATIONS.

a. Overview. Oceanic operating procedures differ depending upon the size of the aircraft, type and number of powerplants, range with or without long-range tanks installed, operation type (general or commercial), navigation equipment installed, state (country) of departure, body of water to be transversed, and the qualifications of the flightcrew. The following chapters discuss operational factors required for the Atlantic, Pacific, Gulf of Mexico, and the Caribbean. Various types of navigation equipment are also discussed. It is the pilot's responsibility to read the sections that pertain to the flight in addition to the general discussion in this Chapter. The most stringent conditions exist in the Northern Atlantic due to the high density of traffic between North America and Europe. The most hazardous area for light aircraft is the long route between the U.S. west coast and the Hawaiian Islands.

b. U.S.-Registered Aircraft. FAA inspectors will ensure that contingency procedures specific to the authorized area of operation are detailed in U.S.-registered air carrier operator's training and check airman programs and manuals. In the case of non air carrier operators, these same procedures must be demonstrated to inspectors prior to obtaining an LOA for operations in special airspace. It should be emphasized that the improper application of contingency procedures can result in collision with other aircraft. Further inherent in contingency procedures is the requirement to contact ATC whenever the aircraft is unable to continue flight according to its current ATC clearance. This includes situations when the aircraft is off course and/or unable to maintain its assigned altitude. A failure to comply with this requirement prevents ATC from taking measures to provide separation between adjacent aircraft and the aircraft that has deviated from its clearance. Failure to contact ATC is also contrary to ICAO Annex 2 and FAR 91.703, the latter of which requires compliance with Annex 2 by all aircraft of U.S. registry. Contingency procedures for NAT MNPS airspace can be found in Chapter 3 of this AC. For aircraft operating in the NOPAC composite route system, contingency procedures can be found in Chapter 4 of this AC. Navigation specialists are available within the FAA to aid district offices in their initial and ongoing evaluation of operator's navigation programs. If there are questions concerning any aspect of navigation programs, contact: Federal Aviation Administration, Flight Standards National Field Office, AFS-500, P.O. Box 20034, Washington, DC 20041, (703) 661-0333.

10. EXTENDED-RANGE OPERATIONS WITH TWO-ENGINE AIRPLANES (ETOPS).

Operators desiring to obtain approval under FAR 121.161 for two-engine airplanes to operate over a route that contains a point farther than 1 hour flying time at the normal one-engine inoperative cruise speed (in still air) from an adequate airport should refer to AC 120-42, "Extended Range Operation with Two-Engine Airplanes (ETOPS)." This AC defines the tasks that must be accomplished by an operator in preparation for the monitoring process that will be undertaken by the FAA principal maintenance inspector (PMI). This monitoring process is necessary to obtain an ETOPS authorization which requires an approval from the Director, Flight Standards Service, for a deviation to the operating rule of FAR 121.61. To meet the requirements of this deviation, the operator must be able to substantiate that the type design reliability and the performance of the proposed airplane/engine combination have been evaluated per the guidance in AC 120-42A and have been found suitable for extended range operations, and submit an application package that includes supplemental maintenance requirements and programs that allow for safe operations under an ETOPS authorization.

11. EMERGENCY PROCEDURES.

*a. **Introduction.*** When conducting flights, especially extended flights, outside the United States and its territories, full consideration should be given to the quality and availability of air navigation services in the airspace to be used. As much information as possible should be obtained concerning the location and range of navaids and availability of SAR services. SAR international standards and recommended practices are contained in Annex 12 to the Convention. Each ICAO region has published air navigation plans that include the facilities, services, and procedures required for international air navigation within that particular region.

*b. **Pilot Procedures.*** Any pilot who experiences an emergency (alert, distress, uncertainty) during flight should take three steps to obtain assistance.

(1) If equipped with radar beacon transponder and unable to establish voice communication with ATC, switch to Mode A/3 and Code 7700. If crash is imminent and the aircraft is equipped with an emergency locator transmitter (ELT), activate the emergency signal if possible.

(2) Transmit as much of the following message as possible on the appropriate air-ground frequency, preferably in the order shown below:

(a) "Mayday, mayday, mayday" for distress, "pan, pan, pan" for other types of emergency;

(b) WHO - name of station addressed, circumstances permitting;

(c) WHAT - nature of the distress or emergency condition, intentions of the person in command; and

(d) WHERE - present position, FL, altitude, and any other useful information.

The most important parts of the message are who, what, and where. If no response is received on the air-ground frequency, repeat the message on the aeronautical stations on 121.5 MHz. Other useful frequencies for attracting the attention of a maritime station are distress frequencies 2182 or 4125 KHz. An aircraft in distress may use any available means, including any frequency, to attract attention and make known the situation.

(3) Comply with the information and clearances received. Accept the communications control offered by the ground radio station, silence any interfering radio stations, and do not shift frequency or shift to a ground station unless absolutely necessary or instructed to do so.

*c. **Two-way Radio Failure.*** Pilots of flights that experience two-way radio failure are expected to follow the applicable procedures. If the pilot is lost, or is otherwise unable to follow procedures, the pilot may attempt to alert civilian or military radar systems in the area of operation. The pilot should remember that there are two ways to declare an emergency: squawk emergency on the transponder - 7700; or send an emergency message - 121.5 MHz. Ground stations have various electronic means of assisting in these situations, including receipt of emergency procedures, direction finding (DF) bearings, and detection of transponder emergency squawk.

*d. **The Four C's.*** When confronted with an emergency, pilots should remember the four C's:

(1) Confess the situation to any ground station. Don't wait too long.

(2) Communicate with the ground link and convey as much of the distress message as possible on the first transmission.

(3) Climb if possible for better radar and DF detection. If flying at a low altitude, chances of radio contact are improved by climbing. Chances of alerting radar systems may be improved by climbing or descending. Note that unauthorized climb or descent under IFR conditions within controlled airspace is prohibited except in an emergency. Any variation in altitude is unknown to ATC unless the facility has radar with height-finding capability.

(4) Comply with advice, information, and clearances received. Assist the ground control station in controlling communications on the distress frequency in use. Instruct interfering stations to maintain radio silence until needed.

For ditching or crash landing, if there is no additional risk of fire and circumstances permit, the radio should be set for continuous transmission. If a pilot is apprehensive or doubtful about a situation, assistance should be requested. SAR facilities are ready and willing to help. There is no penalty for their use. Safety is not a luxury; the pilot must take action.

e. Search and Rescue. SAR is a life-saving service provided by many governments that are assisted by aviation and other organizations. This service provides search, survival aid, and rescue of personnel of missing or crashed aircraft. Before departure, a responsible individual at the departure point should be advised of the flight plan and itinerary. Search efforts are often wasted, and rescue is delayed, because a pilot departed without informing anyone of the flight plan. To protect all personnel on the aircraft, these steps should be followed:

(1) File a flight plan with the appropriate authority in person, by telephone, or by radio.

(2) Close the flight plan with the appropriate authority immediately upon landing.

(3) If the flight lands at other than the intended destination, report the landing immediately to the appropriate authority.

(4) If an en route landing is delayed more than 30 minutes (for turbojets), notify the appropriate authority.

(5) Failure to close a flight plan within 30 minutes of landing may initiate a search.

f. Crashed Aircraft. If a crashed aircraft is observed, determine if the crash is marked with a yellow cross. If so, the crash has been reported and identified. If the site is not marked with a yellow cross, determine, if possible, the type and number of aircraft and whether there is evidence of survivors. Fix the location of the crash as accurately as possible, and transmit the information to the nearest appropriate communication facility. If possible, orbit the scene to guide other assisting aircraft until relieved by another aircraft. Immediately after landing, make a full report to the appropriate authority.

g. Crash Landing Survival and Rescue. To enhance the chances of survival and rescue in the event of a crash landing, it is important to carry survival equipment suitable to the areas the flight passes over. If a forced landing occurs at sea, survival chances are governed by the crew's proficiency in emergency procedures and the effectiveness of water survival equipment on board the aircraft. In the event that an emergency water landing is required, the crew should contact the Coast Guard and request Automated Merchant Vessel Report (AMVER) system information. Within minutes the crew will be given the name and location of every merchant vessel within 100 miles of the aircraft's reported position. The speed of rescue on land or at sea depends upon how accurately the position is determined. If the flight plan has been followed and the position is on course, rescue is expedited. Unless there is good reason to believe that the crash site cannot be located by search aircraft, it is best to remain near the aircraft and prepare to signal when search aircraft approach.

h. Ditching and Evacuation. When a forewarned ditch is imminent, the first step is to communicate with oceanic control and the passengers. The PIC should initiate the distress call to the appropriate agency per ATC instructions or as indicated in the IFIM. When contacting oceanic control, give the following information: aircraft identification; timed position; altitude; ground speed; true course; hours of fuel remaining; a description of the emergency; pilot's intentions; and the assistance desired. Oceanic control will report the situation to the Coast Guard. The Coast Guard activates the AMVER system, sending a seagoing vessel to the area.

i. International Procedures. A Coast Guard station or a nearby ship can furnish information on the surface wind, recommended ditching heading, and sea conditions in the event of a ditching. The pilot in range of a ship should ditch in close proximity to the vessel, which will stand by to pick up passengers and assist in any other way.

The passengers and crew must be prepared prior to ditching. Lifevests must be put on, seatbelts fastened, impact position must be assumed, and loose articles must be stowed. The passengers should then be briefed on lifevest inflation and evacuation of the aircraft. Crewmembers should make an inspection to ensure that lifejackets are properly worn. Personnel should be paired off in preparation for evacuation. Older persons should be paired with able-bodied men to assist them. Children and nonswimmers should be paired with swimmers whenever possible; experienced swimmers should be paired with more dependent persons. To avoid injury, passengers must remain in their seats during the ditching, and must brace themselves to meet at least two impacts in the manner instructed by the flightcrew. The method of bracing is determined by the location and arrangement of the seats and by selection of the crash position. Regardless of the method or location, seatbelts should be strapped as tightly as possible across the hipbones. The recommended ditching position is to adjust the seat to vertical position. Just before landing, fold the arms and rest them on the knees. Bend the body as far forward as possible, and rest the head firmly on the arms. If available, a pillow, blanket, or clothing should be held in front of the head to cushion any impact. Illustrated ditching cards are helpful in showing the desired position.

It is usually best for the pilot to observe the sea surface from 2,000 feet to determine the primary swell direction. Wind condition permitting, the landing should be parallel to the swells. When the PIC advises that ditching is imminent, a crewmember or flight attendant should attach the emergency escape lifelines, position the liferafts near the emergency exits, attach the liferaft lanyards to the chair tracks, and assume a position where the passengers can be monitored during the ditching. If there is an available passenger seat, the crewmember or flight attendant should consider occupying the seat with immediate access to the emergency escape window. This position should be coordinated with the cockpit crewmembers so that one person opens the escape hatches on the opposite side, and each is responsible for securing the appropriate lifeline, inflating and launching the liferaft, and aiding the passengers in evacuating the aircraft. A public address announcement should be made immediately before impact advising the passengers that there will be at least two impacts. The passengers should be advised to "stand by for ditching" at 1,000 feet or 2 minutes before ditching. Prior to impact, the command "brace for impact" should be given. Passengers and crew should not release their shoulder harnesses or seatbelts until the aircraft is at a complete stop. The passengers should hold the crash position until the aircraft has stopped.

j. Evacuation. Once the aircraft is stopped, release seatbelts and shoulder harnesses and move quickly to the cabin door. The PIC should be in command of the evacuation, and should expedite evacuation of passengers and flight personnel. Lifevests must be inflated as soon as the passengers exit the aircraft.

k. Liferafts. Most corporate aircraft stow liferafts in the rear of the aircraft. Consequently, it is imperative for the rafts to be moved near the exits before impact. It is equally important that the rafts be secured so that they will remain near the exits during ditching. The rafts must be secured to the aircraft before being deployed to prevent the raft from being carried away. The last step is raft inflation by jerking the lanyards to release the cover and begin inflation. Once the rafts are inflated, passengers should board the rafts and ensure the load is evenly distributed. The sea anchor is then deployed and the torus section is inflated. Canopy poles are then installed and the canopy is erected or inflated. Care must be taken to ensure that the canopy is not lost in strong winds.

*l. **Signaling.*** Signaling and survival equipment are usually located in the torus section of the raft. Signaling equipment usually includes locator beacons, flares, flashlight, mirror, and possibly a transceiver radio. The locator beacon, depending on design, can be used continuously or intermittently. Other signaling devices should not be used unless an aircraft or surface vessel is heard or seen. If a transceiver radio is available, it used be used to transmit in blind to attract attention. These radios usually have a battery with a 20-30 hours life span.

m. Survival. Mental attitude cannot be overemphasized when discussing survival. The crew must demonstrate total confidence that rescue is simply a matter of time. The right attitude also reinforces a will to live even when physical condition is at its lowest point. All rafts should be equipped with water desalting kits, and rain water should be trapped on the canopy and collected. Any injuries sustained during ditching should be treated as soon as possible. Food and water are important; however, life can be sustained for up to 6 days without water and up to 3 weeks without food. The crew's proficiency is the single most important element. Once the ditching and evacuation of the aircraft is completed, chances of survival are very good.

n. Pyrotechnic Signaling Devices. FAR Parts 91, 121, 125, and 135 require the carriage of at least one signaling device for extended overwater operations. For the purpose of this AC, "Coast Guard approved" refers to the minimum standards suggested by the FAA for the acquisition and use of pyrotechnic visual distress signaling devices. Reliance on Coast Guard expertise in this area is a result of their historical involvement with the entire spectrum of SAR techniques. There is a wide variety of signaling devices available, and no single device is ideal under all circumstances. Pyrotechnics make excellent distress signals, but the drawback is that they can only be used once. Coast Guard approved visual distress signaling devices fall into three general categories: daylight signals, night signals, and devices acceptable for both day and night use. Red hand-held flares can be used by day, but are most effective at night or in restricted visibility. Hand-held devices may expel ash and slag as they burn. The flare itself is very hot and can cause a fire if dropped. Caution should be used to ensure that the device does not drip onto persons or flammable materials. Orange smoke signals, both floating and hand-held, are good for day use, particularly on clear days. The signals are effective in light or moderate winds. However, higher winds tend to keep the smoke close to the water and disperse it. Red parachute flares, both pistol and rocket propelled, are good signals for day and night use because of their altitude, slow descent, and intensity. However, the slow descent can make them drift away from the site and lead rescuers astray. Pistol launched or self-contained rocket propelled red meteors are not effective at night. Because of their rapid descent, they are less affected by the wind. However, the burning time is shorter and therefore the signals are not as readily observed. When using one of these devices, the wind must be taken into account. In calm winds, the device should be fired away from the wind at a 60 degree arc to the horizon. As wind increases, increase the angle to no more than 80-85 degrees. No pyrotechnic device should be fired straight up in calm winds; the device can fall back on the individual. Pyrotechnic devices should be stored in a cool, dry location and must be readily accessible in event of an emergency. A watertight container clearly marked "Distress Signals" is recommended. Coast Guard approved pyrotechnic devices have a service life expiration date. At this time, the expiration date may not exceed 42 months from the date of manufacture.

NUMBER MARKED ON DEVICE	DESCRIPTION OF DEVICE	ACCEPTED FOR USE
160.021	Hand-held red flare distress signal.	Day & night
160.022	Floating orange smoke distress signal (5 minutes).	Day only
160.024 160.028	Pistol-projected parachute red flare distress signal. Must be used with a suitable approved launching device.	Day & night
160.036	Self-contained rocket propelled parachute red flare distress signal.	Day & night
160.037	Hand-held orange smoke distress signal.	Day only
160.057	Floating orange smoke distress signal (15 minutes).	Day only
160.066	Red aerial pyrotechnical flare distress signal. May be meteor or parachute type and may need an approved suitable launching device.	Day & night

12. MONITORING OF NAVIGATION SYSTEM PERFORMANCE.

a. The Monitoring Process. To ensure compliance with any MNPS, states need to establish procedures for the systematic or periodic monitoring of the navigation performance actually achieved. This should be supported by formal notification of PIC's, operators, and states of registry of any gross deviations from assigned track. Close cooperation between flightcrews, operators, and aviation authorities is required to ensure that unsatisfactory performance is recognized and corrected. Incident reporting procedures that encourage cooperation by the flight crewmembers involved are essential to safe operations. In the event of a significant deterioration in navigation performance, whether the product of random excursions by operators or the result of an equipment system's low performance level, corrective action is required. In this situation, ATC must accept responsibility for advising user states and operators, either directly or through the Central Monitoring Agency (CMA), of the action being taken to correct the situation. In the absence of an agreement with the concerned state(s) to exclude offending aircraft from the system, it may be necessary to temporarily increase separation while resolving the problem.

The monitoring process includes four distinct actions:

- Monitoring the operator's navigation performance in cooperation with the flightcrew.
- Monitoring of the operator by the state having jurisdiction over that operator to ensure that adequate provisions are being applied by the operator while conducting authorized flight operations.
- Monitoring of actual navigation performance during normal flight operations by means of radar used by the ATC units of states providing service in the region.
- Monitoring can also be done on the basis of position reporting.

Because of the large variety of circumstances existing in the relationships between states and their operators engaged in oceanic operations, it is not expected that all states will make maximum effort to comply with the responsibilities resulting from the application of special airspace restrictions (such as MNPS) while keeping administrative arrangements within reasonable limits.

b. Monitoring by the Operators. While operators understandably want to avoid excessive documentation, postflight monitoring and analysis should be carried out for two important reasons: it facilitates the investigation of any reported gross navigational errors (GNE), and assists in identifying any deterioration in equipment performance (refer to the definition of GNE in Appendix 4).

Decisions regarding monitoring of an aircraft's navigation performance are largely the prerogative of individual operators. In deciding what records should be kept, airlines should consider the stringent requirements associated with special airspaces such as MNPS. Airlines are required to investigate all errors of 20 NM or greater in MNPS airspace. Whether these deviations are observed by radar or by the flightcrew, it is imperative that the cause of the deviation be determined and eliminated. Therefore, it is necessary to keep complete in-flight records so that any analysis can be made.

Operators should review their documentation to ensure that it provides all the information required to reconstruct the flight, if necessary, some weeks later. These records also satisfy the ICAO regulation that a flight journal be kept. Specific requirements could include, but are not limited to, the following:

- details of the initial position inserted in the equipment, original planned flight track, and flight levels;
- all ATC clearances and revisions;
- all reports (times, positions, etc.) made to ATC;
- all information used in the actual navigation of the flight, including a record of waypoint numbers allocated to specific points, estimated time of arrival (ETA) and actual times of arrival (ATA);
- routine monitoring of Omega navigation system (ONS)/very low frequency (VLF) station signals in use/strength;
- comments on any navigation problems relating to the flight, including information on any significant discrepancies between inertial navigation system (INS) and/or Omega displays, other equipment abnormalities, and any discrepancies relating to ATC clearances or information passed to the aircraft following ground radar observations;
- sufficient information on accuracy checks to permit an overall performance assessment;
- records of terminal errors and of checks made against navigation facilities immediately prior to entering oceanic airspace and, to the extent possible, details of the Omega/VLF signals in use; and
- details of any manual updates made to INS or Omega units.

It is also important that the forms used for the trip journal make it easy to examine key factors. Therefore, documentation might include a question to the crew such as, "Did a track error of 20 NM or more occur on this flight? Yes/No."

c. ***Monitoring of the Operator by the State.*** Decisions regarding the monitoring of operators by the state may be taken unilaterally, but there should be a cooperative process concerning the specifications to be satisfied by the operator while planning and reviewing achieved performance. Much of this process involves FAA-approved procedures and monitoring to ensure compliance. Varied circumstances influence the relationships between states and their operators, and also impact monitoring functions. Certain states require operators to maintain an aircraft log in which the crew records the performance of the navigation equipment. This log is used as a basis for investigation if significant equipment deficiencies occur. Other states require operators to use a form to record the performance of INS and Omega navigation equipment. The more complex the form, the more problems are likely to be encountered in its compilation and analysis. Separate forms may be justified for Omega and INS. States can use whatever methods or forms they prefer, but should carefully consider what information is necessary. Examples of factors to consider include:

(1) Warnings of deteriorating INS accuracy.

(2) Provision of a simple record to facilitate analysis of deviations.

(3) A record of performance of flight operation in areas where there is no radar coverage.

In the case of Omega, there have been reports of the metallic structure of a terminal building adversely affecting navigation readouts. It may be more appropriate to record readings shortly after landing and before taxiing, or over a landfall point after an oceanic crossing. Such readings give a less reliable picture of the overwater performance than is the case with INS. However, they are likely to indicate a large error that might result from a "lane slip." If a GNE is attributed to the use of Omega, a report should be completed by the operator and forwarded to the Omega Association, with a copy to the Central Monitoring Agency. The addresses of these organizations are contained in Appendix 1, Figure 1-4 of this AC.

d. ***Direct Action by States in the Monitoring Process.*** Apart from the monitoring functions of operators and states having jurisdiction over operators flying in the NAT region, it is vital to monitor actual navigation performance as observed by ATC radars of NAT provider states. This monitoring function covers four distinct phases:

(1) The acquisition and use of monitoring data.

(2) Action by the ATC unit in the case of radar observed flight deviations, including follow-up action by the operator and/or state concerned.

(3) Periodic issuances of a summary of radar observed deviations to all interested states and international organizations to apprise users of the general situation in the NAT region regarding navigation performance achieved by flights.

(4) The collection of specific data on navigational performance by all flights, to serve as a basis for the assessment of compliance to the special navigation area requirements by all traffic in the oceanic airspace concerned by its application and the relationship to the safety of separation standards used. The following are checklists of items discussed in this chapter, and are provided as a convenience to the reader. The checklists do not necessarily include every item that must be checked for an international flight.

1. PERSONAL DOCUMENTS	
Airmen's Certificate	
Physical	
Passport	
Extra Photos	
Visa (if required)	
Tourist Card (if required)	
Immunization Records (PHS-731)	
Traveler's Checks	
Credit Cards	
Cash	
Passenger manifest (Full name, Passport no.)	
Trip itinerary	

2. AIRCRAFT DOCUMENTS	
Airworthiness Certificate	
Registration	
Radio licenses	
MNPS Certification (if flying in MNPS airspace)	
Aircraft flight manual	
Maintenance records	
Certification of insurance (U.S. Military 1if planning on using a military base) or foreign)	
Import papers (for aircraft of foreign manufacture)	

3. OPERATIONS PERMITS	
Flight authorization letter	
Overflight permit	
Landing permits	
Advance Notice	
Export licenses (nav. equipm)	
Military (including corridor briefing)	
Customs overflight	
Customs Landing Rights	

4. INSPECTIONS	
Customs forms	
Immigrations	
Agricultural (disinfectant)	
General declarations	

5. GROUND HANDLING	
Handling agents	
FBO's	
Fuel (credit cards, carnets)	

6. COMMUNICATIONS & NAVIGATION EQUIPMENT	
VHF	
UHF	
HF SSB	
Headphones	
Portables (ELT's, etc.)	
Spares	

7. AGREEMENTS	
ARINC	
BERNA	
STOCKHOLM	

8. NAVIGATION EQUIPMENT	
VOR	
DME	
INERTIAL	
VLF/OMEGA	
LORAN	
GPS	

9. PUBLICATIONS	
Updated aircraft documents	
Charts	
Sectionals	
WAC's	
Plotting	
Approach	
Area	
Terminal	
ONC's	
FLIPs	
NAT message (current for North Atlantic)	
Flight Plans	
ICAO completed	
Blank ICAO	
Flight Plans	
Operations manual	
International Flight Information Manual	
Maintenance manuals	
Manufacturer's equipment source list	
Customs Guide	

10. WEATHER Wind Factors en route and consdieration for the calculation of ETP's (Equal Time Points of No-Return)	
Boeing Seasonal Wind Factor	
IATA Seasonal Wind Factor	
Current Route Wind Factor (What weather reporting services is intended to be used?)	

11. SURVIVAL EQUIPMENT	
Area survival kit (with text)	
Medical kit (with text)	
Emergency Locator Transmitter	
Floatation equipment	

12. FACILITATION AIDS	
U.S. Department of State	
U.S. Dept of Commerce	
U.S. Customs Service	
National Flight Data Center (FAA)	
FAA Office of International Aviation (AFS-5)	
FAA Aviation Security (ACO-100)	

13. OTHER CHECK LIST CONSIDERATIONS	
Preflight Planner	
Aircraft locks	
Spare keys	
Security devices	
Commissary supplies	
Electrical adapters (razors, etc.)	
Ground transportation	
Hotel reservations	
Catering	
Slot reservations	

CHAPTER 3. NORTH ATLANTIC OPERATIONS

1. CHARACTERISTICS OF THE AIRSPACE.

a. Introduction. The North Atlantic (NAT) region includes the following flight information regions (FIR): Bodo Oceanic, Gander Oceanic, New York Oceanic, Reykjavik, Santa Maria Oceanic, Shanwick Oceanic, and Sondrestrom. Most of the airspace in these FIR's is high seas airspace, wherein the International Civil Aviation Organization (ICAO) Council has determined that all rules regarding flight and operation of aircraft apply without exception. However, responsibility for enforcement of these rules rests with the state of registry of the aircraft or the state of the operator. Flight rules are contained in Annex 2 to the Convention on International Civil Aviation, and procedural aspects are covered in ICAO Doc 7030, "NAT Regional Supplementary Procedures." The majority of the airspace is controlled airspace. Instrument flight rules (IFR) apply to all flights at or above flight level (FL) 60 or 2000 feet above ground level (AGL), whichever is higher. These airspaces include:

- the New York Oceanic, Gander Oceanic, Shanwick Oceanic, Santa Maria Oceanic
- the Bodo Oceanic FIR when operating more than 100 nautical miles (NM) seaward from the shoreline above FL 195
- Sondrestrom FIR when operating outside the shoreline of Greenland
- Reykjavik FIR when operating in the oceanic sector, or in the domestic sector at or above FL 200
- the Shannon Oceanic Transition Area (SOTA)

The SOTA is a portion of the Shanwick oceanic control area (OCA) to the south of Ireland within which air traffic services (ATS) are provided by Shannon Air Traffic Control (ATC) center. Communication with aircraft is by very high frequency (VHF), and secondary surveillance radar (SSR) service is provided. The SOTA is an integral part of the Shanwick OCA, and minimum navigation performance specifications (MNPS) procedures and requirements apply. Search and rescue (SAR) vessels and aircraft are stationed at some locations in the NAT region, but SAR aircraft may not always be available.

b. MNPS Airspace. MNPS airspace is that portion of the NAT airspace between FL's 275 and 400, between latitudes N27° and the North Pole; bounded in the east by the eastern boundaries of control areas (CTA) Santa Maria Oceanic, Shanwick Oceanic, and Reykjavik; and bounded in the west by the western boundary of CTA's Reykjavik and Gander Oceanic, and New York Oceanic east of longitude W60° and south of N38°30'. All aircraft operating in MNPS airspace are required to have a specified minimum navigation performance capability that has been verified by the state of registry or by the state of the operator, as appropriate. In the United States, this verification is accomplished by issuing a Letter of Authorization (LOA) or by granting authorization in the operations specifications. Within the NAT region, a volume of airspace can be established for special use, usually military. Such airspace is known as a temporary airspace reservation. This reservation can be stationary or in motion, depending on whether its position remains fixed with relation to the surface of the earth or changes with time.

c. RVSM Airspace. Reduced vertical separation minimum (RVSM) airspace is airspace where aircraft are separated vertically by 1,000 feet (300 meters). Initial implementation of RVSM airspace will be in the NAT MNPS. However, the guidance provided in this Advisory Circular (AC) can be adapted for use in other areas where RVSM is applied.

d. Characteristics of the Traffic. Within the NAT region there are both civil and military operations. Civil operations include supersonic and subsonic commercial flights and international general aviation (IGA).

Due to passenger demands, time zone differences, and airport noise restrictions, much of the NAT air traffic falls into one of two categories: westbound traffic departing Europe in the morning, and eastbound traffic departing North America in the evening. The effect is to concentrate most of the traffic unidirectionally, with peak westbound traffic operating between 1130 coordinated universal time (UTC) and 1900 UTC (Figure 3-1), and peak eastbound traffic between 0100 UTC and 0800 UTC at 30°W (Figure 3-2). To optimize service to the bulk of the traffic, a system of organized tracks is constructed every 12 hours to accommodate as much traffic as possible on or close to their minimum cost paths. Traffic flow on the Europe-Alaska axis is also predominantly unidirectional. In the Reykjavik CTA the westbound peak is between 1200-1800 UTC, and the eastbound traffic is peak between 0100-0600 UTC. To facilitate the traffic flow during peak hours and prevent multiple random routes, a polar track structure (PTS) consisting of 10 fixed tracks has been established. Within MNPS airspace, it is not mandatory to route on either the organized track system (OTS) or the PTS. Traffic flying on other than fixed tracks is said to fly on random tracks. During 1991, approximately 50 percent of transatlantic aircraft operated on the structured track, with the remaining traffic operating on random tracks. Records indicate that approximately 86 percent of the flights across the NAT region are public transport, 11 percent are military, and 3 percent are IGA.

e. Provider States. ICAO states that provide ATS within the NAT region are Canada, Denmark, Iceland, Ireland, Norway, Portugal, the United Kingdom, and the United States. These states are known as the NAT Provider States.

f. Pilot Qualification Requirements. The minimum pilot qualification for any flight across the NAT is a private pilot license. An instrument rating (IR) is required if operating at FL 60 or above. Some states (for example, Canada) require pilots to hold an IR for operating at any altitude in the NAT region, so it is imperative that pilots are acquainted with states' varying legislative requirements. Pilots must comply with the regulations imposed by the state of registry of the aircraft being flown and with the regulations of countries in which they land or overfly. Irrespective of the mandatory requirements, it is strongly recommended that all pilots hold a valid IR. In addition to cross-county flight time, the demanding nature of the NAT operational environment requires that the pilot-in-command (PIC) meet the recent experience requirements stipulated by the state of registry for the PIC; have adequate recent flight experience in the use of long-range navigation equipment and communications equipment; and have recent partial panel training and training in dead reckoning (DR) navigation techniques.

g. Regulatory Requirements for NAT Flights. Pilots must comply with regulations imposed by the state of registry of the aircraft being flown. Pilots must also comply with regulations of states in which they land or overfly. In particular, Aeronautical Information Publications (AIP) for these states should be checked prior to departure.

h. Flight Rules Over the High Seas. ICAO member states have agreed that the flight rules which apply over the high seas will be those established by ICAO. However, responsibility for enforcement of these rules rests with the state of registry of the aircraft or state of the operator. In the United States, Federal Aviation Regulations (FAR) 91.703 is the regulation by which the Federal Aviation Administration (FAA) requires compliance with ICAO rules. The flight rules are contained in ICAO Annex 2, and procedural aspects are covered in ICAO Doc 4444 (Procedures for Air Navigation - Rules of the Air and Air Traffic Services (PANS RAC)) and ICAO Doc 7030 (Regional Supplementary Procedures).

FIGURE 3-1. SAMPLE WESTBOUND NAT TRACK MESSAGE

	NAT TRACKS FL 310/370 INCLUSIVE APRIL 25/1130 UTC TO APRIL 25/1900UTC
A	57/10 58/20 59/30 58/40 56/50 SCROD YYR West lvls 310 330 350 370 East lvls nil Eur rts west 2 Eur rts east nil Nar NA220 NA 230
B	56/10 57/20 58/30 57/40 55/50 Oystr Klamm West lvls 310 330 350 370 East lvls nil Eur rts west 2 Eur rts east nil Nar NA202 NA204
C	55/10 56/20 57/30 56/40 54/50 Carpe Redby West lvls 310 330 350 370 East lvls nil Eur rts west 2 Eur rts east nil Nar NA180 NA182
D	54/15 55/20 56/30 55/40 53/50 Yay West lvls 310 330 350 370 East lvls nil Eur rts west 2 via Ackil Eur rts east nil Nar NA160 NA166
E	53/15 54/20 55/30 54/40 52/50 Dotty West lvls 310 330 350 370 East lvls nil Eur rts west 2 via SNN Eur rts east nil Nar NA152 NA154

FIGURE 3-2. SAMPLE EASTBOUND NAT TRACK MESSAGE

	NAT TRACKS FL 330/390 INCLUSIVE APRIL 25/0100UTC TO APRIL 25/0800UTC
V	YSG 51/50 52/40 53/30 54/20 54/15 ACKIL WEST LVLS NIL EAST LVLS 330 350 370 390 EUR RTS WEST NIL EUR RTS EAST NIL NAR NA141 NA149
W	YQX 50/50 51/40 52/30 53/20 53/15 SNW WEST LVLS NIL EAST LVLS 330 350 370 390 EUR RTS WEST NIL EUR RTS EAST NIL NAR NA125 NA127 NA131
X	VYSTA 49/50 50/40 51/30 52/20 52/15 CRK WEST LVLS NIL EAST LVLS 330 350 370 390 EUR RTS WEST NIL EUR RTS EAST NIL NAR NA105 NA107 NA111
Y	YYT 48/50 49/40 50/30 51/20 51/15 TIVLI WEST LVLS NIL EAST LVLS 330 350 370 390 EUR RTS WEST NIL EUR RTS EAST NIL NAR NA83 NA89 NA93
Z	COLOR 47/50 48/40 49/30 50/20 50/08 LND WEST LVLS NIL EAST LVLS 330 350 370 390 EUR RTS WEST NIL EUR RTS EAST NIL NAR NA41 NA51 NA53

NOTE: Occasionally tracks on two successive systems may appear to have the same coordinate, but pilots should ensure that the tracks are, in fact, exactly identical. Pilots should also check to what extent the associated landfall/termination points and domestic routings are also identical.

i. Operating Requirements. All flights must file an IFR flight plan when intending to fly in NAT airspace at FL 60 and above in New York, Gander, Shanwick, Santa Maria and Reykjavik Oceanic FIR's; at FL 60 and above in the Bodo Oceanic FIR beyond 100 NM seaward from the shoreline; and at FL 200 and above in the Sondrestrom FIR. All flights which cross international borders must file a flight plan. While en route, all changes to IFR flight plans shall be reported as soon as practicable to the appropriate ATS unit as prescribed. An arrival report must also be sent to the appropriate ATS unit. When the flight plan cannot be closed by means of the aircraft radio, a telephone or telegraphic message should be sent. Failure to close flight plans may result in needless search operations. ICAO member states have agreed that aircraft with their registration mark will comply with the Standards and Recommended Practices (SARP) concerning the operation of aircraft contained in ICAO Annex 6, as well as the Procedures for Air Navigation Services - Aircraft Operations (PANS OPS), stated in ICAO Doc 8168, Volume 1, as a minimum.

The quality of navigational performance required in the operation of aircraft is based on the need for safe and economic flight. It is often necessary to define the required performance level of a navigation system in relation to a particular air traffic environment or route structure. No single statement of operational requirements, although meeting basic safety requirements, can adequately reflect the many different combinations of operating conditions. Criteria established for the most exacting regions may be unsuitable for other operations. However, it is necessary to establish stringent specifications to permit operations in an area. Failure to meet the criteria may result in exclusion of aircraft from airspace. In determining performance criteria, there must be a capability to allow operations in specific areas while applying minimum separations standards to accommodate present and forecast traffic. The criteria established should be protected for a specified period, thus assuring the cost-effectiveness to operators of the equipment necessary to ensure the required level of performance. It is not intended that there should be international standardization of equipment selected by individual operators. However, it is essential that the equipment selected and their method of operation must be capable of meeting the navigation performance specifications for a particular area.

In an air traffic environment where there is a multiplicity of tracks, the aim is that no aircraft should cross the half-standard minimum separation value established between any two tracks, thus ensuring that aircraft operating on another track are not placed at risk of collision. The need is to ensure that the large majority of traffic is concentrated close to the designated track and that any deviations, whether the result of inadequate system performance or human error, are contained before reaching the half-standard. Total safety is unlikely to be achieved, but performance requirements need to relate to a prescribed target level of safety (TLS). TLS is a generic term representing the level of risk considered acceptable in particular circumstances, and is critically dependent on an assessment of collision risk. Collision risk refers to the number of midair accidents likely to occur due to loss of separation in a prescribed volume of airspace for a specific number of flight hours.

In airspace where the bulk of the air traffic flows along fixed routes, the need is to ensure that aircraft adhere to their cleared tracks and remain within any protected airspace. The conditional requirements are related to the need to avoid risk of collision with traffic operating adjacent to the protected airspace, and to avoid disruption of other traffic flows. Such adherence is also an essential requirement to ensure the safety of any ATS action regarding crossing traffic where the minimum separation values need to be kept at the lowest possible value (Figure 3-3).

FIGURE 3-3. NAR EXAMPLE - INTERNATIONAL FLIGHT INFORMATION MANUAL (IFIM)

It is expected that current North Atlantic route (NAR) documentation will be carried on the flightdeck of each aircraft operating within the NAR system, including a description of the current NAR and the information contained in the current NAT/OTS message. The official NAR route descriptions are contained in both Canadian Ministry of Transportation (MOT) and U.S. FAA publications. The official FAA listing appears in the IFIM, issued annually and amended quarterly. Changes to the NAR routes are advertised in the biweekly publication "International Notices to Airmen." The following list divides the NAR route description into two sections according to the direction of the flight. Each section is subdivided according to route portion (common or noncommon). The common portion describes the NAR route between the costal fix and the inland navigational facility. The noncommon portion describes the route between the NAR route system airport being used and the inland navigational facility.

NAR EASTBOUND ROUTES - COMMON PORTION (FOR TRAINING PURPOSES ONLY - NOT TO BE USED FOR NAVIGATION)

NAR Designator	Inland Nav. Facility	Route Description	Costal Fix
NA21	Nantucket	Control 1146 WHALE BLUSE Sable Island	BANCS
NA23	Nantucket	Direct	BANCS
NA25	CANAL	SABLE	BANCS
NA27	Watertown	J595 HL595 Saint John (N.B.) HL506 Sable Island	BANCS
NA29	Sherbrooke	HL500 J500 Millinocket J506 HL506 Sable Island	BANCS
NA31	Sherbrooke	Direct	BANCS
NA41	Nantucket	CANSO	COLOR
NA43	Nantucket	Direct	COLOR
NA45	Nantucket	J585 HL585 Yarmouth HL575 Halifax CANSO	COLOR
NA47	Watertown	J595 HL595 Saint John (N.B.) HL506 Halifax CANSO	COLOR
NA49	Sherbrooke	HL500 J500 Millinocket J506 HL506 Halifax CANSO	COLOR
NA51	Sherbrooke	Direct	COLOR
NA53	CANAL	J575 HL575 Halifax CANSO	COLOR
NA81	Nantucket	J585 HL585 Yarmouth HL575	St.Johns (Nfld.)

NON-COMMON PORTION EASTBOUND VIA NANTUCKET

FROM	NON-COMMON PORTION	INLAND NAV FACILITY
Kennedy	SARDI	Nantucket

NAR WESTBOUND ROUTES - COMMON PORTION (FOR TRAINING PURPOSES ONLY - NOT TO BE USED FOR NAVIGATION)

NAR Designator	Costal Fix	Route Description	Inland Nav. Facility
NA120	Gander	HL577 Sydney HL575	Yarmouth
NA122	Gander	Direct	Hyannis
NA124	Gander	HL577 Sydney HL575 J575	Boston
NA126	Gander	Direct	Boston
NA128	Gander	HL500 Channel Head HL573 J573	Kennebunk
NA130 NA132	Gander Gander	Direct HL500 Moncton HL509 J509 HL509	Kennebunk Beauce
NA140	Springdale	HL579 Stephenville HL581 J581	Kennebunk
NA142	Springdale	Direct	Kennebunk
NA144	Springdale	Direct	Boston
NA146	Springdale	HL579 Stephenville HL581 CHEPS HL509 J509 HL509	Beauce

j. Navigation Equipment and Procedures. To meet specific requirements regarding overall navigational performance of equipment and procedures, installation and approval must be in accordance with applicable civil airworthiness requirements, with particuiar reference to the following:

(1) the primary equipment information displays must be visible to, and all controls usable by, the appropriate crewmembers while seated at their duty stations;

(2) warning of failures or malfunctions must be provided by visual or aural signals;

(3) the airborne system must be protected against power interruptions and/or abnormalities; and

(4) the equipment must not be the source of objectional radio frequency interference and must not be adversely affected by interference from other systems in the aircraft.

The operations manual must contain such pertinent material as required to define all operational limitations associated with the system's performance. For example, in the case of a station-referenced system, the manual would include details of the areas where an adequate signal level may be received or, in the case of an inertial system, any limitations of the system's ground alignment and of the time period within which adequate navigational performance within specified limits can be reasonably assured. Experience has clearly demonstrated that the presence of sophisticated navigational equipment on board an aircraft does not, by itself, ensure that a high level of performance will be achieved. Two operators may have identical equipment, suggesting that they would achieve similar performance. This will not be the case unless the equipment is properly installed and maintained, and correctly used by the operating crews. Therefore, it is essential to provide adequate training for the personnel operating or maintaining the equipment, and that mandatory operating drills and procedures are included in crew training courses.

k. Sources of Navigation Errors. A significant proportion of navigation errors result from the use of incorrect data. To minimize the problem, source data must be clearly legible under the worst cockpit lighting situations and presented in a format suitable for error free use in the cockpit environment. On navigation (radio facility) charts, all position coordinates should ideally be printed in dark blue or black numerals against the white background. If coordinates would normally appear against a locally tinted background, they should be enclosed in a white box. Positively no information should be overprinted on top of position coordinates. If groups of position coordinates must appear in close proximity to each other, the position referenced by each set of coordinates should be clearly indicated by means of a leader. Navigational documents, such as track messages or flight plans, should be double spaced or boxed to minimize the possibility of line slippage when the information is read. It is advisable to provide pilots with a simple plotting chart of suitable scale (1 inch equal to 120 NM has been used successfully on NAT routes) in order to facilitate a visual presentation of an intended route that is otherwise defined only in terms of navigational coordinates. (For more details, see the NAT MNPS Airspace Operations Manual.) In parts of the NAT, Omega signals from the Liberia station can be badly affected by modal interference, especially at night along any part of the signal path. Consequently, when any other transmitters are shut down for reasons such as scheduled maintenance, Omega tracking problems can occur. For operations in MNPS airspace, it is generally accepted that the very low frequency (VLF) backup is advisable.

Errors involving aircraft equipped with Omega were discovered to be disproportionately high by the NAT Special Planning Group (SPG). No positive conclusion has been reached as to why the Omega gross navigation error (GNE) record is so poor, but implementation of the following suggestions is likely to lead to improvement. States of registry should ensure that their operators understand the importance of the strength of received signals. It is essential to choose the best antenna; to ensure, by careful skin mapping, that it is well located; and to check that there is no loss of efficiency at the antenna coupling as the result of inadequate drainage. The regular monitoring and logging of station signals and signal strength by the flightcrews will assist maintenance personnel in evaluations of the system's performance. Operators using Omega for MNPS operations will appreciate the need to provide crews with the latest information on the status of Omega and VLF transmissions. Omega equipped aircraft using E-field antennae are likely to suffer prolonged loss of signal reception when operating in or near clouds. Due to the recent improvement in Omega equipment and software, old equipment without updated software should not be purchased. If old equipment is still in use, every effort should be made to incorporate software modifications to achieve the best possible performance standards.

Several high power, nondirectional radio beacons (NDB) are located in the NAT region that are useful to automatic direction finder (ADF) equipped aircraft. Some of these stations, including commercial band transmitters, are not monitored for outages or interference by transmitters on adjacent frequencies and may be severely affected by atmospheric conditions. VHF communications coverage extends to line-of-sight distance from facilities in Canada, Iceland, Greenland, Faeroe Islands, the Azores, and coastal Europe. The Canadian VHF coverage is extended by use of a remote facility in southern Greenland. High frequency (HF) communications are available throughout the NAT region for ATC purposes, and HF is mandatory for flight within the Shanwick OCA. Use of HF by pilots of IGA flights permits proper monitoring of the flight progress. HF equipped flights should be able to receive HF VOLMET broadcasts, which contain continual updates on the meteorological situation at major terminals in Europe and North America and significant meteorological information (sigmet) warnings.

2. STATE RESPONSIBILITY.

It is implicit in the concept of MNPS that all operations within the airspace, whether by public transport or general aviation aircraft, achieve the highest standards of navigation performance accuracy. All flights within NAT MNPS airspace must have the approval of either the state of registry of the aircraft or the state of the operator. Such approvals encompass all aspects of the expected navigation performance accuracy of the aircraft, including the navigation equipment carried, installation and maintenance procedures, and crew navigation procedures and training. Due to local circumstances and varying national arrangements, procedures and methods employed for issuing approvals can vary considerably between states. As new operators apply to conduct operations in MNPS airspace, states not familiar with approvals should be able to draw on the experience of other states. It is essential to the integrity of the MNPS concept that knowledge is shared; therefore, states that have issued supplementary material are urged to make it available to ICAO.

3. PURPOSE AND CONCEPTS OF MNPS.

ICAO SARP for aircraft operation state that, for flights in defined portions of airspace where MNPS are prescribed, an airplane shall be provided with navigation equipment which continuously indicates to the flightcrew the aircraft's adherence to or departure from track to the required degree of accuracy at any point along that track, and which has been authorized by the state of the operator or the state of registry for the MNPS operations concerned. Since its inception in 1965, the North Atlantic Special Planning Group (NAT SPG) has been developing methods and procedures allied to the safe separation between aircraft on tracks in the NAT region. In 1975, the NAT SPG proposed establishing an MNPS for all aircraft using the North Atlantic Organized Track System (NAT OTS) to enable a reduction in the lateral separation minimums. The rationale and foundation for MNPS is based on a mathematical model that expresses the relationship between collision risk and separation. The integrity of MNPS airspace is maintained by a series of procedures that include approval of navigation equipment and its operation, along with continuous monitoring of the navigation accuracy by aircraft in MNPS airspace. It is essential to the application of the lateral separation minimums that all operations in MNPS airspace by public transport, IGA, and state aircraft achieve the highest standards of navigation performance accuracy. Some FAR Part 91 operators erroneously believe that, because they are not required to hold an air carrier certificate, they should not be subject to stringent separation requirements. This belief is incorrect; whenever an aircraft operating on the NAT OTS deviates from course, there will be another aircraft located 60 NM or less to either side of the assigned track. If a collision results from faulty procedures or any other reason, the results are equally catastrophic regardless of whether the offending aircraft is operated under FAR Part 91 or Part 121.

a. NAT MNPS. MNPS are applied to aircraft operating between FL 275 and 400 within the Shanwick, Gander, and Reykjavik OCA's; part of the New York OCA; and Santa Maria OCA. Continuous monitoring of the navigation accuracy of aircraft using MNPS airspace is carried out by use of radars covering the exits from the airspace in order to confirm that the required navigation standard is being achieved. On the basis of such monitoring, it has been agreed by ICAO that the lateral separation minimum for aircraft operating in MNPS airspace shall be 60 NM. It is implicit in the concept of MNPS, and essential to the application of the quoted lateral separation minimum, that all operations in MNPS airspace achieve the highest standards of navigation performance accuracy. Checks are carried out from time to time to verify the approval status of aircraft operating within MNPS airspace. Aircraft that are approved for operations within the NAT MNPS airspace shall have navigation performance capability such that:

(1) the standard deviation of lateral track errors shall be less that 6.3 NM (11.7 km)

(2) the proportion of the total flight time spent by the aircraft 30 NM (55.6 km) or more off the cleared track shall be less than 5.3 x 10-4

(3) the proportion of the total flight time spent by aircraft between 50 and 70 NM (92.6 and 129.6 km) off the cleared track shall be less than 13 x 10-5

The MNPS shall be applicable in that volume of airspace defined on page 3-1 of this AC.

b. Application of MNPS. It is essential that stringent minimum navigation performance requirements be applied only to those route structures and localities where compliance is essential to safe and cost-effective operation with minimum interference with the free movement of air traffic. Proposals for the adoption and enforcement of criteria in a particular region should take into account the effects of any new regulatory requirements on all operations to ensure that any exclusion of traffic from desirable tracks will be kept to a reasonable minimum, and that satisfactory alternate tracks with a lower density are available for excluded traffic. Navigation performance specifications must be formulated in a manner acceptable to both equipment manufacturers and aircraft operators. These specifications should define the maximum proportion of total flight time during which aircraft can be allowed to deviate specified distances. These specifications should apply for a period of at least 10 years after implementation. Specifications relating to the separation between routes will normally be determined by regional agreements based upon assessment of navigational performance in that area or on those routes. In most cases, route spacing is based on the known performance of the majority of existing traffic to ensure that a new navigational system can meet the specified criteria. Confirmation of compliance is likely to be a long-term process, since the number of large errors that can be accepted is very low. Once performance criteria are established, continuous monitoring is needed to ensure that the required specifications and standards are maintained, and that there is no gradual erosion of safety standards. If the monitoring process shows that overall system performance is consistently better than the required navigation performance specifications, procedures may be adjusted to benefit the majority of users.

c. General Route Structure. As previously explained, much of the NAT traffic contributes to one of two flows: a westbound flow from Europe in the morning, and an eastbound flow from North America in the evening. The constraints of the necessary horizontal separation criteria and a limited economical height band (FL 310 - FL 390) make the airspace congested at peak hours. Airspace utilization is improved by strategic use of so-called "opposite direction" FL's; i.e., FL's 310, 350, and 390 eastbound, and FL's 330 and 370 westbound during periods of peak flow. Utilization is further improved by the application of mach number technique, whereby aircraft operating successively along suitable routes maintain an appropriate mach number for a relevant portion of that flight. Experience has shown that when two or more aircraft operate on the same route at the same FL, use of the mach number technique is more likely to maintain constant longitudinal separation than other methods. When the variability of the weather is introduced, it becomes necessary to create a track structure that takes into account all known factors and offers operators a choice of economically viable routes as close as possible to the minimum time track (MTT). This variable track structure is the OTS. Figure 3-4 is an example of preferred routes for westbound NAT traffic.

d. Organized Track System. After determination of basic MTT's, with due consideration to airlines' preferred tracks and taking into account airspace restrictions such as danger areas and military airspace reservations, the OTS is constructed by the appropriate oceanic area control center (OAC). The nighttime (eastbound) OTS is constructed by the Gander OAC, and the daytime (westbound) by Shanwick OAC (Prestwick), each taking into account tracks that New York, Reykjavik and/or Santa Maria may require in their respective OAC's. In each case, OAC planners consult each other, coordinate as necessary with adjacent OAC's and domestic ATC agencies, and ensure that the proposed system is viable for lateral and vertical separation criteria. They also take into account the anticipated requirements of the opposite direction of traffic and ensure that sufficient track and FL profiles are provided to satisfy anticipated traffic demand. The impact on domestic route structures and the serviceability of transition area radars and navaids are checked before the OTS is finalized.

The agreed OTS is then promulgated as a NAT track message via the Aeronautical Fixed Telecommunications Network (AFTN). A typical time of publication of the westbound OTS is 0000 UTC, with the eastbound OTS at 1200 UTC. This message gives full details of the OTS coordinates as well as the FL's that are expected to be in use on each track. Correct interpretation of the track message by operators and pilots is essential to both economy of operation and in minimizing the possibility of misunderstanding leading to the use of incorrect track coordinates. Oceanic airspace outside the published OTS is available for random operations, subject to separation criteria and NOTAM restrictions. Flights that do not operate on the OTS, or that join or leave an organized track at some intermediate point, are considered to be random operations.

e. ***Other Routes and Route Structures Within or Adjacent to NAT MNPS.*** When NAT MNPS airspace was introduced, it was recognized that some special procedures and routes were needed. Procedures were required for aircraft suffering partial loss of their full navigational capability, with consideration of those aircraft operating along a number of relatively short-range routes within MNPS airspace. Further experience showed that account also had to be taken to cover aircraft not equipped with HF radio. Flights operating along these special routes still need state approval to operate within MNPS airspace.

FIGURE 3-4.

SAMPLE OF PREFERRED ROUTES FOR NAT TRAFFIC - WESTBOUND
1 OCA points North of N57° 2 OCA points N55°-N57° 3 OCA points South of N55°

Originating Area	OCA Entry Points	NAT Structure	Domestic Routing
Copenhagen FIR	N61° W10° N60° W10°	1,2,3	ADN STN UN610/UN601 or SUM UN612/UN603
	N59° W10° N58° W10°	1,2,3	ADN STN UN610/UN601 or SUM UN593/UN584
	N57° W10°	1,2,3	GORDO UR23 GOW UN572
	N56° W10°	1,2,3	GORDO UR23 GOW UN563
	N55° W10°	1,2,3	GORDO UR23 GOW MAC UN552
Manchester TMA	N57° W10°	1,2,3	WAL B3/UB3 BEL UN570
	N56° W10°	1,2,3	WAL B3/UB3 BEL UN561
	N55° W10°	1,2,3	WAL B3/UB3 BEL UN551
London/Gatwick	N56° W10°	1	SAM UR14 DUB ERNAN UN560
	N55° W10°	1,2	SAM UR14 DUB ERNAN UN550
	via Ackil	1,2	SAM UR14 KARMA UG1 STU UA29 ACKIL UN541 or UN531
	via SNN	1,2,3	SAM UR14 KARMA UG1 SNN UN540 or UN530 or UN521
	via CRK	1,2,3	SAM UR37 CRK UN520 or UN512

SAMPLE OF PREFERRED ROUTES FOR NAT TRAFFIC - WESTBOUND—Continued
1 OCA points North of N57° 2 OCA points N55°-N57° 3 OCA points South of N55°

Originating Area	OCA Entry Points	NAT Structure	Domestic Routing
London TMA	N51° W15°	1,2,3	SAM UR37 MERLY UB40 TIVLI UN510
	N61° W10° N60° W10°	1,2,3	POL UB4 TLA UN601 STN UN610 or UN601
	N59° W10° N58° W10°	1,2,3	POL UB4 MARGO GOW UN590 BEN UN590 or UN581
	N57° W10°	1	TNT/ROBIN UR3 WAL UB3 BEL UN570
		2	POL UB4 MARGO MAC UN571
		3	POL UB4 MARGO GOW UN572
	N56° W10°	1	UG1 STU UR14 DUB ERNAN UN560
		2	TNT/ROBIN UR3 WAL UB3 BEL UN561
		3	POL UB4 MARGO MAC UN562
	N55° W10°	1,2	UG1 STU UR14 DUB ERNAN UN550
		3	TNT/ROBIN UR3 WAL UB3 BEL UN551
	via Ackil	1,2	UG1 STU UA29 ACKIL UN541 or UN531
		3	TNT UR3 WAL UB1 DUB UB1 ACKIL UN541 or UN531
	via SNN	1,2,3	UG1 SNN UN540 or UN530 or UN521
	via CRK	1,2,3	UG1 STU UB10 CRK UN520 or UN511
	N51° W15°	1,2,3	UG1 STU UB10 CRK UN511
	N50° W08°	1,2,3	R8 SAM UR8 LND UN500
France FIR/UIR	N61° W10° N60° W10°	1,2,3	UB4 TLA UN601 STN UN610 or UN601

SAMPLE OF PREFERRED ROUTES FOR NAT TRAFFIC - WESTBOUND—Continued
1 OCA points North of N57° 2 OCA points N55°-N57° 3 OCA points South of N55°

Originating Area	OCA Entry Points	NAT Structure	Domestic Routing
	N59° W10° N58° W10°	1,2,3	UB4 MARGO GOW UN590 BEN UN590 or UN581
	N57° W10°	1	UB4 ROBIN UR3 WAL UB3 BEL UN570
		2	UB4 MARGO MAC UN571
		3	UB4 MARGO GOW UN572
	N56° W10°	1,2	UB4 UA30 UG1 STU UR14 DUB UN560 ERNAN UN560
		3	UB4 ROBIN UR3 WAL UB3 BEL UN561
	N55° W10°	1,2	UB4 UA30 UG1 STU UR14 DUB UN560 ERNAN UN550
		3	UB4 ROBIN UR3 WAL UB3 BEL UN551
	via Ackil	1,2	LIZAD UG4 SNN UG4 ACKIL UN541 or UN531
	via Ackil	3	UB4 UA30 UG1 STU UA29 ACKIL UN541 or UN531
	via SNN	1,2,3	LIZAD UG4 SNN UN540 or UN530 or UN521
	via CRK	1,2,3	LIZAD UG4 CRK UN520 or UN511
	N51° W15°	1,2,3	UG4 TIVLI UN510
	N50° W08°	1,2,3	LIZAD UG4 LND UN500

f. ***Routes for Aircraft With Only One Long-Range Navigation System.*** A number of special routes have been developed for aircraft equipped with only one long-range navigation system (LRNS). These routes are within MNPS airspace, and state approval is required for operations in this airspace. Aircraft that are equipped with normal short-range navigation equipment (VHF omnidirectional radio range (VOR)/distance measuring equipment (DME), ADF) and at least one fully operational set of one of the following types of navigational equipment:

- Doppler with computer
- Global Positioning System (GPS)
- inertial navigation system (INS)
- Omega
- Loran-C (not applicable to all routes)
- flight management system/inertial reference system (FMS/IRS) Aircraft with this equipment are capable of meeting the MNPS while operating along the routes listed below:

NOTE: Routes (a) through (g), listed below, were known as "Blue Spruce" routes and are now referred to as "special" routes. Continuous VHF coverage exists on these routes at FL 300 and above except as noted.

- Stornoway } - N60° W10° - N61° W12°34′ - ALDAN - Keflavik; (HF required on this route)

  Benbecula } - N61° W10° - ALDAN - Keflavik (VHF coverage exists, and subject to prior coordination with Scottish Airways and Shanwick, this route can be used by non HF equipped aircraft.)

- Machrihanish }
  Glasgow } - N57° W10° - N60° W15° - N61° W16°30′ - BREKI -
  Shannon } Keflavik; (HF is required on this route)
  Belfast }
- Keflavik - GIMLI - Kulusuk - Sondre Stromfjord - Frobay (HF is required on this route);
- Keflavik - EMBLA - N63° W30° - N61° W40°W - Prins Christian Sund;
- Prins Christian Sund - N59° W50° - PRAWN - NAIN;
- Prins Christian Sund - N59° W50° - PORGY - Hopedale;
- Prins Christian Sund - N58° W50° - LOACH - Goose VOR;
- Cork } - LOACH - Goose VOR;
  Lands End - Gapli } (HF is required on this route);
- Funchal/Porto Santo - Santa Maria/Ponta Delgada/Lajes;
- Lisboa/Porto/Faro - Ponta Delgada/Santa Maria/Lajes;
- between Greenland and Canada (HF is required over the Greenland icecap below FL 195):
  - Sondre Stromfjord NDB N67° W60°, Cape Hooper NDB;
  - Kook Islands NDB, N66° W60°, Cape Dyer NDB;
  - Kook Island NDB, N66° W60°, N64° W63°, Frobay VOR; and
- between Iceland and Greenland: Reykjanesskoli NDB, N69°30′ W22°40′, Constable Pynt NDB.

g. ***Routes for Aircraft with Short-Range Navigation Equipment.*** The following routes may be flown by aircraft with short-range navigation equipment (VOR/DME, ADF), but an LOA for operation within MNPS airspace is still necessary (see below).

(1) Flesland - Myggenes - INGO - Keflavik (G3)

(2) Sumburgh - Akeraberg - Myggenes (G11)

h. Procedures for Aircraft Suffering Partial Loss of Navigation Capability Before Entry into MNPS Airspace. ICAO Annex 6, Parts I and II, Chapter 7 state that aircraft must be sufficiently provided with navigation equipment to ensure that, in the event of the failure of one item of equipment at any stage of flight, the remaining equipment will enable the aircraft to proceed in accordance with MNPS requirements where applicable. For flight in NAT MNPS airspace, this is interpreted to mean that, while two sets of long-range navigation equipment have to be carried when operating in the major part of the MNPS airspace, there are routes on which carriage of only one set each of long-range and short-range navigation equipment is required. If an aircraft suffers partial loss of navigation capability prior to entry into oceanic airspace (for example, only one INS or FMS/IRS is serviceable), the pilot should consider using one of the special routes listed above. Use of these routes following partial loss of navigation capability is subject to the following criteria:

(1) sufficient navigation capability remains to meet the MNPS; i.e., one LRNS plus short-range navigation aid;

(2) the requirements of ICAO Annex 6, Parts I and II, Chapter 7 with regard to the provision of navigation equipment necessary to enable the aircraft to be navigated in accordance with its operational flight plan and the requirements of ATS can be met by relying on the use of short-range navigation aids in the event of failure of the remaining LRNS;

(3) a revised flight plan is filed with the appropriate ATS unit; and

(4) an appropriate ATC clearance is obtained.

NOTE: A revised oceanic ATC clearance will be issued after coordination between all OAC's concerned. If the OTS extends to the northern part of the NAT region at the time of the incident, the aircraft may be required to accept a lower than optimum FL in its revised oceanic clearance, especially during peak traffic periods.

i. Special Provisions for Aircraft Not Equipped for Operation in MNPS Airspace to Climb or Descend Through MNPS Airspace. Some aircraft, particularly the higher performance IGA aircraft, operate at FL's above the upper limit of MNPS airspace (FL 410 and above). Depending on their point of departure, such aircraft often require a comparatively brief penetration of MNPS airspace. In order that non-MNPS equipped aircraft are not unduly penalized by being excluded from operating at their most economic cruising level, provisions are made for climb and descent through MNPS. The NAT SPG agreed to the following provisions on the understanding that these would be published in the relevant AIP's by the states concerned, stating the VOR/DME's to be used and indicating those parts of the MNPS airspace which may be affected by this procedure. Aircraft not equipped for operation in MNPS airspace may be cleared by the responsible ATC unit to climb or descend through MNPS airspace provided:

(1) the climb or descent can be completed within the usable coverage of selected VOR/DME's and/or within the radar coverage of the ATC unit issuing such clearance;

(2) the aircraft is able to maintain direct pilot-controller communications on VHF; and

(3) MNPS aircraft operating in that part of the MNPS airspace affected by such climb or descent are not penalized by the application of this procedure.

4. OPERATIONAL APPROVAL TO FLY IN MNPS AND/OR RVSM AIRSPACE.

a. Methods of Approval. In the United States, operational approval to fly in MNPS and/or RVSM airspace is obtained by the issuance of operations specifications for certificated operators or by issuance of an LOA to noncertificated operators. Previously, LOA's (called certificates by ATC and foreign governments) have been nonstandard, have not had an expiration date, and were not crew specific in spite of ICAO regulations requiring that crews be trained to operate in MNPS airspace. Upon publication of this AC and guidance to FAA inspectors, the following changes will be enacted:

(1) LOA's will be standardized as per the format shown in Figure 3-5.

(2) LOA's will have a 24 calendar months validity period.

(3) Current holders of an LOA will be required to obtain a new LOA by October 1, 1996. A new LOA can be obtained in person or by mail by surrendering the old LOA and submitting a letter in the format shown in Figure 3-6 and a completed LOA letter in the format shown in Figure 3-5.

(4) Operators applying for an initial LOA can expect the following from the FAA inspector handling their request:

(a) inspection of navigation equipment installation;

(b) verification that the aircraft has the required communication and navigation equipment for operations in MNPS airspace; and

(c) verification that crews that will fly the aircraft and/or flight departments responsible for MNPS crews have the qualifications to use the navigation and communication equipment installed in the aircraft. If the inspector determines that a flight department and/or crew does not have adequate qualifications, a proving run will be required. Qualifications may be acquired by various methods. It is recommended that crews receive training from either a commercially-conducted oceanic procedures course or a course conducted by their flight training department, and not depend solely on the self-study of oceanic procedures.

(d) The inspector will verify that the aircraft is a U.S.-registered aircraft, properly registered under the provisions of FAR Part 47. Inspectors will need assurance that aircraft registered to corporations have the name and address (not Post Office box) of an individual U.S. citizen responsible for crew(s) performance in MNPS airspace.

(5) All LOA's will be assigned a unique tracking number by the issuing office, and will be valid for 24 months. (ATC and/or foreign ATS may request the number and date of the LOA). Renewal of the LOA's will follow the same procedure as outlined in paragraph 3, above, if the aircraft's equipment has not changed since the issuance of the previous LOA. If new equipment has been installed, a new application for an LOA must be made in the same manner as that required for the initial LOA. The LOA must be carried in the aircraft at all times when operating in MNPS airspace.

b. Installation Approvals. In most cases, operators will be able to select navigation equipment with established performance capability. When a new system is proposed or major changes have been made in an existing system, an evaluation will be required to establish the quality of performance before authorization for use as a primary system. (Detailed information on proving and validation flights is contained in Chapter 8 of this AC.) Before an installation can be approved and authorized as a primary navigation system, an FAA avionics inspector must ascertain the approval status of the installed LRNS equipment by review of the aircraft records to determine the basis for LRNS installation.

FIGURE 3-5. FORMAT FOR AN LOA TO OPERATE IN THE NAT MNPS

This letter constitutes approval for the named aircraft to operate in the North Atlantic Minimum Performance Specification Airspace (NAT MNPS) and/or Reduced Vertical Separation Minimum (RVSM) airspace or to conduct oceanic flight by the authorized operator or crew listed under the conditions and limitations below.

Aircraft make and model ____________________ N-Number ________________________

Aircraft serial number ______________________ Aircraft color _____________________

NAVIGATION EQUIPMENT

TYPE/MANUFACTURER/MODEL	PART NUMBER	DATE INSTALLED

COMMUNICATION EQUIPMENT

TYPE/MANUFACTURER/MODEL	PART NUMBER	DATE INSTALLED

Aircraft base of operations (city, state, zip) ____
Name of aircraft owner/operator ____
Crew training conducted by ____
Print name of person responsible for crew operations or agent for service (must be a U.S. citizen) ________________________________
Signature of person responsible for crew operations or agent for service ____
Street address (cannot be a Post Office box) ______________________________________
City, state, zip code ____

FOR FAA USE ONLY (To be completed by issuing office)

This approval is for: MNPS only ________________ MNPS and RVSM ________________
Authorization Number ________________________________
Aircraft limitations (if applicable) ____
Program Tracking and Reporting Subsystem (PTRS) tracking number _____________
Date of Issuance ________________ Expiration Date ________________

This authorization is subject to the conditions that all operations conducted within NAT MNPS airspace are in accordance with FAR § 91.705 and the flight rules contained in International Civil Aviation Organization (ICAO) Annex 2, and that all operations outside of the United States comply with FAR § 91.703 and Annex 2. The person responsible for crew operations or agent for service must accept responsibility for complying with the stated regulations by signing this document. This document is considered invalid until signed. If the person signing this document relinquishes responsibility, changes mailing address, or the aircraft changes ownership or base of operation, this letter becomes invalid and the signee should immediately notify the issuing office of the change. LOA's can be renewed via a letter or fax request submitted at least 30 days prior to the expiration date if no changes have been made. If any changes have been made, application for a new LOA must be made in the same manner as that required for the initial LOA.

____
Office Manager's Signature

FIGURE 3-6. FORMAT FOR LETTER TO RENEW LOA

FROM: [*person or department requesting LOA*]

[*company name (if applicable)*]

[*street address*] **(P.O. Box not acceptable)**

[*city, state, zip code*]

TO: Federal Aviation Administration (FAA)

Flight Standards District Office

[*street address*]

[*city, state, zip*]

Dear Inspector:

Enclosed is an expired Letter of Authorization (LOA) and a completed form requesting a new LOA for operations in Minimum Navigation Performance Specification and/or Reduced Vertical Separation Minimum airspace. [*Format for LOA is in Figure 3-5 of this Chapter.*]

I/we certify than any changes that have taken place since the expired LOA was issued are reflected on the attached LOA form. I/we further certify that I/we have obtained a copy of the Oceanic Operations advisory circular, and are familiar with its contents.

Sincerely,

[*person's signature responsible for crew operations or agent for service*]
[*typed name of person responsible for crew operations or agent for service*]
[*title*]
[*date*]

NOTE: The letter should be sent to the office that issued expired LOA.

FIGURE 3-7. INVESTIGATIVE REPORT FOR SPECIAL USE AIRSPACE LOA

It is an FAA responsibility to reply to the North Atlantic Central Monitoring Agency (NAT CMA) whenever an operator is suspected of not having authorization or of having improper authorization to fly in special use airspace. Routine (random) monitoring may also be the reason for initiation of a request to verify special use airspace authorization. The following form will be used by Aviation Safety Inspectors (ASI) to investigate alleged operations into MNPS airspace without authorization or with improper authorization. The form is included in this AC to alert operators that operations in MNPS airspace will be strictly monitored and to advise operators of the investigative responsibilities of ASI's.

PART 1 GENERAL INFORMATION
1. Operator's name and address
2. Aircraft identification number/type
3. Aircraft home base
4. PIC's name
5. PIC's address
6. PIC's certificate number Type of certificate
7. Date and time (UTC) ATC observed aircraft in special use airspace. (If aircraft did not enter special use airspace, disregard the next question.)
8. Radar unit observing aircraft in special use airspace

Investigator	Date	Routing Symbol

FIGURE 3-7. INVESTIGATIVE REPORT FOR SPECIAL USE AIRSPACE LOA - Continued

PART 2 OPERATOR INFORMATION
9. Was a letter of authorization issued to this operator? If so, list LOA number (if applicable) or the date of issue and issuing office.
10. For which special use airspace was the LOA issued?
11. Has any navigation equipment been removed since issuance of the LOA? (List, if applicable)
12. Has any navigation equipment been installed since issuance of the LOA? (List, if applicable)
13. Have any altimeters been removed since issuance of the LOA? (List, if applicable)
14. Have any altimeters been installed since issuance of the LOA? (List, if applicable)
15. Did crew experience any navigation or altimeter equipment malfunctions?
16. Did PIC attend any international training courses? If so, list source(s) of training.
17. List latest date of PIC initial or recurrent training.
18. Did the PIC have a clear understanding of the special use airspace restrictions and PIC operational responsibilities?
19. What followup action is planned to prevent recurrence?

Investigator	Date	Routing Symbol

(2) The operator must furnish proper aircraft documentation showing the approval basis of the installation. The original equipment list, which may be the basis for compliance with the aircraft type certificate (TC), and FAA Form 337, "Major Repairs and Major Alterations," showing compliance with an appropriate aircraft supplemental type certificate (STC) or FAA field approval.

(3) If the LRNS equipment has met the accuracy requirements of FAR Part 91, Appendix C as determined by the manufacturer during certification flight tests in MNPS in conjunction with the appropriate aircraft certification office (ACO), the limitations section of the flight manual supplement will state that the particular LRNS equipment is authorized for use in NAT MNPS. If that authorization is not found in the limitations section, the request for approval to operate in MNPS airspace will be denied.

c. Acceptable Means of Compliance. In developing the MNPS concept, it was recognized that an indication of an "adequate means of compliance" would be needed, with specifications in terms of aircraft equipment. However, equipment specifications are only one part of the total quality of performance required. Flightcrews must be qualified for oceanic operations and be specifically qualified to operate under the rigid demands of the NAT MNPS airspace rules. The operator may prepare an international operations procedures manual, or may incorporate those procedures as a separate chapter of the Aircraft Operations Manual. In either case, the information must be accessible to the flightcrew. The manual should include specific preflight, in-flight, and postflight procedures. It should specify the crewmembers responsible for waypoint insertion and verification, the waypoint coordinates source, and procedures for waypoint insertion and verification. Much of this information will depend upon the type of LRNS equipment in use. Procedures for recording equipment accuracy should be included. An actual log should be depicted in the manual, and a sample log page submitted with the application for the LOA. Additionally, plotting chart procedures should be included in the manual and a completed sample chart should be submitted. An LRNS checklist that includes LRNS equipment failure procedures should be incorporated with the regular aircraft checklists.

d. Navigational Requirements. There are two navigational requirements for aircraft planning to operate in NAT MNPS airspace. One refers to track-keeping accuracy, and the second refers to stand-by equipment with comparable performance characteristics (refer to ICAO Annex 6 Parts I and II, Chapter 7). To justify consideration for state approval for unrestricted operation in NAT MNPS airspace, an aircraft needs to be equipped with two fully serviceable LRNS's. It is not satisfactory for NAT MNPS operations to rely on intermittent updates of aircraft position. The standards require navigation equipment that continuously indicates to the flightcrew the aircraft's adherence to or departure from track, to the required degree of accuracy, at any point along that track. Thus, it is highly desirable, and probably essential, that the navigation system in use is coupled to the autopilot so that continuous steering guidance is provided.

e. INS, Inertial Sensor System (ISS), IRS, and Flight Management Control System (FMCS) Equipment. Extensive experience has been gained, both in the NAT region and on a world-wide basis, in the use of INS's, ISS, IRS's, and FMCS's. INS and ISS/IRS, when coupled with a FMCS for automatic flight guidance, have clearly demonstrated a capability to meet the MNPS. Some smaller aircraft may carry two IRS's (or ISS), but only one FMCS. Such an arrangement may meet trackkeeping parameters, but does not provide the required redundancy (in terms of continuous indication of position relative to track or of automatic steering guidance) should the FMCS fail. If failure occurs, dual FMCS's are required to obtain MNPS certification. INS is considered to be an LRNS. An FMCS with inputs from one or more IRS/ISS is considered an LRNS.

f. Omega Navigation System (ONS). Omega/VLF navigation systems are capable of satisfying the MNPS and have demonstrated levels of accuracy comparable to INS. However, monitoring of navigation performance in the NAT region has shown that the number of GNE's attributable to Omega equipped aircraft is disproportionately high when compared to INS equipped aircraft. Advice from the Omega Association suggests that many GNE's result from faulty positioning and installation of antennae, inadequate maintenance, and the use of old, unmodified equipment. States need to pay particular attention to these issues before granting MNPS approval to aircraft equipped with Omega. An ONS is considered to be a LRNS. An FMCS with inputs from one or more Omega sensor systems (OSS) is considered to be a LRNS. (Further information on Omega is contained in Chapter 8.)

g. Loran-C Equipment. Loran-C equipment with an integral navigation computer has an acceptable performance accuracy, but use of this equipment entails limited MNPS approval. Aircraft operations are restricted to routes where unambiguous ground wave cover is available (see Loran-C coverage diagrams in Appendix 2).

h. Doppler Equipment. The use of Doppler equipment capable of displaying drift, groundspeed, and cross-track error has been approved, on occasions, in conjunction with single INS, Omega, or Omega/VLF for operations in NAT MNPS airspace. However, such approvals are considered to be at the lowest acceptable level of navigation suitable for MNPS airspace. Doppler requires that continuous attention be paid to in-flight rating of, and compensation for, systematic errors to guard against failure of the other single aid. Thus, installation of Doppler radar plus one other LRNS cannot be recommended for unrestricted MNPS operations.

i. GPS. GPS technology is changing rapidly; therefore, FAA GPS policies and procedures are also changing. Chapter 8 of this AC, at the time of publication, contains the latest GPS guidance; however, operators should be advised that the most recent GPS information will be distributed through other FAA documentation that is published more frequently.

j. Summary. For state approval of unrestricted operations in MNPS airspace, an aircraft is required to be equipped with two fully serviceable LRNS's. An LRNS may be an INS, an ONS, or an FMCS with inputs from one or more IRS or ONS. Each LRNS must be capable of providing a continuous indication to the flightcrew of the aircraft's position relative to track. It is highly desirable, and probably essential, that the navigation system employed for the provisions of steering guidance is capable of being coupled to the autopilot.

5. RVSM - ADDITIONAL CONSIDERATIONS FOR APPROVAL.

a. General. Airspace where RVSM is applied should be considered special use airspace. Both the individual operator and the specific aircraft type or types which the operator intends to use should be approved by the appropriate FSDO before the operator conducts flights in RVSM airspace. Draft AC 91-RVSM, "Approval of Aircraft and Operators for Light in Airspace Above FL 290 Where a 1,000 Foot Vertical Separation is Applied," is scheduled for publication in late 1993. This document will provide specific guidance for the approval of aircraft types for flight in airspace where RVSM is applied.

b. Approval of Aircraft. Each aircraft type that an operator intends to use in RVSM airspace should have received FAA approval in accordance with AC 91-RVSM. The specific airworthiness approval process and the continued airworthiness maintenance requirements will be detailed in AC 91- RVSM. Operational approval is described in the following paragraph.

c. Operational Approval. Section 4 of this Chapter describes in general the administrative process which an operator should follow to receive approval or to renew a LOA to operate an aircraft in RVSM airspace. The FSDO to which an application for approval has been submitted must be satisfied that operational programs are adequate. Flightcrew qualifications as well as operation manuals will be evaluated. Approvals will be granted through the issuance of operation specifications or the issuance of an LOA. Further approval will be granted for each individual aircraft group utilized by an operator. The FSDO will ensure that each operator can maintain high levels of height- keeping performance. Details of these standards can be found in AC 91-RVSM.

d. Preapplication Meeting. A preapplication meeting should be scheduled between the operator and the certificate management office (CMO) or FSDO. The intent of this meeting is to inform the operator of FAA expectations in regard to approval to operate in a RVSM environment. The content of the operator

RVSM application, FAA review and evaluation, validation flight requirements, and conditions for removal of RVSM authority should be basic items of discussion.

e. Content of Operator RVSM Application. The following paragraphs describes the material which an operator applying for RVSM authority should provide to the FAA for review and evaluation at least 60 days prior to the intended start of RVSM operations.

f. Application Form. Figure 3-5 is an acceptable format for a LOA. This figure may be copied and the top section down to the "For FAA Use Only" section filled out by the operator.

g. Airworthiness Documents. Sufficient documentation must be available to show that the aircraft has been approved by appropriate airworthiness authorities.

h. Description of Aircraft Equipment. A description of the aircraft equipment appropriate to operations in an RVSM environment should be included on the application form.

i. Training Programs and Operating Practice and Procedures. FAR Part 121 and FAR Part 135 operators should submit training syllabuses and other appropriate material to the certificate-holding district office (CHDO) or FSDO to show that the operating practices, procedures, and training items related to RVSM operations are appropriately incorporated in initial and recurrent training programs. FAR Part 91 operators must demonstrate to the FSDO that their knowledge of RVSM operating practices, procedures and qualifications is equivalent to FAR Part 121 and FAR Part 135 operators and is sufficient to warrant the granting of an LOA to conduct RVSM operations. Practice and procedural training in the areas listed in Chapter 10 of this AC should be standardized along with the specific guidelines that follow.

(1) During flight planning, the flightcrew should pay particular attention to conditions which may affect operation in RVSM airspace. These include, but may not be limited to:

(a) reported and forecast weather conditions on the route of flight

(b) minimum equipment requirements pertaining to height-keeping systems

(2) The following specific actions should be accomplished during preflight:

(a) Review maintenance logs and forms to ascertain the condition of equipment required for flight in the RVSM airspace. Ensure that maintenance action has been taken to correct defects to required equipment.

(b) During the external inspection of aircraft, particular attention should be paid to the condition of static sources and the fuselage skin in the vicinity of each static source, and of any other component that affects altimeter system accuracy. This check may be accomplished by a qualified and authorized person other than the pilot; e.g., a flight engineer or maintenance personnel.

(c) Before takeoff, the aircraft altimeters should be set to the local altimeter (QNH) setting and should display a known elevation (e.g., field elevation) within the limits specified in the aircraft's operating manuals. The two primary altimeters should also agree within limits specified by the aircraft's operating manual. An alternate procedure using airport altitude (QFE) may also be used. In either case, the maximum deviation value for the checks cited in operating manuals should not exceed 75 feet.

(d) Before takeoff, equipment required for flight in RVSM airspace should be operative, and indications of malfunctions should be resolved.

(3) Before entering RVSM airspace, the pilot should review the status of required equipment. Should any of the required equipment fail prior to entering RVSM airspace, the pilot should request a new clearance so as to avoid flight in this airspace. The following equipment should be operating normally:

(a) two primary altitude measurement systems

(b) one automatic altitude-control system

(c) one altitude-alerting device

NOTE: Redundancy requirements for altitude control systems should be established by regional agreement after an evaluation of criteria such as mean time between failures, length of flight segments, and availability of direct pilot-controller communications and radar surveillance. An operating transponder may not be required for entry into all designated RVSM airspaces. The operator should determine the requirements for an operational transponder in each RVSM area where operations are intended. The operator should also determine the transponder requirements for transition areas adjacent to RVSM airspace.

(4) The following actions should be accomplished while in-flight:

(a) Emphasis should be placed on promptly setting the subscale on all primary and standby altimeters to 29.92'' Hg/1013.2 hPa when passing the transition altitude and rechecking for proper altimeter setting when reaching the initial cleared flight level (CFL).

(b) In level cruise, it is essential that the aircraft is flown at the CFL. This requires that particular care is taken to ensure that ATC clearances are fully understood and followed. Except in contingency or emergency situations, the aircraft should not intentionally depart from CFL without a positive clearance from ATC.

(c) During cleared transition between levels, the aircraft should not be allowed to overshoot or undershoot the old or new FL by more than 150 feet (45 meters).

NOTE: It is recommended that the level off be accomplished using the altitude capture feature of the automatic altitude-control system, if installed.

(d) An automatic altitude-control system should be operative and engaged during level cruise, except when circumstances such as the need to retrim the aircraft or turbulence require disengagement. In any event, adherence to cruise altitude should be done by reference to one of the two primary altimeters.

(e) The altitude-alerting system should be operative.

(f) At intervals of approximately 1 hour, cross-checks between the primary altimeter should be made. A minimum of two must agree within ± 200 feet (± 60 meters). Failure to meet this condition will require that the altimetry system be reported and that ATC be notified.

(g) For flights conducted in oceanic/remote areas, the hourly altimeter cross-check should include comparing the primary altimeters to the standby altimeter. This information can be useful in contingency situations, such as when a spread/split between primary altimeters or altimeter system malfunctions occurs.

(h) The operating altitude reporting transponder should be connected to the altimetry system being used to control the aircraft.

(i) If the pilot is advised in real time that the aircraft has been identified by a height monitoring system as exhibiting a total vertical error (TVE) greater than ± 300 feet (± 90 meters) and/or altitude system error (ASE) greater than ± 245 feet (± 75 meters), then the pilot should follow established regional procedures to protect the safe operation of the aircraft. (This assumes that the monitoring system will identify TVE or ASE within agreed levels of accuracy and confidence.)

(j) If the pilot is notified by ATC of an assigned altitude deviation (AAD) error which exceeds ± 300 feet (± 90 meters), the pilot should take action to return to the CFL as quickly as possible.

j. Contingency Procedures After Entering RVSM Airspace. The pilot should notify ATC of contingencies which affect the ability to maintain the CFL and coordinate a plan of action. Section 6 of this

Chapter contains detailed guidance for contingency procedures for NAT airspace. Examples of equipment failure that should be reported to ATC include the following:

(1) failure of all automatic altitude control systems aboard the aircraft;

(2) loss of redundancy of altimetry systems, or any part of these, aboard the aircraft;

(3) loss of thrust on an engine necessitating descent; and

(4) any other equipment failure affecting the ability to maintain CFL.

The pilot should notify ATC when encountering greater than moderate turbulence. If unable to notify ATC and obtain an ATC clearance prior to deviating from the assigned CFL, the pilot should follow established contingency procedures to leave the assigned route or track and obtain ATC clearance as soon as possible.

k. Flightcrew Training. Chapter 10 of this AC details crew training for oceanic operations.

6. SPECIFIC CONTINGENCY PROCEDURES FOR THE NAT AIRSPACE.

a. Background. If a pilot is unsure of the vertical or lateral position of the aircraft, or if the aircraft deviates from its assigned altitude or track for cause without prior ATC clearance, the pilot must take action to mitigate the potential for collision with aircraft on adjacent routes or FL's. In this situation, the pilot should alert adjacent aircraft by making maximum use of aircraft lighting and by broadcasting position, FL, and intentions on 121.5 megahertz (MHz). Unless the nature of the contingency dictates otherwise, the pilot should advise ATC as soon as possible of a contingency situation and request an ATC clearance before deviating from the assigned route or FL if possible. If a revised ATC clearance cannot be obtained in a timely manner and action is required to avoid potential conflict with other aircraft, then the aircraft should be flown at an altitude and/or track where other aircraft are least likely to be encountered. This can be accomplished by offsetting from routes or altitudes normally flown in the airspace. In order of preference, these are the following actions:

- The pilot may offset half the lateral distance between routes or tracks.
- The pilot may offset half the vertical distance between altitude normally flown.
- The pilot may also consider descending below FL 285 or climbing above FL 410 (these altitudes are sparsely occupied).

When executing a contingency maneuver, the pilot should perform the following:

- watch for conflicting traffic;
- continue to alert other aircraft using 121.5 MHz and aircraft lights;
- continue to fly tracks or altitudes which are likely to be occupied; and
- obtain an ATC clearance as soon as possible.

7. THE MONITORING PROCESS IN THE NAT REGION.

a. Introduction. Radar stations that monitor NAT oceanic airspace boundaries collect data that includes information on MNPS airspace flights derived from agreed radar stations and data from other radars concerning non-MNPS airspace flights. The MNPS data gives direct input into the risk modelling of the MNPS airspace, while the non-MNPS data provides a wider understanding of navigation in the NAT region and allows followup action to be taken on a larger number of flights that are believed to have had a navigation error. The data collection process includes continuous collection of all deviations of 20 Nm or more, and collection of data on deviations of less than 20 NM as required.

b. Central Monitoring Agency (CMA). In March 1980, the NAT SPG realized that implementation of the 60 NM lateral separation minimum would place special importance on the monitoring and assessment of navigation performance. Therefore, the SPG agreed to collect, collate and circulate data regarding navigation performance in the NAT region to states participating in the monitoring. The United Kingdom acts as CMA on behalf of the NAT SPG and has accepted responsibility for the collection, analysis, and dissemination of data relevant to navigation specifications. Information received includes the following:

(1) monthly routine reports (from Canada and the United Kingdom) on the number of MNPS flight operations, both OTS and random;

(2) reports of GNE's observed by radar supplemented by information on causes, responses by operators and/or states, and the corrective action taken; and

(3) information on errors not observed by radar that became known by other means or from other sources.

The reports of errors not observed by radar are recorded because their inclusion and investigation can provide useful information, particularly in respect to errors and/or omissions resulting from non-compliance with the prescribed position reporting procedures, errors resulting from misunderstandings of clearances, and/or differences in interpretations between pilots and ATC regarding instructions passed. The CMA provides participating states with a monthly summary so that they may be kept current on overall developments. The CMA also provides special reports as necessary to enable states to decide on a common course of action.

c. ***Deviations from Track.*** If a deviation of 20 NM or more from assigned track is observed by radar, it is important that the pilot is immediately advised and that any comment is recorded. Followup action includes notification of the operator, the operator's state of registry, and the CMA. The appropriate authority of the state that collected the data will investigate the causes of each deviation, either directly or through the CMA, in cooperation with the operator. That agency also notifies the operator's state of registry. Such a procedure is used by Canada, France, Iceland, Ireland and the United Kingdom. All information about detected deviations and their causes, as well as any other information relating to navigation performance within the NAT region, is made available to the NAT SPG by the CMA. The data is provided on a monthly basis in a format permitting ready determination of whether MNPS criteria are being met. Such analysis is made of all available data to determine overall safety. Analysis is also made of data concerning specific navigation systems or operators, if it is suspected that they may no longer meet the specification.

If one or more of the MNPS criteria have been exceeded, the NAT SPG reviews the data and, if necessary, proposes appropriate action. There are at least two general classes of errors that can result in large lateral deviations. One of these concerns a progressive deviation from track because of navigation inaccuracy, and the other covers cases when an aircraft flies to or along a track adjacent to its intended track as the result of an operational error. The second type, though extremely dangerous, cannot be prevented by increasing the lateral separation but must be eliminated by improvements to the operating procedures.

If summary statistics indicate that the MNPS criteria are greatly exceeded, rapid response to the causes of the problems may be necessary. In such a case, the states responsible for ATC in the NAT region will take prompt action after consultation with at least the major affected users. An example of when such prompt action may be necessary is a serious disturbance of the coverage of station-referenced systems due to unserviceability of ground stations or severe ionospheric disturbances. Such action must be possible even when the number of large deviations in the limited area where the navigation performance is monitored is not excessive and if there is a reason to believe that large errors might occur elsewhere.

When the summary statistics show that the criteria have not been greatly exceeded, or if the observed performance merely shows a trend towards degradation, it will be more useful to conduct a detailed investigation, for instance by the NAT SPG. Although this may take several months, it must be remembered that the TLS is equivalent to expecting about one collision every 150 years, and that a small increase in the statistical probability of collision during a 6 or 12 months period is considered acceptable. An investigation may show that the cause of a large deviation can be eliminated by improved procedures, which will then be brought to the attention of the operators and/or ATC through the appropriate channels. Results of the actions will then be closely observed. If the causes cannot be eliminated quickly, the aircraft's state(s) of registry should temporarily exclude offending operators from MNPS airspace. In order to restore the situation, an increase in lateral separation should be made only in extreme cases and only when other actions have failed to produce the desired results. It is important that all agencies react promptly to reports of radar-based deviations. Investigation should begin at once so that consideration can be given to the need for remedial action (equipment improvements, crew training, etc.), especially if a specific trend becomes evident. In order for the deviation reports to receive prompt study, it would be prudent for each airline/operator to designate an individual to be responsible for receiving reports and initiating investigations. This individual's name and address should be made available to the appropriate ATC authorities.

Experience with the monitoring process shows that a number of the observed GNE's are attributable to aircraft operating in MNPS airspace without the required approval. For this reason, ATC units have been requested to notify the CMA of any flights, identified as a result of random checks, that operated in MNPS airspace but are considered unauthorized for that operation. In 1990, to reinforce the random checks, the NAT SPG introduced a program of tactical monitoring to help identify aircraft operating within MNPS airspace without the required approval. Currently Canada, Iceland and the United Kingdom participate in the program by selectively asking pilots requesting clearance to enter NAT MNPS airspace to confirm that they have been approved for that operation. Pilots unable to confirm, or uncertain of their approval status, are issued a clearance to operate outside MNPS airspace and a report is forwarded to the CMA for followup.

*d. **Followup of Observed and Reported Deviations.*** Different arrangements exist within those states participating in monitoring, but followup action on observed deviations of 20 NM or more by aircraft operating within MNPS airspace generally includes the following steps:

(1) the observing ATC unit should, if at all possible, inform the pilot of the observed error, that an error report will be processed, and record any comment made by the pilot at the time of notification; and

(2) all operators and relevant ATC units should be notified of the deviation, either directly by the observing ATC unit or by an agency designated by the state, by the speediest means available (telephone, AFTN, telex) and with the least possible delay.

When a U.S.-registered aircraft that is not clearly identified as an air carrier or military operator is involved in a deviation, a copy of the initial error signal should be sent to the company/agency that submitted the ICAO flight plan. The full flight plan details and the name of the PIC should then be forwarded to the Federal Aviation Administration, Flight Standards National Field Office, AFS-550, P.O. Box 20034, Washington, DC 20041.

For aircraft operating outside MNPS airspace:

(1) the observing ATC unit should, if at all possible, inform the pilot of the observed error, that an error report will be processed, and record any comment made by the pilot at the time of notification; and

(2) if the observed deviation from track is 50 NM or more, all operators and relevant ATC units should be notified of the deviation, either directly by the observing ATC unit or by an agency designated by the state, by the speediest means available (telephone, AFTN, telex) and with the least possible delay. This should be followed as soon as possible by a written confirmation. All notifications should be copied to the CMA and the operator's state of registry.

(3) If the observed deviation from track is 20 NM or more but less than 50 NM, the observing ATC unit, or other agency designated by the state, should notify the CMA of the deviation with the least possible delay (telephone, AFTN, telex). This should be followed as soon as possible by a written confirmation if necessary. The CMA will advise the state of registry.

e. Additional Reports to CMA. Whenever possible, details of the following occurrences should be reported to the CMA. Any erosion of the longitudinal separation between aircraft in MNPS airspace in excess of 3 minutes, altitude deviations of 300 ft or more, as observed on radar (Mode 'C' SSR) or by scrutiny of pilot reports (see Figure 1-4, Appendix 1), or any occasion when ATC takes action to prevent a GNE should be reported.

f. Further Followup by Operator and/or State. Subsequent followup on observed deviations of 20 NM or more, reported in accordance with the above provisions, should initially be conducted between the operator and a designated state agency responsible for the ATC unit that observed the deviation, on the understanding that:

(1) deviations of 20 NM or more but less than 50 NM, occurring outside MNPS airspace, will not normally require further action. If an investigation is deemed necessary it will be conducted by the state of registry;

(2) monitoring states may request the assistance of other states in monitoring activities;

(3) the operator's state of registry should be requested to conduct a further investigation if deemed necessary;

(4) all correspondence should be copied and forwarded to the CMA; and

(5) the European office of ICAO will assist in those cases when no response is obtained from either the operator or the state of registry.

When a GNE in MNPS airspace is observed by ATC, crews shall provide the controlling authority with detailed information on the cause of the error, including LOA number and expiration date, upon request. This information is not necessarily for the purpose of enforcement. In many cases, equipment errors and/or procedural errors caused the error, and investigators are able to work with crews to eliminate future occurrences. The type of data needed for an Oceanic Navigation Error Report (ONER) is listed in Figure 3-8. Pilots will be required to provide ATC with most of this information, and should be prepared to do so when operating in MNPS airspace. Most of the information should be contained in the flight journal for each flight in MNPS airspace, and will always be available. Altitude deviations, erosion of longitudinal separation, and requests for verification of LOA's may also require investigations. All of these investigations are similar to an investigation of a GNE. Therefore, crews must provide the controlling authority with detailed information on these deviations in a similar manner.

FIGURE 3-8. OCEANIC NAVIGATION ERROR REPORT

TO: AFS-500 - FAX NUMBER (703) 661-0367 and CMA - TELEX NUMBER 883092

FROM: ______________ - FAX NUMBER ______________/PHONE NUMBER ______________

INFORMATION PROVIDED BY AIR TRAFFIC (ONER OR OADR)
1. Gross navigation error report message ☐ Altitude deviation of 300 feet or more ☐ (Check one)
2. Reporting agency and reporting number, if used
3. Date of occurrence
4. Time of occurrence (UTC)
5. Aircraft identification and operator (If military, provide call sign)
6. Aircraft type
7. ATC cleared route or track
8. Radar observed position (in latitude and longitude) and distance left or right of assigned route or track or observed* or reported** flight level or altitude (*Use observed if Mode C; **reported if pilot reported)
9. Assigned flight level or altitude
10. Crew comments when notified
11. Location where flight plan filed (For general aviation aircraft, insert the 4-letter ICAO location identifier. For air carrier aircraft insert the company or agency which filed the flight plan.)
12. Type of long-range navigation equipment in use
13. Did ATC advise operator of occurrence?
14. Remarks (anything which might assist in the investigation or analysis)
15. Flight plan data. (Forward flight plan, if available. If the flight plan is not available, enter any available information to help locate the operator, such as identification of departure and arrival points.)
16. Please acknowledge receipt.

FIGURE 3-8. OCEANIC NAVIGATION ERROR REPORT - Continued

TO BE COMPLETED BY FLIGHT STANDARDS
17. Operator/crew identification and remarks (For military, provide call sign only)
18. Was the use of special use airspace authorized?
19. Cause of deviation
20. Investigator's comments
21. Corrective action recommended or initiated
22. Flight Standards National Field Office assigned report number
23. Attachments - Please indicate what additional information is attached to this report by circling "yes" or "no," as appropriate. • ONER/OADR supplemental information record* Yes No • Flight log Yes No • Waypoint notebook Yes No • ATC flight plan Yes No • Other (please identify) ______________________ * See FAA Order 8700.1, Chapter 223.

FIGURE 3-9. OCEANIC ALTITUDE DEVIATION REPORT

TO: AFS-500 - FAX NUMBER (703) 661-0367 and CMA - TELEX NUMBER 883092

FROM: ____________ - FAX NUMBER ____________/PHONE NUMBER ____________

INFORMATION PROVIDED BY AIR TRAFFIC (ONER OR OADR)
1. Gross navigation error report message ☐ Altitude deviation of 300 feet or more ☐ (Check one)
2. Reporting agency and reporting number, if used
3. Date of occurrence
4. Time of occurrence (UTC)
5. Aircraft identification and operator (If military, provide call sign)
6. Aircraft type
7. ATC cleared route or track
8. Radar observed position (in latitude and longitude) and distance left or right of assigned route or track or observed* or reported** flight level or altitude (*Use observed if Mode C; **reported if pilot reported)
9. Assigned flight level or altitude
10. Crew comments when notified
11. Location where flight plan filed (For general aviation aircraft, insert the 4-letter ICAO location identifier. For air carrier aircraft insert the company or agency which filed the flight plan.)
12. Type of long-range navigation equipment in use
13. Did ATC advise operator of occurrence?
14. Remarks (anything which might assist in the investigation or analysis)
15. Flight plan data. (Forward flight plan, if available. If the flight plan is not available, enter any available information to help locate the operator, such as identification of departure and arrival points.)
16. Please acknowledge receipt.

FIGURE 3-9. OCEANIC ALTITUDE DEVIATION REPORT - Continued

TO BE COMPLETED BY FLIGHT STANDARDS
17. Operator/crew identification and remarks (For military, provide call sign only)
18. Was the use of special use airspace authorized?
19. Cause of deviation
20. Investigator's comments
21. Corrective action recommended or initiated
22. Flight Standards National Field Office assigned report number
23. Attachments - Please indicate what additional information is attached to this report by circling "yes" or "no," as appropriate. • ONER/OADR supplemental information record* Yes No • Flight log Yes No • Waypoint notebook Yes No • ATC flight plan Yes No • Other (please identify) ____________ * See FAA Order 8700.1, Chapter 223.

8. AIRCRAFT EQUIPMENT AND IN-FLIGHT OPERATING PROCEDURES IN MNPS AIRSPACE.

a. Introduction. Good operating practices in navigation are essential to application of the MNPS concept. Fundamental differences exist between navigation systems, but the basic procedures for their application have much in common. Most Omega flightdeck displays have intentionally been designed so that controls and information displays resemble INS as much as possible. In this AC, "Omega" refers to automatic equipment that meets the ARINC 580-599 specifications. Equipment that requires manual correction or plotting to determine position increases flightcrew workload and the possibility of error, and is not recommended for use in normal operations.

b. Cockpit Layout and Equipment Installation. Efficient operation and monitoring of the aircraft navigation system is enhanced if careful consideration is given to the location of the system components in the cockpit and to the various features provided. Control display units (CDU) should be within the primary visual scan of, and conveniently accessible to, either pilot. This places them forward and inboard of each pilot. CDU's should not be mounted on the overhead panel or on the aft portion of the central pedestal (i.e., to the side or rear of the pilot), nor should they be located outboard of each pilot. Retrofit costs and considerations should not override optimum location of the CDU's.

During navigation of the aircraft, it has become customary to display certain critical navigation system outputs continuously, such as cross-track error (XTK) and miles-to-go to next waypoint.

These outputs are displayed on the panel mounted radio navigation indicators, with a switch to permit selection of ADF/VOR or INS/ONS. Some operators recommend that present position be displayed on the steering CDU (either INS or ONS) and XTK miles on the other.

Flight progress alert lights should also be provided on the instrument panel. The waypoint alert light, to indicate that the waypoint is being approached, is standard. However, consideration should also be given to the installation of a XTK alert light, triggered to indicate a deviation such as 6-10 NM of XTK deviation. If the navigation system is inadvertently decoupled from the autopilot, such a light provides an early warning of XTK error. Also, some form of autopilot status light could be considered (e.g., green when coupled to the navigation system, red when uncoupled). The monitoring process has shown that errors occur because of the INS/ONS being inadvertently disconnected from the autopilot. There are problems in modifying existing equipment, but a cross-track warning system would be useful. Operators placing orders for new equipment should discuss this possibility with the manufacturer.

Navigation equipment should be protected from damage. Fluids can very easily cause damage; CDU's in particular should be protected from spilled beverages, and all component parts should be protected from moisture. A good standard of INS maintenance is important; a poor standard, or the approval of a regime which permits many in-flight failures, may not be cost effective because of the expensive difficulties which can result. It is preferable not to locate equipment in baggage holds, but if this cannot be avoided it requires protection against jarring and crushing. Care should be taken to prevent freight or baggage obstructing the ventilation of navigation units. Ventilation is an essential part of the cooling required for INS, Omega and Doppler equipment. The greatest problem is to provide adequate cooling of the equipment after the aircraft has been heat soaked while parked at a tropical airport. Adequate cooling is likely to be needed most of the time, so cooling facilities and warning of their failure are necessary.

c. Training. Whether using INS or ONS, crews need proper training. In the case of Omega, experience suggests more extensive training is necessary to ensure that crews have a general understanding of problems that may be encountered in-flight. INS and Omega, because of their precision and reliability, can induce a sense of complacency that tends to obscure the value of standard procedures, especially cross-checks. Under these circumstances, errors occur more easily. Special training programs for flightcrews using Omega should include efficient use of the equipment and indoctrination in the necessity and methods of avoiding errors. Crewmembers should be trained to develop a meticulous method of using CDU's, with careful cross-checking at all operational stages, in line with the procedures described in the NAT MNPS Operations Manual.

The operator should seek to retain the interest and cooperation of flightcrews in ensuring that a good standard of navigation performance is continuously maintained. This may be achieved during ground refresher courses, periodic routine checks, or by issuing periodic newsletters. Such newsletters might include statistics on fleet navigation performance, and could include analyses of errors and reports volunteered by crews on instances of equipment being mishandled. However, reminders should not be so frequent as to be self-defeating. Crew training should stress the need for accurate trackkeeping and emphasize the need for good navigation along track (i.e., careful application of the mach number technique, accurate position reporting, and the use of accurate time in reporting positions).

d. Great Circle Routes. The navigation systems discussed in this AC, with their computers and related displays, provide the ability to fly direct Great Circle routes. This feature can be attractive and useful to crews, and they need not be discouraged from taking advantage of it. However, during initial and refresher training, operators should ensure that crews are aware that it is necessary to obtain an ATC clearance for such routes; that the wind effect may be such that the Great Circle path is not the minimum time path of greatest value for fuel economy; and that, if not properly cleared by ATC, there may be the risk of the aircraft inadvertently entering restricted airspace or crossing political boundaries without authority. Finally, crew training should also include instruction on what action should be considered in the event of navigation systems failure.

9. OPERATIONS OUTSIDE MNPS AIRSPACE.

a. Introduction. Aircraft may operate in the NAT region either within or outside of MNPS airspace. For operations within MNPS airspace, a specific approval from the state of registry or the state of the operator is required, regardless of the category of the operator; i.e., state, IGA or public transport. This section provides information to pilots for flight planning and operations, in particular of light aircraft, wishing to cross the NAT region below FL 275. Pilots wishing to cross at FL 410 or above should make particular note of the climb/descent provisions below. A number of incidents have occurred with NAT IGA flights that were caused by noncompliance with basic requirements for navigation and communications equipment needed for oceanic flights or flights over remote areas. Most of these incidents were potentially hazardous to the occupants of the aircraft and to SAR personnel. Some have resulted in needless and expensive alert activities on the part of ATC and in search activities on the part of rescue facilities. Reduction or elimination of the incidents, which have generally involved flights that were considerably off-course or had not reported their position as required, is needed so that the unnecessary expenditure of resources is eliminated. In support of this, the NAT SPG published (in October 1990) the "North Atlantic International General Aviation Operations Manual." This manual simplifies many of the technical aspects contained in this AC, and is an excellent supplement.

b. The NAT Operational Environment. The climate affecting NAT flight operations is demanding throughout the year, with storms or other adverse weather likely to be encountered during any season. It is probable that at least a portion of the route will be affected by adverse weather conditions. The scarcity of alternate airports available to transatlantic flights requires that all significant weather systems along the route be considered during flight planning.

c. Flight Preparation. Refer to Chapter 2 of this AC.

d. Equipment Requirements. Refer to Chapter 2 of this AC.

e. Communication Requirements. The VHF emergency frequency 121.5 MHz is not authorized for routine use. The frequency 131.800 MHz has been designated for use as the air-to-air communication channel in the NAT region. Additional communication requirements are detailed in Chapter 2 of this AC.

f. Special Requirements for Flights Transiting Greenland. The elevation of the highest point in Greenland is 13,120 feet mean sea level (MSL), and the general elevation of the icecap is 9,000 feet MSL. Due to low temperatures and high wind speeds, the lowest usable FL under certain conditions may be FL

235 near the highest point, and FL 190 over the icecap. Information on the lowest usable FL on published ATS routes can be obtained from the Sondrestrom Flight Information Center. High capacity cabin heating systems are needed due to the very low in-flight temperatures usually encountered, even during the summer. Rapidly changing weather situations involving severe icing, turbulence, and heavy precipitation are common and require extra vigilance by pilots. The changes may be so rapid that they are difficult to forecast. An emergency locator transmitter (ELT) is required transiting Greenland due to the very difficult terrain that hampers searches. Compliance with the regulations is monitored, and states of registry will be informed of any infractions.

Airport flight information is available at Narssarssuaq, Nuuk/Godthab, Kulusuk, Ilulissat/Jakobshavn, and Constable Point airports. Approach and tower control services are provided within the Thule and Sondrestrom TMA/CTR. Only flight information and alerting service are provided within the Sondrestrom FIR below FL 195. IFR flights operating within the Sondrestrom FIR below FL 195 must have functional radio equipment capable of operating on the published HF frequencies for Sondrestrom. Flights operating within the Sondrestrom FIR below FL 195 (i.e., Reykjavik or Gander CTA's) and outside of VHF coverage of Iceland or Gander must have functional radio equipment capable of operating on the published HF frequencies for Iceland/ Gander.

g. Special Requirements for Flights Transiting Iceland. The general elevation of the mountainous areas in Iceland is approximately 8000 feet MSL. Due to the great difference in pressure and high wind speeds, the lowest usable FL may, under certain conditions, be FL 120. An ELT with an energy supply independent of the aircraft must be carried, and must be capable of functioning continuously outside the aircraft for at least 48 hours, and transmitting simultaneously on the frequencies 121.5 and 243 MHz. Aircraft should be equipped with sufficient and appropriate arctic survival equipment, including as a minimum the following:

(1) a signalling sheet (1 x 1 meter) in a reflecting color

(2) a compass

(3) a winter sleeping bag for each person on the aircraft

(4) matches in waterproof covers

(5) a ball of string

(6) a stove and fuel supply or other self-contained means of providing heat for cooking, with the accompanying mess-tins

(7) a snow saw

(8) candles or other self-contained means of providing heat, with a burning time of about 2 hours/ person, with the total carried to be no less that 40 hours of burning time

(9) personal clothing suitable for the climatic conditions along the route to be overflown

(10) an arctic survival manual

(11) mosquito netting and insect repellent

Aircraft operating in the oceanic sector of the Reykjavik FIR must maintain a continuous watch on the appropriate frequency of Iceland Radio. When operations take place outside of VHF coverage, carriage of an HF transceiver operational on appropriate frequencies is mandatory. However, prior approval may be obtained for flight outside VHF coverage and without HF equipment. Flights operating under this special approval are responsible for obtaining similar approval for operating in the airspace of adjacent ATC units. Flights between FL 80 and FL 195 on the route between Sondrestrom and Keflavik, passing through 65N 30W and Kulusuk, are exempted from the HF requirements. Flights between the United Kingdom and Iceland, which are routed at or north of 61N 10W, are exempted from the HF equipment requirement. However, if the VHF transmitter/receiver at Faeroe Islands is unserviceable, prior approval is required from Reykjavik area control center (ACC).

Navigation equipment adequate for operation in accordance with the flight plan and with ATC clearances shall be carried. SSR transponders with Mode 3/A and C are required in Iceland. Pilots shall operate SSR transponders continuously on Mode A, Code 2000. Departing aircraft shall retain the last assigned code for 30 minutes after entry into NAT oceanic airspace unless otherwise instructed by ATC. This procedure does not affect the use of special purpose codes 7500, 7600 or 7700 when required.

10. TEMPORARY AIRSPACE RESERVATIONS.

a. Introduction. The NAT SPG members have agreed to applicable definitions regarding airspace reservations, principles governing the establishment and management of airspace reservations, and specific values to be used in the NAT region in order to keep controlled flights separated from airspace reservations.

b. Management of Temporary Airspace Reservations. Prior to requesting the establishment of a temporary airspace reservation, the requesting agency shall obtain full information on the likely effect of such a reservation on air traffic. Such information shall include areas of high traffic density that may exist in the vicinity or at the planned location of the airspace reservation, as well as information on peak periods of traffic operating through such areas. In light of that information, the requesting agency should, to the extent possible, select the site of the airspace reservation and the time and duration so as to have the least effect on normal flight operations in that area. In specifying the extent and duration of a requested temporary airspace reservation, the requesting agency shall limit the size of the area to the absolute minimum required to contain the intended activities within that area, taking due account of:

(1) the navigation capability of aircraft or other vehicles within the reservation;

(2) the means available to monitor those activities so as to guarantee that they will be confined within the airspace reservation; and

(3) the ability to interrupt or terminate activities.

The protection required for aircraft operating in the vicinity will be ensured by the ATC unit responsible for the airspace where the temporary airspace reservation is located. For this reason, the requesting agency should not add any protective value to the size of the area requested. The duration of the airspace reservation shall be limited, taking a realistic account of activity preparation and the time required to vacate the reservation after the completion of the activities. The actual use of the temporary airspace reservation shall be based on appropriate arrangements made between the requesting agency and the ATS unit responsible for the airspace, or special agents acting on its behalf. Such arrangements should cover the start of the use of the temporary airspace reservation; the termination of its use; and emergency provisions in case of unforeseen events affecting the activities to be conducted within the temporary airspace reservation. When a temporary airspace reservation extends into the area of responsibility of more than one ATS unit, the requesting agency shall negotiate this airspace reservation simultaneously with all ATS units concerned or the special agents acting on their behalf. The arrangements concluded shall be covered by common arrangements applicable to all parties concerned. If a temporary airspace reservation is likely to affect the provision of ATS by adjacent ATS units, the ATS unit directly affected by that airspace reservation shall ensure that the necessary coordination with those affected ATS units takes place in advance. The ATS unit normally responsible for ATS in the area of a temporary airspace reservation shall ensure that all traffic operating under its responsibility will not approach within the limits (horizontal and vertical) of the temporary airspace. Where necessary, such values shall be uniform and shall be established in accordance with agreements reached between the ATC authorities concerned for temporary airspace reservations in a given area.

CHAPTER 4. NORTHERN PACIFIC OCEANIC OPERATIONS

1. THE NOPAC SYSTEM.

a. General. Due to increases in passenger demand, time zone differences, airport noise restrictions, and other factors, most Northern Pacific (NOPAC) air traffic is concentrated in predictable flow patterns. The effect of these flows is that eastbound traffic peaks between 0800 coordinated universal time (UTC) and 2000 UTC, and westbound traffic peaks between 2200 UTC and 0800 UTC. During peak periods, airspace becomes congested due to the limitations of the lateral and longitudinal separation required. This is compounded by winds aloft and route distances. The long route distances add to the critical aspects of the airspace because climb approval and altitude availability may necessitate in-flight decisions concerning destination. The most critical altitudes are flight levels (FL) 310 to 410.

b. Composite Route System. To more adequately meet present and future demands, the NOPAC Composite Route System was implemented in March 1982 to maximize use of available airspace while providing a safe and orderly traffic flow. The composite route system is comprised of five air traffic service (ATS) routes that travel the NOPAC between Alaska and Japan. The two northern routes are used for westbound traffic except for R580, which is used for eastbound traffic transiting the Tokyo/Anchorage flight information region (FIR) between 1000 UTC and 1700 UTC. The three southern routes are used for eastbound traffic, except that A590 is used for westbound aircraft crossing the Tokyo/Anchorage FIR between 2300 UTC and 0500 UTC when R220 and R580 traffic is saturated. The system allows a combination of 50 nautical miles (NM) lateral separation and 1,000 feet vertical separation on immediately adjacent routes. By management of route and altitude assignments, any aircraft at the same altitude and not longitudinally separated are laterally separated by at least 100 NM. Any aircraft on the same route are separated by 2,000 feet vertically or 20 minutes longitudinally. The longitudinal separation can be reduced to 10 minutes or less when mach techniques are applied. Standard oceanic (noncomposite) separation is used elsewhere unless radar services are provided or aircraft are within domestic control areas where domestic nonradar control procedures are used. A sample of a composite route, with latitude/longitude coordinates of reporting points and magnetic bearings and distances between them, follows:

Route R220

- BETHEL VORTAC - 239° 312 NM 057° -
- NABIE (N59°18.0′ W171°45.4′) - 237° 3296 NM 056° -
- NUKKS (N57°15.1′ E179°44.3′) - 237° 3297 NM 054° -
- NEEVA (N54°40.7′ E172°11.8′) - 241° 3281 NM 060° -
- NINNO (N52°21.5′ E165°22.8′) - 240° 3280 NM 058° -
- NIPPO (FIR boundary) (N49°41.9′ E159°19.3′) - 238° 3330 NM 053° -
- NYTIM (N46°11.9′ E153°00.5′) - 233° 3330 NM 051° -
- NOKKA (N42°23.3′ E147°28.8′) - 231° 3163 NM 049° -
- NOHO (N40°25.0′ E145°00.0′) - 231° 3122 NM 049° -
- NANAC (N38°54.2′ E143°13.9′)

(VHF) frequency 128.95 megahertz (MHz) is for exclusive use as an air-to-air communications channel. In emergencies, however, initial contact for such relays may be established on 121.5 MHz (the frequency guarded by all aircraft operating in the oceanic airspace) and transferred as necessary to 128.95 MHz. In normal HF propagation conditions, appropriate overdue action procedures are taken by ATC in the absence of position reports or relays. In all cases of communications failure, the pilot should follow the oceanic clearance last received and not revert to the original flight plan.

5. MACH NUMBER TECHNIQUE. Mach number technique for the South Pacific is identical to that used in NOPAC (see paragraph 5 in Chapter 4).

6. IN-FLIGHT CONTINGENCIES.

a. General. The procedures for in-flight contingencies are often aircraft specific, and therefore cannot be covered in detail here for every aircraft. However, the procedures listed provide for such cases as inability to maintain assigned FL due to weather, aircraft performance, and pressurization failure. These procedures are primarily applicable when rapid descent, turning back, or both are necessary. The pilot's judgment determines the sequence of actions taken while considering the specific circumstances.

b. Basic Procedures. If an aircraft experiences navigational difficulties, it is essential that the pilot inform ATC as soon as the condition is apparent so that appropriate action can be taken to prevent conflicts with other aircraft. If any aircraft is unable to continue flight in accordance with its ATC clearance, a revised clearance shall, whenever possible, be obtained prior to initiating any action, using the radio telephone distress or urgent signals, as appropriate. If prior clearance cannot be obtained, an ATC clearance shall be obtained at the earliest possible time; in the meantime, the aircraft shall broadcast its position (including the ATS route designator) and intentions on 121.5 MHz at suitable intervals until ATC clearance is received. In such circumstances, communications with certain VHF stations may be practical. Frequencies should be verified before using. A list of these stations follows:

Adak approach - 134.1 MHz
Shemya tower - 126.2 MHz
Anchorage Center - 128.5 MHz (Cold Bay)
Anchorage Center - 127.4 MHz (Dutch Harbor)
Anchorage Center - 127.8 MHz (St. Paul Island)
Anchorage Center - 128.2 MHz (Shemya)

If unable to comply with these provisions, the aircraft should leave its assigned route by turning 90 degrees to the right or left whenever possible. The direction of the turn should be determined by the position of the aircraft within the route system. The turn should be made in a direction that will keep the aircraft within the system and prevent any possible chance of a conflict with other traffic. For instance, aircraft on NOPAC routes should always turn south due to the proximity of these routes to the Russian FIR's. Aircraft on the northern route of the CEPAC route structure should turn south; aircraft on the southern route of the CEPAC route structure should turn north. An aircraft able to maintain its assigned level should, nevertheless, climb or descend 500 feet while acquiring and maintaining, in either direction, a track laterally separated by 25 nautical miles from its assigned route or track.

OTR-11 serves as a departure route from RJAA (Narita) and RJTT (Tokyo) into the eastbound NOPAC routes, and for eastbound traffic overflying Japan. OTR-11 routing is:

CVC (Choshi) - KAGIS - A590
CVC (Choshi) - KAGIS - 085° 91NM 266° - ABETS - A591
CVC (Choshi) - KAGIS - SCR (Score) - COMFE - G344

(2) Within the Anchorage/Oakland control area (CTA)/FIR's, OTR-14 serves traffic departing North America and transiting the Gulf of Alaska for the NOPAC route system. OTR-14 routing is:

N54°20' W0140°00' - 277° 402NM 090° - MARLO (N57°27.9' W150°31.7') - J123 - AKN (King Salmon) - EHM (Cape Newenham) - 250° 281NM 069° - OYSTA (N58°12.9' W170°57.4') - 251° 305NM 069° - NUKKS (N57°15.1' E179°44.3') - R220

OTR-15 serves traffic departing North America and transiting the Gulf of Alaska for the NOPAC composite route system. OTR-15 routing is:

N52°30' W140°00' - 274° 388NM 087° - N55°05' W150°00' - 273° 312NM 089° - PDN (Port Heiden NDB) - 258° 379NM 074° - SPY (St. Paul Island NDB/DME) - 250° 308NM 069° - ORDON (N56°12.8' W179°23.3') - R580

OTR-16 serves traffic departing the United States and transiting the North Pole for the NOPAC route system. OTR-16 routing is:

N48°00' W150°00' - 273° 416NM 088° - N50°15' W160°00' - 265° 385NM 081° - N51°10' W170°00' - 270° 250NM 089° - NUD (Adak) - J115 - SYA (Shemya) - 255° 296NM - 073° - OMPPA (N51°26.3' E166°20.2') - R580

2. GENERAL PROCEDURES.

a. Climb Times. All aircraft entering the Anchorage FIR and planning a higher altitude en route should forward the time that the climb to higher altitude is desired. This information should be included with the first mandatory position report. Although most carriers include climb times in their flight plans, actual loads, weather conditions, outside air temperature, and other factors are almost always different from the forecast situation. Pilots should notify air traffic control (ATC) if the climb time differs significantly. Climb times are used by controllers to determine action that may be necessary to preclude merging air traffic conditions. Advance planning usually means better airspace use, more altitude change approvals, and better service to more users. Without accurate climb times, an altitude change for one aircraft may cause other flights to be trapped at low FL's. Traffic permitting, cruise climbs to higher en route altitudes will be approved when requested.

b. Visual Flight Rules (VFR) Climbs. Requests for VFR climbs can only be approved when the aircraft is within the confines of Control 1234/Anchorage Continental FIR or Woody Island Control Area (formerly known as Control 1235).

c. Peak Traffic Constraints. Eastbound peak traffic periods are 1000 UTC to 1800 UTC. West-bound peak traffic period is 0000 UTC to 0700 UTC. Due to traffic volume, flights desiring to operate opposite the peak traffic flow can expect to be rerouted or restricted to a low altitude. If feasible, users planning to operate in the NOPAC composite area at airspeeds below mach 0.78 should use other than the peak hours for their flights. This avoids congestion and expedites traffic.

3. FLIGHT PLANS AND PREFERRED ROUTES.

a. Flight Plans. Flightcrews operating in the composite route system are expected to carry a flight plan for each of the composite routes for the direction to be flown, plus a plan for Route A590 since that route is used for eastbound or westbound traffic at different times. This prevents unnecessary delays, since pilots may be assigned routes other than those filed in the flight plan. Flight plans should be filed according to International Civil Aviation Organization (ICAO) procedures and format. This permits automatic flight data processing at oceanic control centers and oceanic radio stations en route. Flights originating outside of Anchorage or Tokyo regions that enter oceanic airspace without intermediate stops should submit flight plans as early as possible. In addition to the normal requirements of addressing the flight plan to all oceanic control centers en route, associated oceanic radio stations should be addressed. This provides those stations with information such as flight identification, selective calling (selcal), aircraft registration, destination, and estimated time of arrival (ETA). This information is necessary to control traffic. A properly addressed flight plan that is formatted according to ICAO standards is automatically handled by oceanic centers. When planning a flight via composite routes, list the point of entry followed by the route designator and the point of exit.

b. Preferred Routes. Prior to 1300 UTC daily, users may inform Anchorage Air Route Traffic Control Center (ARTCC) by teletype of their proposed routes. Preferred ATS routes are announced daily for aircraft entering the Anchorage FIR en route to the composite route system between 2200 UTC and 0500 UTC daily. Between 1300 UTC and 1330 UTC, Anchorage ARTCC issues an international Notice to Airmen (NOTAM) that specifies the transition route that must be filed for flights planned for R220, R580, and A590.

NOTAM example: "West coast operators...the following routes are in use today between 2200 UTC and 0500 UTC for westbound aircraft entering the Anchorage FIR and transitioning to the NOPAC: for R220, B327 over MARLO; for R580, G469 over NESSY; for A590, A342 over BLOWS."

Aircraft entering the composite route system between 0400 UTC and 2000 UTC daily must file via R220. Aircraft departing Anchorage for the NOPAC route system between 2200 UTC and 0300 UTC may anticipate a restriction of 10 minutes between successive departures. Due to a route crossing in a nonradar environment, westbound arrivals destined for RJCC, RJCH, RJSM and other westbound aircraft leaving the NOPAC system by way of V51 must file via R220. R580 is an eastbound track for aircraft entering the Anchorage FIR between 1000 UTC and 1700 UTC daily. The preferred route to Alaska, Europe, midwestern United States, and U.S. east coast airports is by way of R580 - OZZIE - flight planned route.

To Alaska, Canada, U.S. west coast, midwest United States, and U.S. east coast airports:

- A590 - SPY - G469 - NESSY - flight planned route
- A590 - EMH - B327 - MARLO - flight planned route
- A590 - EHM - J996R - ANC - flight planned route

To Canada, U.S. west coast, and southwestern United States airports:

- R591 - ARGOS - G215 - DUVAL - flight planned route
- R591 - ASHER - A342 - BLOWS - flight planned route

To U.S. west coast and southwestern airports: G344-CHIPT-R451-SAVRY-flight planned route.

4. COMMUNICATIONS AND POSITION REPORTING.

a. High Frequency (HF) Communications. Most NOPAC area communications are conducted on HF single sideband. Pilots communicate with control centers through oceanic radio stations. Aircraft reports, messages and requests are relayed by the station to the appropriate ATC center by interphone, computer, or teletype. The relay function, coupled with the need for intercenter coordination, may cause delays in handling routine requests. Priority message handling procedures for urgent communications reduce time lag; however, flightcrews should consider the possibility of delays when requesting step climbs, reroutes, or other routine requests requiring action by ATC. Delays can be reduced by advance planning. Aircraft entering a FIR should establish communication with the appropriate oceanic radio station. The station will advise the aircraft of the primary and secondary HF channels in use. If possible, the aircraft should monitor both channels. If only one frequency can be monitored, the primary should be guarded and the secondary should be the first frequency checked if communication is lost on the primary. If the selcal unit is working when initial contact is made, the aircraft may maintain a selcal watch on the appropriate frequencies. If the selcal unit is inoperative or the radio station's selcal transmitter is malfunctioning, the aircraft shall maintain a listening watch on the appropriate NOPAC frequency. The NOPAC HF net operates on the following assigned frequencies: 2932 kilohertz (KHz), 5628 KHz, 6655 KHz, 8951 KHz, 10048 KHz, 11330 KHz, 13273 KHz, and 17904 KHz.

b. Guard Station. The oceanic radio station guarding for flight operations is normally the station associated with the ATC center responsible for the FIR. At the FIR boundary, the responsibility for the guard normally changes to the station associated with the new FIR. The flight must ensure that it establishes communication with each successive guard facility. Each oceanic radio station normally listens continuously on all assigned frequencies. If en route HF communications fail, every effort should be made by the flightcrew to relay progress reports through other aircraft. The VHF frequency 128.95 megahertz (MHz) is for exclusive use as an air-to-air communication channel. In emergencies, however, initial contact for such relays may be established on 121.5 MHz. In normal HF propagation conditions, appropriate overdue action procedures are taken by ATC in the absence of position reports or relays. In all cases of communication failure, the pilot should follow the oceanic clearance last received and acknowledged.

c. Air-to-Ground Very High Frequency (VHF) Communication. Oceanic radio stations normally have VHF capability within 200 NM of their geographic location. The frequency is listed in the appropriate publications. This frequency may be used prior to departure from the adjacent international airport to establish communication with the radio station, or for aircraft operating within range to relay progress reports or other messages to their company's operations. All international flights departing from Anchorage or Fairbanks, Alaska, should relay their departure time to the FAA Flight Service Station (FSS) on VHF for use in transmitting departure messages.

d. Air-to-Air VHF Communication. Frequency 128.95 MHz has been designated for use in air-to-air communications between aircraft operating in the Pacific area out of range of VHF ground stations to exchange operational information and facilitate resolution of operational problems.

e. Time and Position Reports. When operating on a fixed route with designated reporting points, aircraft should report over such points. Unless otherwise required by ATC, position reports for flights on routes not defined by designated reporting points should be made at the significant points listed in the flight plan. By requiring aircraft to report at intermediate points, ATC is guided by the requirement for positional information at ICAO established intervals and by the need to accommodate varying types of aircraft, traffic load, and weather conditions. When reporting to oceanic radio stations, the prefix "position" should be used on initial contact or prior to the text of the message. Keep in mind that the operator is typing the report into a teletype or computer terminal; it is imperative that the person transmitting the report speak slowly and distinctly so that the message can be correctly copied on the first attempt. To minimize radio frequency congestion, routine weather information and fuel remaining information should not be included in position reports made directly to Anchorage ARTCC. Position reports must include information on the present position, estimated next position, and ensuing position(s) in the sequence indicated below:

(1) Present position

(a) The word "position"

(b) Aircraft identification

(c) Reporting point name or, if not named:

(i) for east-west flights, latitude in degrees and minutes, and longitude in degrees only (in Tokyo FIR, degrees and minutes)

(ii) for north-south flights, latitude in degrees only (in Tokyo FIR, degrees and minutes) and longitude in degrees only (in Tokyo FIR, degrees and minutes)

(d) time over reporting point in four digits UTC

(e) altitude - FL at which the aircraft is currently operating, plus the assigned altitude if the aircraft is climbing or descending to an assigned altitude

(2) Estimated next position information shall include

(a) name of the next required position information point or, if not named, as in (1)(c) above; and

(b) estimated time over next position. If the estimated time is in error by more than 5 minutes (3 minutes in Tokyo FIR), a revised estimate shall be forwarded to Tokyo or Anchorage FIR, as appropriate, as soon as possible.

(3) Ensuing position information shall include the name of the next successive reporting point, whether compulsory or not. If the point is not named, use the procedure in (1)(c) above.

f. ***Special Reporting Procedures.*** All aircraft operating on ATS routes R220, R580, R591, and G344 must cross-check their position over reporting points abeam Shemya VORTAC (109.0 MHz, DME-27, identification SYA). In addition to normal reporting procedures, pilots shall provide the cross-check in terms of the DME distance when crossing the specified radial. The radial/DME distances are as follows:

- for NEEVA on R220, SYA 328R/135 DME
- for ONADE on R580, SYA 328R/068 DME
- for AMMOE on R591, SYA 148R/050 DME
- for CHIPT on G344, SYA 148R/100 DME

A July 1985 memorandum of understanding between the United States, USSR (currently Russia), and Japan provides for direct voice communication between Anchorage ARTCC, Tokyo ACC, and Khabarovsk ACC to allow coordination between these facilities in assisting civil aircraft in certain emergency situations. These situations are mechanical problems requiring immediate landing, unlawful seizure of an aircraft, loss of communication, unidentified aircraft in USSR (Russia) FIR, and possible entry of aircraft into USSR (Russia) FIR. This communication link is checked daily at 0000 UTC.

g. ***Transponder Codes.*** When operating west of 164E, transponders should be set to Mode A Code 2000. When east of 164E, a discrete code may be assigned. This code should be maintained unless otherwise advised by ATC. If no discrete code is assigned, transponders should be set to Code 2000.

5. MACH NUMBER TECHNIQUE.

a. ***Background.*** The term "mach number technique" is used to describe the technique of clearing turbojet aircraft operating along the same route to maintain specified mach numbers in order to maintain adequate longitudinal separation between successive aircraft at, climbing to, or descending to the same altitude. The principal objective of the use of this technique is to improve use of the airspace on long routes where ATC has no means other than position reports to ensure the longitudinal separation of aircraft is not reduced below the established minimum. Experience has demonstrated that two or more turbojet aircraft on the same route and FL are more likely to maintain a constant time interval when this technique is used. This is because the aircraft are normally subject to the same wind and air temperature, and minor variations in speed tend to be neutralized over long periods of flight.

b. ***Application Procedures.*** Information on the planned mach number must be included in the flight plan for turbojet aircraft operating in oceanic airspace. For all flight plans, the true mach number must be included in Item 15 of the ICAO flight plan. The true airspeed (TAS) in knots equivalent to the planned mach number shall be specified in the remarks section of Item 18 on the same form, along with the abbreviation "TAS" and the four-figure group. When the mach number technique is applied, the normal requirement for ATC to calculate estimated times for the aircraft to pass significant points still applies. This is necessary to ensure longitudinal separation and coordination between ATC units. Intervention by ATC should not be necessary unless position reports indicate that longitudinal separation may be deteriorating to unacceptable levels. In applying this technique, it is imperative that pilots adhere strictly to their assigned cruise mach number at all times, including during climbs and descents, unless a specific reclearance is obtained from

ATC. If an immediate temporary change in the mach number is essential before a revised clearance can be obtained, ATC must be notified as soon as possible that a change has been made.

6. IN-FLIGHT CONTINGENCIES.

a. General. Not all contingencies can be covered in this Advisory Circular (AC), but the following procedures provide for cases such as inability to maintain FL due to weather, aircraft performance, and pressurization failure. They are useful when rapid descent, turn back, or both are required. The pilot's judgment determines the sequence of actions taken.

b. Basic Procedures. If an aircraft experiences navigational difficulties, it is essential that the pilot inform ATC as soon as possible so that the appropriate action can be taken to prevent conflict with other aircraft. If an aircraft is unable to continue flight according to ATC clearance, a revised clearance shall be obtained whenever possible before any action is taken. If prior clearance cannot be obtained, ATC clearance shall be obtained at the earliest possible time. In the interim, the aircraft shall broadcast its position and intentions, including the ATS route designator, on 121.5 MHz at suitable intervals until ATC clearance is received. In such circumstances, communication may also be accomplished on VHF with certain stations, such as ADAK approach on 134.1 MHz; Shemya Tower on 126.2 MHz; Anchorage Center on 118.5 MHz (Cold Bay); on 124.4 MHz at Dutch Harbor; on 127.8 MHz at St. Paul Island; and on 128.2 MHz at Shemya.

If unable to comply with these procedures, the aircraft should leave its assigned route by turning 90 degrees to the right or left whenever possible. The direction of the turn should be determined by the position of the aircraft relative to the route system. Aircraft operating on ATS Route R220 under these circumstances should, if possible, avoid turning northward to leave the route because of the route's proximity to the boundary between Anchorage/Tokyo and the USSR (Russia) FIR. An aircraft that is able to maintain its assigned level should climb or descend 500 feet while acquiring and maintaining, in either direction, a track laterally separated from its assigned route by 20 NM. For subsequent level flight, a level should be selected that differs by 500 feet from those normally used.

CHAPTER 5. SOUTHERN PACIFIC OCEANIC OPERATIONS

1. CENTRAL EAST PACIFIC (CEPAC) COMPOSITE AIRSPACE. CEPAC composite airspace is an organized route system, at or above flight levels (FL) 290 between the west coast of the continental United States and Hawaii, within the Honolulu and Oakland Control Areas (CTA) Flight Information Region (FIR). The organized route system between Hawaii and Los Angeles or San Francisco is comprised of six air traffic service (ATS) routes from FL 290 to FL 410. The same rules used for the North Pacific (NOPAC) routes apply to these routes, including mach number technique and contingencies.

2. CENTRAL PACIFIC AREA (CENPAC). Oakland Oceanic CTA has designated the airspace south of G344 (southernmost NOPAC route) and north of Hawaii as the CENPAC area. Two air traffic routes have been constructed in this area: A227 and R339. These are standard ATS routes with no special separation requirements, and there are no special rules to file a flight plan or to fly on these routes. Just south of R339, a free flow boundary has been established. When operating north of this boundary, flight must be conducted on one of the five NOPAC routes or on A227 or R339. Random traffic is only authorized south of the free flow boundary.

3. TOKYO-HONOLULU FLEXIBLE TRACK SYSTEM. A flexible track system (FTS) consisting of two flexible track routes (FTR) is permanently established between Tokyo and Honolulu to achieve more efficient use of the airspace for traffic operating at FL 290 or above. The routes are effective daily between 1200 coordinated universal time (UTC) and 1700 UTC within the Tokyo fix, and between 1300 UTC and 1900 UTC within the Oakland fix. The routes are published daily in Class 1 Notices to Airmen (NOTAM) and are designated "North FTS" and "South FTS." The FTS must be filed on the International Civil Aviation Organization (ICAO) flight plan by coordinates.

4. COMMUNICATIONS AND POSITION REPORTING.

a. Communications. Most CEPAC and CENPAC area communications are conducted on high frequency (HF), predominantly by single side band (SSB). Pilots communicate with control centers via oceanic radio stations. Aircraft reports, messages, and requests are relayed by the station to the appropriate air traffic control center (ATCC) by interphone, computer display, or teletype message. The relay function, coupled with the need for intercenter coordination, may cause delays in the handling of routine aircraft requests. There are priority message handling procedures for processing urgent messages that reduce any time lag; however, the crew should take possible delays into consideration when requesting step climbs, reroutes, or other routine requests requiring air traffic control (ATC) action. Delays can be reduced by advance planning of such requests.

b. Frequency monitoring. Aircraft should establish communications with the appropriate oceanic radio station upon entering a specific FIR. The station advises the aircraft of the primary and secondary HF frequencies in use. If possible, the flightcrew should monitor both of these frequencies. If only one frequency can be monitored, the primary should be guarded with the secondary being the first one checked in the event of lost communications on the primary frequency. If the selective calling (selcal) unit is working at the time of the initial contact, the crew should maintain a selcal watch on the appropriate frequencies. If the selcal unit is inoperative, or if the radio station has a malfunctioning selcal transmitter, the crew should maintain a listening watch. The oceanic station guarding for flight operations is normally the station associated with the ATCC responsible for the FIR (i.e., Honolulu Aeronautical Radio, Incorporated (ARINC) for the Anchorage FIR and Tokyo Radio for the Tokyo FIR). At the FIR boundary the responsibility for the guard is changed, under normal signal conditions, to the station associated with each new FIR. The flightcrew must ensure that it has established communications with the new guard facility. Normally, each oceanic radio station continuously listens on all assigned frequencies. If en route HF communications fail, every effort should be made by the flightcrew to relay progress reports through other aircraft. The very high frequency nonscheduled commercial aircraft landing for commercial purposes must obtain permission from the Secretary, Air Transport Licensing Authority, P.O. Box N975, Nassau, New Providence, Bahamas, prior to departure.

b. Special Notices.

(1) Flights made between sunset and sunrise must be conducted under instrument flight rules (IFR). With the exception of Freeport International and Nassau International Airports, no aircraft will be permitted to land or take off at any location in the Bahamas between sunset and sunrise without prior approval from the Director of Civil Aviation.

(2) New Providence - Nassau: Amphibious aircraft on international flights landing at the Nassau Marine Base must first land at Nassau International Airport for customs and immigration clearance.

(3) Before turning onto final approach and taxiing out for takeoff, it is recommended that pilots announce their identification, location, and intention on 122.8 megahertz (MHz) at uncontrolled airports. Arriving aircraft should fly over the airstrip at 1,000 feet above ground level to observe other traffic and fly a left-hand pattern. Extreme caution should be exercised when flying an approach or taking off from any of the outer islands. These fields are uncontrolled, but the attractiveness of the Caribbean makes them very popular destinations for both commercial operators and pleasure pilots. A wide range in crew island-flying ability levels often exists, and aircraft using these uncontrolled fields have significant differences in performance capabilities.

3. CUBA.

a. Personal Entry Requirements. The accuracy and currency of the following information is uncertain because of the difficulty in obtaining information about this country. All aircraft arriving from or departing for Cuba must land at or depart from Miami International Airport. A passport and a visa are required.

b. Aircraft Entry Requirements. All private and nonscheduled commercial aircraft overflying or landing for commercial or noncommercial purposes must obtain prior approval from the Ministerio Del Transporte Area Aeronautica, Calle 23-No. 64 Vedado, Plaza de la Revolucion, Cuidad de La Habana 4, Cuba at least 48 hours prior to overflying, and at least 10 days prior if landing. All requests must include provisions for prepaid reply. All requests must include the following information:

- Name, nationality and address of the aircraft operator.
- Aircraft type and registration marks.
- Name of pilot-in-command (PIC).
- Place of origin and destination.
- Air corridor and routes to be used under the flight plan.
- Date of the flight.
- Purpose of the flight.
- Number of passengers and type and amount of cargo.
- Statements of third party insurance liability coverage.
- Radio frequencies available.

All flights into Cuban airspace, including those in the established air corridors of Maya, Giron, and Nuevas, must be able to establish and maintain communications with Havana flight information region (FIR)/control area (CTA) 10 minutes prior to airspace entry. All flights must have a flight plan on file with Havana FIR/CTA at least 1 hour prior to airspace entry. In addition, any aircraft overflying or landing in Cuba must carry the following documents on board:

CHAPTER 6. CARIBBEAN OPERATIONS EXCLUSIVE OF THE GULF OF MEXICO

1. GENERAL INFORMATION.

a. International Flight Information Manual (IFIM). The following information is provided to inform crews of problem areas that may be encountered when traveling in the Caribbean, Central America, and South America. The IFIM contains specific information on an individual country's requirements for the following:

- Personal entry requirements.
- Embassy information.
- Aircraft entry requirements.
- Corporate aircraft restraints.
- Special notices.
- Aeronautical information sources.
- International Notices to Airmen (NOTAM) office.
- Airports of entry.

Detailed information regarding flights into Mexico is contained in the "Mexico Flight Manual," published by the Texas Aeronautic Commission, P.O. Box 12607, Capitol Station, Austin, Texas 78711.

b. Disease Control. Central and South American countries periodically experience epidemics of communicable diseases. Pilots and crews departing for destinations in the Caribbean, Central America, and South America should contact the U.S. Department of State in Washington, DC both well ahead of the proposed flight and just prior to the proposed flight. The initial contact should be made to determine if immunization is required and to determine the time period required for the immunizations to become effective. Some countries will actually isolate a crew and/or passengers if a particular immunization has not run the course of its incubation period. The final contact to the State Department is made to determine the latest health warnings in effect at the destination and/or possible intermediate stopping points. Under the International Health Regulations adopted by the World Health Organization, a country may require International Certificates of Vaccination against yellow fever and cholera from international travelers. No vaccinations are required to return to the United States from any country.

c. Passports. Those countries that do not require a passport to frequently enter or depart, require both crews and passengers to have documentary evidence of identity and U.S. citizenship. Although a passport is the best form of identification, a birth certificate, Certificate of Naturalization, or Certificate of Citizenship may suffice as evidence of citizenship. Refer to Chapter 2, Section 4 of this advisory circular (AC) for additional information on passports and entry requirements.

d. Altimeter Settings. Pilots and crews should be especially aware of the altimeter setting requirements of many of the Caribbean Islands. Various islands have different altimeter setting requirements. For example, Grand Turk requires en route flight level (QNE) at flight level (FL) 60 or above, and Punta Caucedo in the Dominican Republic requires QNE above FL 40. (See Chapter 2 of this AC for definitions of QNE, field elevation (QNH), and airport altitude (QFE).)

2. BAHAMAS.

a. Aircraft Entry Requirements. Private aircraft overflying or landing in the Bahamas for noncommercial purposes need not obtain prior permission. However, prior notification to the destination airport is required, and a flight plan must be on file. Permission must be obtained from the Ministry of Transport for overflight and landing clearances for nonscheduled commercial aircraft. In addition to having a flight plan on file, *d. Alert Areas.* Alert areas are areas wherein a large volume of pilot training flights or unusual aeronautical activity is contained. All activity within alert areas must be conducted according to the FAR, without waiver, and no activity that may be hazardous to other aircraft may be conducted. All aircraft within an alert area, both participating and nonparticipating, are equally responsible for collision avoidance.

e. Controlled Firing Areas. Controlled firing areas contain activities such as the firing of missiles and rockets, ordnance disposal, and static testing of large rocket motors. The users of these areas are responsible for immediate suspension of activities in the event that the activity might endanger nonparticipating aircraft. The controlled firing area locations in the Gulf of Mexico are published in Notices to Airmen (NOTAM).

f. Key West International Airport. FAR Part 121 operations that land or depart from Key West International Airport must meet the special airport requirements of FAR 121.445.

g. Noise-Sensitive Areas. Noise-sensitive areas include outdoor assemblies of persons, churches, hospitals, schools, nursing homes, designated residential areas, and national park areas. As national park areas, wildlife refuges are considered noise-sensitive areas. Numerous wildlife refuges are located along the U.S. coastline surrounding the Gulf of Mexico, and many of these refuges have large bird populations. The heaviest concentrations of these refuges are along the Texas and Florida coasts. VFR flights over noise-sensitive areas should be no lower than 2,000 feet above the surface, weather permitting, even if flight at a lower altitude is otherwise permitted under FAR 91.119. The surface is defined as the highest terrain within 2,000 feet laterally of the route of flight, or the uppermost rim of a canyon or valley.

h. Warning Areas. Warning areas are established in international airspace and contain operations hazardous to nonparticipating aircraft. IFR clearances through this airspace can be issued when hazardous operations are not taking place. Because there is no provision in international agreements for prohibiting flights in international airspace, there is no restriction on flights in these areas. However, pilots should take note of the location of all warning areas along a planned route.

i. Restricted Areas. Restricted areas are designated under FAR Part 73 to contain activities considered hazardous to nonparticipating aircraft. Aircraft may not operate within 3 nautical miles (NM) of a restricted area unless authorized under the provisions of FAR 73.13. There are numerous restricted areas near and along the Gulf of Mexico coastline. Pilots should be aware of these areas and plan flights accordingly.

2. NAVIGATION AND COMMUNICATIONS IN THE GULF OF MEXICO.

a. Background. ICAO Annex 6, Part II contains standards and recommended practices adopted as the minimum standards for all airplanes engaged in general aviation international air navigation. It requires those aircraft operated in accordance with IFR, at night, or on a VFR controlled flights (such as in CTA/FIR oceanic airspace) to have installed and approved radio communications equipment capable of conducting two-way communication at any time with the appropriate aeronautical stations on the prescribed frequencies.

b. High Frequency (HF) and VHF Communications. Due to the inherent "line of sight" limitations of VHF radio equipment used for international oceanic airspace communications, aircraft operating on an IFR or controlled VFR flight plan beyond VHF communications capability are required to maintain a continuous listening watch and communications capability on the assigned HF frequencies. Although these frequencies will be assigned by ATC, actual communication will be with general purpose communication facilities such as an international flight service station (FSS) or Aeronautical Radio Inc. (ARINC). These facilities will be responsible for the relay of position reports and other information between the aircraft and ATC. Except in an emergency, the use of relay on VHF through aircraft operating at higher altitudes is not an acceptable method of communication with ATC.

c. Communication and Position Reporting. The following describes an area in the Houston CTA/FIR where direct air traffic communication is not available:

tive that pilots have current charts in the cockpit and that the flightcrew has a comprehensive knowledge of the new classifications.

b. National Parks, Wildlife Refuges, and Bird Activity. South Florida has a number of national parks and wildlife refuges. These areas are home to large numbers of animals and birds, some of which are very sensitive to aircraft noise. Everglades National Park in particular is very aggressive about reporting low-flying aircraft to the FAA. Because of the large expanses of seacoast and the presence of large numbers of migratory birds during certain seasons, the possibility of bird strikes is a very real hazard in south Florida. Pilots should exercise added vigilance at low altitudes and be especially aware of the guidance in the Airman's Information Manual (AIM), Chapter 7, Section 4, entitled "Bird Hazards and Flights Over National Refuges, Parks and Forests."

c. Special Use Airspace and Military Activity. The Miami Aviation International Flight Service Station (AIFSS) keeps information on file concerning the status of special use airspace and military training routes in the airspace within 100 NM of their flight plan area. This airspace covers an area south of the Tampa, Orlando, and Melbourne areas. Information on special use airspace is not distributed by a NOTAM, and military training routes are included in pilot briefings only at the pilot's request. For information on activity more than 100 NM from Miami's flight plan area, contact the appropriate facility while en route.

d. Key West Naval Air Station. There is a high volume of military, high-speed jet aircraft operating in the Key West International and Navy Key West Airports. It is recommended that all civil air traffic proceeding to the Key West area from the direction of Marathon, Florida contact Navy Key West Tower on frequency 126.2 MHz when approximately 10 miles east of the Navy Key West Airport (at approximately Sugar Loaf Key - N24°39' W081°35') for traffic information and/or clearance through or around the Navy Key West Airport traffic area. Radar service is available through Navy Key West approach control on frequency 119.25 MHz. Visual flight rules (VFR) flights departing Key West International Airport should advise the tower of the direction of their flight.

e. Restricted Area R-2916. Of special safety interest in the Lower Keys, Restricted Area 2916 is an area of 4 statute miles in diameter, protected up to 14,000 feet mean sea level. This area contains a tethered aerostat balloon flown at various altitudes and times. All VFR pilots flying south to or across the Lower Keys should treat the restricted area as being active at all times and avoid the area. R-2916 is located 17.5 NM northeast of the Key West very high frequency (VHF) omnidirectional radio range (VOR) (113.5 EYW) on the 066 degree radial. Authorization to enter this area is granted by Miami Air Route Traffic Control Center (ARTCC) on 132.2 MHz.

- Registration certificate.
- Certificate of airworthiness.
- Licenses (certificates) for all crewmembers.
- Aircraft logbooks.
- The onboard radio station licenses.
- A list of passengers' names showing places of embarkation and destination.
- A manifest and detailed declaration of all cargo carried.

c. Special Notices. A NOTAM dated April 1, 1993, contained the following warning regarding Cuban airspace: "The Federal Aviation Administration has been informed that an official Cuban government publication has issued a warning that Cuban Armed Forces will shoot down any aircraft that penetrates Cuban airspace illegally and refuses to obey an order to land for inspection. All pilots should take note; use extreme caution in the area of Cuban airspace; adhere strictly to Cuban requirements for overflight of their territory." Any aircraft that flies over Cuban national territory or jurisdictional waters may be intercepted and required to land if any of the following occur:

- Flying over national territory and jurisdictional waters without proper authorization.
- Flying without proper authorization outside of national routes or established international corridors.
- Executing inappropriate maneuvers.
- Not following any of the instructions from air traffic control (ATC).

d. Legal Considerations. Aircraft that have been ordered to land, or have landed without proper authorization, will be subject to whatever penalties the Cuban authorities may prescribe, without recourse. The pilot and/or aircraft owner will be held responsible for any damage, injuries, or resulting expense. No aircraft may make an overflight carrying photographic equipment, arms, ammunition, explosives, or other articles and substances the Cuban aeronautical authority may specify. Overflights shall not be authorized if the operation constitutes a danger to air navigation or if, in the judgment of the Cuban aeronautical authority, the operator does not offer adequate guaranties to cover any liability incurred because of the overflight. These liabilities include damage and loss caused to subjacent persons or property, and payment for any services rendered or obligations that may arise in connection with the overflight. The use of Cuban radio for flight information, ATC, or other purposes is considered a service, and operators should expect to be billed for its use. Any person or corporation, partnership, organization, or association subject to U.S. jurisdiction and considering the operation of aircraft into Cuba must review current Department of Commerce and Department of State regulations relating to trade and other transactions involving Cuba. Within 1 hour of departure, the PIC must file an IFR flight plan and a written statement with the Immigration and Naturalization Service office at the departure airport. This statement must contain all of the information in the flight plan, the name of each occupant of the aircraft, the number of occupants in the aircraft (including the flightcrew), and a description of any cargo. The U.S. Naval airfield/facilities located at Guantanamo Bay, Cuba are closed to all civilian air traffic except for valid emergencies. All emergency landings will be thoroughly investigated by U.S. authorities to determine their validity and the nature of their business.

4. SOUTH FLORIDA DEPARTURES.

a. Special Airspace Considerations. South Florida has a complex airspace environment. Class C airspace exists at Sarasota, Fort Meyers, Fort Lauderdale, and West Palm Beach. Class B airspace exists at Tampa, Orlando, and Miami with their associated 30 nautical miles (NM) Mode C veils. All pilots should be aware of these areas and be familiar with all associated regulations pertaining to equipment and communication requirements. The new airspace classification went into effect in September 1993. Therefore, it is impera-

CHAPTER 7. GULF OF MEXICO OPERATIONS

1. CHARACTERISTICS OF THE AIRSPACE.

a. General. The airspace above and surrounding the Gulf of Mexico is complex and includes heavy concentrations of multi-altitute military operations, high altitude air carrier operations, and low altitude helicopter activity. There are numerous alert, warning, noise-sensitive, and restricted areas; control zones; heavy concentrations of student pilot activity; and areas of communication and navigation unreliability. As the volume of air traffic in this area has increased, it has become more common for flights to deviate from track, fail to make position reports, or report an incorrect position. Separation of air traffic is a matter of increasing concern in this airspace because of this increased activity. Any operation that is conducted in international airspace on an instrument flight rules (IFR) flight plan, a visual flight rules (VFR) controlled flight plan, or at night and that continues beyond the published range of normal airways navigation facilities (nondirectional radio beacon (NDB), very high frequency (VHF) omnidirectional radio range (VOR)/distance measuring equipment (DME)) is considered to be a long-range navigation operation. Long-range navigation in a control area (CTA) requires that the aircraft be navigated to the degree of accuracy required for the control of air traffic; that is, the aircraft should remain within one-half of the lateral separation standard from the centerline of the assigned track. The aircraft should also remain within the established longitudinal and vertical separation standards for the area of operation. These separation standards can be found in the International Civil Aviation Organization (ICAO) Regional Supplementary Procedures Document 7030/2. For flights conducted within international airspace under U.S. jurisdiction, Federal Aviation Administration (FAA) Order 7110.83, "Oceanic Air Traffic Control Handbook" provides a simplified version of these separation standards. Federal Aviation Regulations (FAR) 91.703(a) requires that civil aircraft must comply with ICAO Annex 2 when operating over the high seas. Annex 2 requires that "aircraft shall be equipped with suitable instruments and with navigation equipment appropriate to the route being flown." In addition, Annex 6, Part II stipulates that an airplane operated in international airspace be provided with navigation equipment that will enable it to proceed in accordance with the flight plan and the requirements of the air traffic services. Annex 2 further requires that an aircraft shall adhere to the "current flight plan unless a request for change has been made and clearance received from the appropriate air traffic control (ATC) facility."

b. Control of Air Traffic. ATC of the airspace over the Gulf of Mexico is assigned to the Houston Air Route Traffic Control Center (ARTCC). This center controls airspace within and outside of the U.S. Air Defense Identification Zone (ADIZ). The Houston CTA/Flight Information Region (FIR) includes the airspace in the northern part of the Gulf of Mexico. This control extends southward from Houston Center's coastal CTA to the middle of the Gulf in the vicinity of longitude N24°30'. The Houston CTA/FIR borders Houston's coastal control in the west and north, and meets Miami's oceanic CTA/FIR at latitude W86 in the east. The southern border of the Houston CTA/FIR is under the control of several Mexican FIR/upper control areas (UTA) and is controlled by Havana CTA in the southeast. Flight operations in this area must be conducted in accordance with the applicable FAR and ICAO Annex 2, "Rules of the Air." The navigation and communication equipment required for operations over the high seas must be installed and fully operational for flight in this airspace.

c. Flight Plans. Unless otherwise authorized by ATC, no aircraft may be operated in oceanic airspace unless a flight plan has been filed. VFR operations in oceanic airspace are permitted only between sunrise and sunset at or below flight level (FL) 180. Although VFR flights are permitted in offshore airspace (the airspace between the U.S. 12-mile limit and the oceanic control area (OCA)/FIR boundary), instrument meteorological conditions (IMC) are commonly encountered. It is recommended that pilots hold an instrument rating, the aircraft be equipped for IFR flight, and that an IFR flight plan be filed.

e. Concept of Navigation Performance. The concept of navigation performance involves the precision that must be maintained for both the assigned route and altitude by an aircraft operating within a particular area. Navigation performance is measured by the deviation (for any cause) from the exact centerline of the route and altitude specified in the ATC clearance. This includes errors due to degraded accuracy and reliability of the airborne and ground-based navigational equipment and the flightcrew's competence in using the equipment. Flightcrew competence involves both flight technical errors and navigational errors. Flight technical error is defined as the accuracy with which the pilot controls the aircraft as measured by success in causing the indicated aircraft position to match the desired position. Standards of navigational performance vary depending on traffic density and the complexity of the routes flown. Variation in traffic density is reflected in the different separation minimums applied by ATC in these two areas. For example, the minimum lateral distance permitted between coaltitude aircraft in Chicago Center's airspace is 8 nautical miles (NM) (3 NM when radar is used), while in North Atlantic (NAT) MNPS airspace it is 60 NM. The airspace assigned by ATC has lateral dimensions on both sides of the exact centerline of the route of flight specified in the ATC clearance equal to one-half of the lateral separation standard (minimum). For example, the overall level of lateral navigation performance necessary for flight safety must be within 4 NM of the airway centerline in Chicago Center's airspace, and within 30 NM in NAT MNPS airspace. FAR's 121.103 and 121.121 require that each aircraft must be navigated to the degree of accuracy required for air traffic control. FAR 91.123 requirements related to compliance with ATC clearances and instructions also reflect this fundamental concept. The concept of navigational performance is also inherent in the ICAO Standards and Recommended Practices (SARP). For example, Annex 2 states that the aircraft "shall adhere to its current flight plan" and "when on an established air traffic service (ATS) route, operate along the defined centerline of that route."

f. Degree of Accuracy Required. The fundamental concept for all IFR navigation standards, practices, and procedures is that all IFR aircraft must be navigated to the degree of accuracy required for control of air traffic. When a flight remains within the assigned three-dimensional block of airspace at all times, that aircraft is considered to be navigated to the degree of accuracy required for the control of air traffic. If an aircraft deviates outside its assigned block of airspace (except during a declared emergency), that aircraft has not been navigated to the required degree of accuracy. ATC separation minimums represent the minimum dimensions of a three-dimensional block of airspace that can be assigned by ATC to control flight. These separation minimums have been established for IFR operations in controlled airspace. These standards are usually established through international agreement and implemented through national regulations. These minimums are established for particular categories of navigational operation and specified areas. Examples include navigation on airways in the national airspace of ICAO member states and long-range navigation in oceanic or remote land areas. Separation minimums establish the minimum lateral, vertical, and longitudinal distances that can be used to safely separate aircraft operating within a specified area. Separation minimums also represent the minimum level of overall navigation performance which can be accommodated at any time without jeopardizing flight safety. Any aircraft deviating greater than one-half the separation minimums established for that operation has failed to meet the required level of navigational performance and to navigate to the degree of accuracy required for control of air traffic. For example, the vertical separation minimum for airplanes operating above flight level (FL) 290 in the United States is 2000 feet. Each aircraft's actual altitude must remain within + 1000 feet of the assigned altitude even when factors such as atmospheric pressure variations and instrument or pilot errors are considered. Where ATS's are provided by the United States, separation minimums are established by the FAR and ATC directives. Where ATS's are provided by contracting ICAO member states, separation minimums are established by those states' national regulations and in ICAO documents. Operations in uncontrolled airspace are not provided ATS, and separation minimums are not normally established for uncontrolled airspace. U.S. national airspace separation minimums can be found in FAA Order 7110.65, "Air Traffic Control." FAA Order 7110.83, "Oceanic Air Traffic Control," prescribes separation minimums in international oceanic airspace delegated to the United States by ICAO. ICAO Document 7030/3, "Regional Supplementary Procedures," prescribes separation minimums in international airspace.

N27°28′ W086°00′ to N27°30′ W087°42′ to
N25°50′ W088°15′ to N25°37′ W091°55′ to
N24°40′ W093°19′ to N24°28′ W088°01′ to
N24°00′ W086°00′ to beginning point.

Pilots planning flights through this area should be aware of the communications and position reporting requirements. HF communications are available for all oceanic flights, and limited VHF coverage is also available on 130.7 megahertz (MHz). The communication requirements for IFR flights within the Houston OCA are as follows:

(1) The aircraft must have functioning two-way radio communications equipment capable of communicating with at least one ground station from any point on the route.

(2) The crew must maintain a continuous listening watch on the appropriate frequency.

(3) All mandatory position reports must be made.

d. Position Reports. When flying an oceanic route in the Gulf of Mexico, position reports must be made over all designated reporting points. A position report must also be made upon crossing the FIR boundary. Unless otherwise required, reporting points should be located at intervals of 5 or 10 degrees latitude (if flying north/south) or longitude (if flying east/west) either north or south of the equator or east or west of the 180 degree meridian. Aircraft transversing 10 degrees of latitude or longitude in 1 hour, 20 minutes should normally report at 10 degree intervals. Slower aircraft should report at 5 degree intervals. In the absence of designated reporting points, position reports shall be made as instructed by ATC. Position reports are vital to air traffic safety and control. Inability to comply is a violation of the FAR and ICAO requirements.

e. Navigation Requirements. Class II navigation on routes in the Gulf of Mexico can be conducted using GPS, VOR/DME, and NDB supplemented by dead reckoning (DR). These routes are located offshore and are shown on en route charts. The areas are established by FAA Order 7110.2C, "Procedures for Handling Airspace Matters," and serve aircraft operations between U.S. territorial limits, OCA/FIR boundaries, and/or domestic flights operating in part over the high seas. These transition CTA's permit ATC to apply domestic procedures and separation minimums. Because independent radar surveillance is maintained within these CTA's, separation minimums are not as large as for other OCA's. As long as radar surveillance is maintained, operations may be conducted on Gulf routes using VOR/DME and NDB supplemented by DR. The radar surveillance provides an equivalent level of safety even though DR may be required for extended periods. Because of the proximity of these routes to shore-based facilities, the accuracy of DR can be enhanced by the use of shore-based navigational aids (navaids). The DR techniques and procedures must be approved as part of the air carrier operator's training program, and should include contingency training for weather avoidance and emergencies. Approval for use of a single long-range navigation system on these routes, as well as the navigation techniques discussed in this paragraph, are part of the operations specifications issued to air carrier operators.

f. Use of NDB for Navigation. The use of NDB as a primary source of navigation on long-range flights presents the operator with numerous limitations and restrictions inherent in low frequency radio equipment and the low frequency signals they receive. NDB navaids of the highest power (2,000 watts or greater) that are maintained and flight checked as suitable for navigation, are limited to a usable service and/or reception range of 75 NM from the facility at any altitude. Although the operator may be able to receive standard AM broadcast stations with NDB equipment, primary dependence on these facilities for navigation is a questionable operating practice. The following are some of the inherent problems associated with reception of these stations:

(1) Infrequent station identification.

(2) Foreign language station identification may be impossible without knowledge of the language.

(3) Transmitter sites are not always located with the studio facilities.

(4) Termination of service without notice.

(5) Weather or atmospheric disturbances may cause erratic and unreliable signal reception.

(6) Flight checks may not have been conducted to verify the suitability and reliability of the facility and signal for navigation.

(7) The "shoreline/mountain" effect may cause signal fluctuations.

(8) Standard broadcast stations are not dedicated for navigation purposes.

Considering these limitations, the operator should be able to navigate so as to maintain the course specified in the ATC clearance. The inadequacies of NDB as the sole source of navigation must be carefully evaluated, as an error of 10 degrees over 2,000 miles can result in a deviation of 350 miles.

3. INTERNATIONAL OPERATIONS.

a. Operations to Mexico. Pilots should be aware of the landing restrictions in effect at Mexico City Airport. A fee of 3.77 million pesos (approximately $ 1,240) will be imposed on aircraft that land or depart from this airport during peak hours (7:00 am - 10:00 am; 5:00 - 9:00 pm). If an aircraft lands during peak hours but departs during nonpeak hours, 75 percent of the fee will be imposed. Operators planning a flight to Mexico should check the NOTAM's for updated information. FAR Part 121 operations to Guadalajara, Mexico must meet FAR 121.445 special airport qualification requirements.

b. Operations to Cuba. FAR 121.445 requirements for special airport qualifications apply to FAR Part 121 operations landing or departing from Guantanamo Bay Naval Air Station. Operators should be aware that the Cuban government has issued a warning that Cuban Armed Forces will shoot down any aircraft that penetrates Cuban airspace without authorization and refuses to land for inspection.

4. MILITARY AND HELICOPTER OPERATIONS.

a. Military Operations Areas (MOA). Military operations represent approximately one third of the air traffic in the Gulf of Mexico. These operations include a high volume of nonhazardous training flights, which are contained within MOA's. MOA's and military training routes (MTR) are shown on VFR and sectional maps. However, MTR's are subject to change every 56 days. Because the charts are only issued every 6 months, pilots are strongly advised to contact the nearest FSS for current route dimensions and status.

b. Helicopter Operations. Pilots should be aware of the nature and extent of helicopter operations within the Gulf of Mexico. The density of helicopter traffic is primarily due to the presence of numerous oil rigs and drilling platforms in the Gulf. The majority of these flights are below 2,000 feet mean sea level at varying distances from the coastline. Additional information on helicopter operations is contained in Chapter 9 of this advisory circular (AC).

CHAPTER 8. LONG-RANGE NAVIGATION

1. GENERAL NAVIGATION CONCEPTS, FAA POLICIES, AND GUIDANCE.

a. General Concepts. In the early days of aviation, few aircraft operated within any given area at the same time. The most demanding navigational requirements were to avoid obstacles and arrive at the intended destination with enough fuel remaining to safely complete a landing. As aviation evolved, the volume of air traffic grew and a corresponding need to prevent collisions increased. Today, the most significant and demanding navigational requirement in aviation is the need to safely separate aircraft. There are several factors that must be understood concerning the separation of aircraft by air traffic control (ATC).

b. Separation of Air Traffic. In many situations, ATC does not have an independent means such as radar to separate air traffic, and must depend entirely on information relayed from an aircraft to determine its actual geographic position and altitude. A flightcrew's precision in navigating the aircraft is critical to ATC's ability to provide safe separation. Even when ATC has an independent means such as radar to verify the aircraft's position, precise navigation and position reports, when required, are still the primary means of providing safe separation. In most situations, ATC does not have the capability or the responsibility for navigating the aircraft. ATC relies on precise navigation by the flightcrew. Therefore, flight safety in all instrument flight rules (IFR) operations depends directly on the operator's ability to achieve and maintain certain levels of navigational performance. ATC radar is used to monitor navigational performance, detect navigational errors, and expedite traffic flow. Any aircraft operating in accordance with ATC instructions must navigate to the level of accuracy required to comply with ATC instructions. Aircraft must be navigated with sufficient precision to avoid airspace where prior ATC clearance or ATC instructions must be obtained. For example, an aircraft flying adjacent to minimum navigation performance specifications (MNPS) airspace must fly with a degree of precision that ensures that aircraft will not inadvertently enter MNPS airspace.

c. VFR Flight. The control of air traffic requires that a certain level of navigational performance be achieved by visual flight rules (VFR) flights to ensure safe separation of aircraft and to expedite the flow of air traffic. During cruising flight, the appropriate VFR flight altitude must be maintained to ensure the required vertical separation between VFR and IFR aircraft and to assist in collision prevention. VFR aircraft must be navigated with sufficient precision to avoid weather conditions that would prevent visual contact with (and avoidance of) other aircraft, and with sufficient precision to locate a suitable airport and land safely. VFR aircraft that require navigational assistance from ATC adversely affect ATC's ability to control air traffic and expedite its flow.

d. The Concept of an ATC Clearance. Issuance of an ATC clearance by a controller, and the acceptance of this clearance by a pilot, is a negotiation process that establishes conditions for the prevention of collision hazards (in-flight and terrain). When a controller issues an IFR clearance, a three-dimensional block of airspace is reserved for that aircraft along the defined route. The controller also agrees to issue clearances to all other controlled air traffic to ensure that all assigned flight routes will be safely separated. When a pilot accepts an ATC IFR clearance, that pilot is agreeing to continuously remain within the assigned three-dimensional block of airspace and to adhere to the flight rules for that operation. The pilot is obligated to comply with this agreement unless an emergency is declared or an amended clearance is received. Any deviation outside the assigned airspace creates a flight safety hazard. In such cases, the aircraft has failed to navigate to the degree of accuracy required for air traffic control and has failed to comply with Federal Aviation Regulations (FAR) and International Civil Aviation Organization (ICAO) requirements. In a nonradar environment, ATC has no independent knowledge of the aircraft's actual position or its relationship to other aircraft. Therefore, ATC's ability to detect a navigational error and resolve collision hazards is seriously degraded when a deviation from an agreed upon clearance occurs.

g. FAR Part 91 Communication Equipment Requirements. FAR 91.511 states the equipment requirements for overwater flights operating more than 30 minutes flying time or 100 NM from the nearest shore. The PIC is required to maintain a continuous listening watch on the appropriate frequency when operating under IFR in controlled airspace.

h. FAR Part 121 Communication Equipment Requirements. Communication equipment requirements for Part 121 operations are contained in FAR's 121.347 and 121.349. Under FAR 121.351(a), extended overwater operations may not be conducted unless the communication requirements of FAR's 121.347 and 121.349 are met. FAR 121.99 communications facilities requirements may be waived for Part 121 operators for flights over certain oceanic areas with one high frequency (HF) radio inoperative if certain conditions and limitations are met.

i. FAR Part 135 Communication Equipment Requirements. The communication equipment required for turbojet airplanes with 10 or more passenger seats and multiengine commuter airplanes are contained in FAR 135.165(a). All other aircraft operated under FAR Part 135 must meet the requirements of FAR 135.165(b). Under FAR 135.165(b)(7), aircraft are required to have an additional communication transmitter for extended overwater operations.

j. Communication Equipment Requirements for Ferry Flights. FAR 91.511 contains the requirements for radio equipment for overwater operations for ferrying FAR Parts 121 or 135 aircraft under Part 91. Certain operable communications equipment must be carried on large and turbine powered multiengine aircraft flown overwater. If both HF and very high frequency (VHF) equipment are required under FAR 91.511, FAR 91.511(d) permits overwater operations with only one HF transmitter and one HF receiver provided that the aircraft is equipped with two independent VHF transmitters and receivers.

k. Concept of Operational Service Volume. The concept of operational service volume is critical to understanding and applying the principles of air navigation. Operational service volume is the volume of airspace surrounding an ICAO standard airways navigation facility that is available for operational use. Within that volume of airspace a signal of usable strength exists and that signal is not operationally limited by cochannel interference. Within this volume of airspace, a navigational aid (navaid) facility's signal-in-space conforms to flight inspection signal strength and course quality standards including frequency protection. ICAO standard navaids are VHF omnidirectional radio range (VOR), VOR/distance measuring equipment (DME), and nondirectional radio beacon (NDB). The national airspace systems of ICAO contracting member states are based on the operational service volume of these facilities. Navigational performance within the operational service volume and ATC separation minimums can be predicated on the use of these facilities. In contrast, the signal-in-space outside the operational service volume has not been shown to meet the flight inspection signal strength, course quality, and frequency protection standards. Therefore, navigational performance and ATC separation minimums cannot be predicated on the use of these facilities alone.

l. Categories of Navigational Operations. A thorough comprehension of the categories of navigational operations is essential to understanding air navigation concepts and requirements, and in evaluating an operator's ability to navigate to the required degree of accuracy. In the broad concept of air navigation, two major categories of navigational operations are identified in the ensuing paragraphs:

m. Class I Navigation. Class I navigation is defined as any en route flight operation conducted in controlled or uncontrolled airspace that is entirely within operational service volumes of ICAO standard navaids (VOR, VOR/DME, NDB). The operational service volume describes a three-dimensional volume of airspace within which any type of en route navigation is categorized as Class I navigation. Within this volume of airspace, IFR navigational performance must be at least as precise as IFR navigation is required to be using VOR, VOR/DME (or NDB in some countries). The definition of Class I navigation is not dependent upon the equipment installed in the aircraft. For example, an aircraft equipped and approved to use Loran-C in the United States as the sole means of en route navigation (no VOR, VOR/DME installed) is conducting Class I navigation when the flight is operating entirely within the operational service volume of federal

VOR's and VOR/DME's. In this example, the Loran-C's IFR navigational performance must be as precise as IFR navigation is required to be using ICAO standard navaids, if IFR operations are to be conducted. In another example, a VFR flight navigated by pilotage is conducting Class I navigation when operating entirely within the operational service volume. However, the VFR navigational performance in this example must be only as precise as VFR pilotage operations are required to be.

The lateral and vertical extent of the airspace where Class I navigation is conducted is determined solely by the operational service volumes of ICAO standard navaids. Class I navigation cannot be conducted outside of this airspace. Class I navigation also includes VFR or IFR navigation operations on the following:

- federal airways
- published IFR direct routes in the United States
- published IFR off-airway routes in the United States
- airways, advisory routes (ADR), direct routes, and off-airway routes published or approved by a foreign government provided that these routings are continuously within the operational service volume (or foreign equivalent) of ICAO standard navaids

Class I navigation requirements are directly related to separation minimums used by ATC. IFR separation minimums applied in the U.S. national airspace system and most other countries are based on the use of ICAO standard navaids. These separation minimums, however, can only be applied by ATC within areas where the navaid's signal-in-space meets flight inspection signal strength and course quality standards. An ICAO standard navaid's signal-in-space conforms to flight inspection signal strength and course quality standards (including frequency protection) within its designated operational service volume. Therefore, air navigation and the safe separation of aircraft within that service volume can be predicated on the use of these facilities.

Within areas where the safe separation of aircraft is based on the use of ICAO standard navaids, any IFR operation must be navigated with at least the same precision as that specified by the appropriate national separation minimums. Any operation or portion of an operation (VFR or IFR) in controlled or uncontrolled airspace, with any navigation system (VOR, VOR/DME, NDB, Loran-C, inertial navigation system (INS), Omega) or any navigational technique (dead reckoning (DR), pilotage), is Class I navigation for that portion of the route that is entirely within the operational service volume of ICAO standard en route navaids.

n. Class II Navigation. Class II navigation is any en route operation that is not categorized as Class I navigation and includes any operation or portion of an operation that takes place outside the operational service volumes of ICAO standard navaids. For example, an aircraft equipped with only VOR conducts Class II navigation when the flight operates in an area outside the operational service volumes of federal VOR's/DME's.

Class II navigation involves operations conducted in areas where the signals-in-space from ICAO standard navaids have not been shown to meet flight inspection signal strength, course quality, and frequency protection standards. Therefore, ATC cannot predicate aircraft separation on the use of these facilities alone and must apply larger separation criteria. When operating outside the operational service volume of ICAO standard navaids, signals from these stations cannot be relied upon as the sole means of conducting long-range operations to the degree of accuracy required for the control of air traffic or as the sole means of obstacle avoidance. Therefore, when operating outside the designated operational service volumes of ICAO standard navaids, operators must use long-range navigation systems (LRNS) (GPS, Loran-C, Omega, INS) or special navigational techniques (DR, pilotage, flight navigator, celestial) or both. These systems and/or techniques are necessary to navigate to the degree of accuracy required for the control of air traffic and to avoid obstacles.

The definition of Class II navigation is not dependent upon the equipment installed in the aircraft. All airspace outside the operational service volume of ICAO standard navaids is a three-dimensional volume of airspace within which any type of en route navigation is categorized as Class II navigation. For any type of navigation within this volume of airspace, the IFR navigational performance must be at least as precise as the navigational performance assumed during establishment of the ATC separation minimums for that volume of airspace. The navigational performance for VFR operations in a Class II navigation volume of airspace must be only as precise as VFR navigation operations are required to be.

In many cases when ATC lateral separation minimums are large (usually 90 NM or greater), and the Class II navigation portion of the flight is short (less than 1 hour), it is possible to meet required levels of navigational performance and conduct Class II navigation using ICAO standard navaids supplemented with special navigational techniques such as DR. For example, it is possible in turbojet airplanes (with proper procedures and training) to fly many routes between the southeastern United States, Caribbean Islands, and South America with VOR/DME and NDB equipment. In these situations, Class II navigation requirements can be met even though significant portions of these routes (less than 1 hour) are outside (beyond) the operational service volumes of ICAO standard navaids. In the domestic United States, it is not uncommon for low altitude VFR flights in aircraft such as helicopters to conduct Class II navigation while outside the operational service volumes of ICAO standard navaids when operating over routes of less than 100 NM in length. Obviously, Class II navigation includes transoceanic operations and operations in desolate/remote land areas such as the Arctic.

Class II navigation does not automatically require the use of long-range navigation systems. In many instances, Class II navigation can be conducted with conventional navaids if special navigational techniques are used to supplement these navaids. Any portion of an en route operation in controlled or uncontrolled airspace, with any navigation system or any navigation technique, is defined as Class II navigation for that portion of the route that is outside (beyond) the operational service volumes of ICAO standard en route navaids.

2. LONG-RANGE NAVIGATION PROCEDURES AND COLLISION AVOIDANCE.

a. Background. Recently an aircraft deviated approximately 60 miles from an assigned NAT track and came within a few feet of colliding with an aircraft assigned to an adjacent track. Following the near miss, the aircraft that had deviated from its track did not follow established contingency procedures for aircraft experiencing navigational uncertainty, thus creating the potential for further conflict with other aircraft as it returned to its assigned track. In this incident, as in the majority of incidents involving gross navigation errors (GNE), the navigation equipment DID NOT malfunction. The incident was caused by the crew's failure to operate the navigation equipment in a disciplined systematic manner during all phases of flight. The incident was further complicated by the crew's failure to comprehend the relationship between navigation performance, contingency procedure, and collision avoidance.

Although navigation errors are infrequent, human errors account for a majority of the errors attributed to aircraft equipped with automated systems. Most inadvertent navigation errors have occurred when the equipment was functioning normally, but the operating procedures prescribed were either inadequate or were not followed. Experience indicates that the increased accuracy and reliability of modern automatic navigation systems can induce a degree of complacency on the part of flightcrews, and may result in failure to routinely cross-check system performance. Under these circumstances, human errors may remain undetected for excessive periods. A common error associated with automated systems is incorrect programming of the oceanic waypoint latitudes by multiples of one degree (60 NM). In an organized track system (OTS), this can result in the flight maintaining a wrong track with high precision and thereby constituting a serious threat to other aircraft properly occupying that track and FL. Vigilance and diligence in properly applying established procedures are essential to safe oceanic navigation. Although operational procedures (checklists) may differ among navigation systems, many good practices and procedures are basic to all automated and semiautomated systems.

IFR long-range operations using pilot-operated electronic long-range navigation equipment shall use the practices and procedures recommended in this advisory circular (AC). Prior to issuing operations specifications authorizing operations requiring long-range navigation equipment, the FAA principal operations inspector (POI) should ensure that these practices and procedures are included and emphasized in the operator's training program, manuals, and check airman program. These basic practices and procedures should be used in conjunction with the more detailed flight planning guidelines in Chapter 2 of this AC. For operations currently authorized by operations specifications or a Letter of Authorization (LOA), the operator's navigation program should be reviewed to ensure that it follows the guidance contained in Chapter 3 of this AC. Any deviation from these requirements must be approved by an FAA navigation specialist through the Flight Standards National Field Office, AFS-500 at Dulles International Airport, Washington, DC 20041.

b. Weather. In addition to the normal review of weather information concerning terminals, crews should be alert for hazardous weather that may require a flight plan change or in-flight rerouting. It is important to obtain a copy of the wind flow chart (constant pressure chart or the equivalent) for the FL and route to be flown. This information may be valuable when evaluating wind forecasting errors, or if DR operations become necessary due to equipment failure. It is desirable to plot the flight route on the chart to increase its usefulness. Also, as the flight progresses, consideration should be given to plotting actual wind information on the chart as a means of evaluating the accuracy of the forecast.

c. Notices to Airmen (NOTAM). Besides checking NOTAM's for departure, destination and alternate airports, NOTAM's concerning navaids or special airspace restrictions along the planned route should be checked. Omega users should obtain NOTAM's concerning Omega station operational status to ensure that the required stations are in service. Further information concerning Omega is contained in Section 7 of this Chapter.

d. Waypoint Symbology. The navigation program should include a standard system for indicating waypoint status, as detailed below. The specific symbology recommended is noted in parenthesis. Variations in specific symbology may be necessary to accommodate the individual operator's program.

(1) Waypoint coordinates have been stored in the computer. (Enter the waypoint number next to the relevant waypoint coordinates.)

(2) Coordinates and zone distances have been independently cross-checked by a second crewmember. (Circle the waypoint number.)

(3) Coordinates and zone distances have been cross-checked during the approaching waypoint check. (Draw a diagonal line through the waypoint number.)

(4) Waypoint passage has occurred. (Draw a second diagonal line through the waypoint number.)

(5) Cross-checking during all phases of flight (flight planning, preflight, en route).

(6) Official (master) document.

(7) Plotting.

e. Plotting Procedures. Use of plotting procedures has had a significant impact on the reduction of GNE's. The use of this technique to plot the flight route on a plotting chart and to plot the computer position approximately 10 minutes after waypoint passage are strongly recommended on all flights when long-range navigation equipment is the sole means of navigation. Use of plotting procedures may be required for routes of shorter duration that transit airspace where special conditions exist, such as reduced lateral separation standards, high density traffic, or proximity to potentially hostile border areas. Plotting procedures should be required for all turbojet operations where the route segment between the operational service volume of ICAO standard navaids (VOR, VOR/DME, NDB) exceeds 725 NM, and for all turboprop operations where the route segment between the operational service volume of ICAO standard navaids exceeds 450 NM. The operational service volume is that volume of airspace surrounding a navaid which is available for operational use, within which a signal of usable strength exists, and where that signal is not operationally limited by cochannel interference. (See Section 1 of this Chapter for additional information on operational service volume.) The operational service volume for a specific navaid can be determined by contacting the Frequency Management Section within each regional Airway Facilities Division. Operational service volume includes the following:

(1) the officially designated standard service volume excluding any portion of the standard service volume that has been restricted

(2) the extended service volume

(3) within the United States (including offshore control areas (CTA)) by published instrument flight procedures (Victor or jet airways, standard instrument departures (SID), standard terminal arrivals (STAR), standard instrument approach procedures (SIAP), or instrument departure)

(4) outside the United States, any designated signal coverage or published instrument flight procedure equivalent to U.S. standards

f. Flight Planning. Many operators use a computerized navigation flight plan. Care should be taken to verify that all en route waypoints are correctly and legibly shown on the flight plan. It is good practice to select a waypoint loading sequence and number each waypoint accordingly. If more than one copy of the flight plan is to be used, one copy should be designated as the official copy. To eliminate possible confusion, ensure that all necessary information (i.e., routing changes, estimated time of arrival (ETA), waypoint loading sequence) is recorded on this flight plan, and this official copy is used for all reports to ATC. Additionally, if the flight is within the NAT OTS, obtain a copy of the current track message (ATC expects the flightcrew to have a copy) and be alert for conflict between the flight plan and the track message. Track messages are issued approximately every 12 hours and describe the NAT routes, gateways and FL's available for eastbound and westbound flights during the period indicated. While planning an overwater flight, pilots should review NOTAM's for any condition that may affect the operation and accuracy of long-range navigation systems (LRNS). This is especially critical for Omega and Loran-C systems, as discussed in those sections of this Chapter. The use of heading information for cross-checking must be approached with caution. In steering a given route segment with a navigation computer, the true heading required to maintain a Great Circle course will change. For example, the true heading to maintain the Great Circle course from 50N 30W to 50N 40W will be 274 degrees at 30W, 270 degrees at 35W, and 265 degrees at 40W. Differences in variation along the route will further change the magnetic heading required to maintain course. The flightcrew must have a thorough understanding of the flight plan heading information and DR technique in order to use this check with any degree of certainty.

g. Navigation Preflight (at aircraft). Navigation system software identification and modification status codes should be verified. Cross-check inputs to navigation computers. Each insertion should be carried out in its entirely by one crewmember and then recalled and verified by another. Cross- check computer flight plan zone distances with zone distance displayed in navigational computers. The cross-check of coordinates and zone distances must be performed on all computer systems individually when the remote loading feature is utilized. For INS, after the systems are placed in the navigation mode, the groundspeed should be checked while the aircraft is stationary. A reading of more than a few knots may indicate an unreliable system. INS procedures are covered in Section 6 of this Chapter.

(1) Cross-check computer flight plan (CFP) gate and waypoint coordinates and identifiers with source documents (airfield diagrams, en route charts, and NAT track messages, if applicable).

(2) Plot the flight route on a chart of appropriate scale. Operational experience has demonstrated that a scale of 1 inch to 120 NM provides the most benefit for plotting purposes.

(3) Compare routing information on ATC flight plans, computer flight plans, NAT track messages, plotting charts, and aircraft observations and reports (AIREP) forms.

(4) It is advisable not to copy waypoint coordinates from source documents (track message, en route charts, etc.) to the flight plan for subsequent insertion into the navigation computers. To avoid errors in transcription, waypoint coordinates should be inserted into the computers directly from the source documents.

(5) Since the initial stage of the flight can be very busy, consideration should be given to ensuring the navigation system waypoint transfer switches are placed in the "auto" position to facilitate outbound tracking and waypoint changeover during this period.

(6) With systems such as INS or Omega that navigate during ground operations, it is advisable to cross-check present position, taxi distance, or groundspeed (as appropriate), prior to takeoff to confirm proper system operation and to ensure that the present position remains accurate.

h. Equipment Preflight. In addition to operating procedures (checklists) to confirm proper system operation, care should be taken to ensure that the navigation equipment is properly programmed. This is a very important procedure and should not be rushed. All navigation information (coordinates or courses and distances) should be programmed by one crewmember and verified by another crewmember. Also, crews should verify that the same waypoint loading sequence is used for each system and indicate on the flight plan that the present position (if applicable) and waypoints have been entered and cross-checked. If time becomes a factor, it is more important to verify that the first two or three waypoints are correct than to rush through the procedure to insert as much information as possible. Consideration should be given to using another cross-check that compares the flight plan or charted distance between waypoints and the distance computed by the navigation system to detect programming or flight planning errors. This serves as a doublecheck on waypoint verification and will also reveal any error in the flight plan. A difference of more than + 2 NM or - 2 NM may indicate a programming or flight planning error.

i. Pretakeoff and Coast Out. Before takeoff, cross-check the computer present position to confirm proper system operation. At least two crewmembers should copy and confirm the oceanic clearance. Perform gross error check (accuracy check) to compare navigation computer position with VOR, VOR/DME, or NDB. Procedures are required for direct overflight of a navaid and for cases when the navaid is NOT directly overflown. The gross error should be recorded in the flight log. For Omega, guidance must be established for lane ambiguity resolution (refer to Section 7 of this Chapter). Outbound from gateway, cross-check VOR, VOR/DME or NDB course and distance information with navigational computers. Compass deviation check (INS only): use for DR and for determining which system is correct when there is disagreement between systems.

j. Within Range of the Outbound Gateway. Flights should not continue beyond the outbound gateway unless the required long-range navigation equipment is functioning properly. To confirm proper operation, certain cross-checks should be performed while within range of the gateway navaid. Since this may be the last positive position cross-check until the inbound gateway, the following practices may also provide valuable information for resolving any later navigation difficulties.

(1) All ATC oceanic clearances should be cross-checked by two crewmembers to ensure the clearance is copied correctly. Any flight plan waypoints that were revised in an ATC clearance should be crossed out and the revised coordinates entered in a legible manner. Prior to proceeding outbound from the gateway, the current ATC clearance should be compared to the flight plan, and the information in the navigation computers for the gateway and the subsequent waypoints should be verified.

(2) A gross error check is a position accuracy cross-check using normal airway facilities such as VOR, VOR/DME or NDB. The gross error check is usually accomplished by flying directly over the gateway (if possible) and subsequently establishing the aircraft on the outbound course using the gateway navaid. This check serves the following purposes:

(a) detects errors that may have accrued in position information since takeoff

e. After Arrival. The individual navigation system errors and error rates, if applicable, should be computed and recorded for future reference. It is desirable to record this information in a document that remains aboard the aircraft to provide subsequent flightcrews with a recent history of system performance. This information may be used with most systems to predict individual system performance for future flights under similar circumstances. Additionally, this information may prove valuable to subsequent flightcrews for resolving navigation abnormalities, such as divergence between systems.

3. LONG-RANGE NAVIGATION PROBLEMS AND RECOMMENDED ACTIONS.

a. Background. Although the accuracy and reliability of the newer navigation systems are excellent, malfunctions and failures occasionally occur. When a malfunction occurs, flightcrews should guard against jumping to conclusions since hasty actions are seldom necessary and may further complicate the situation. Experience has shown that successful resolution of navigation difficulties in oceanic areas usually requires a thorough, thoughtful process that normally begins during preflight planning. The training program manuals and check airman program for air carrier operations should emphasize procedures to be followed in the event of partial and total instrument failure. Non air carrier operators should be prepared to demonstrate this emphasis in their training programs if requesting an LOA for oceanic operations in special airspace. The following guidance is presented for consideration when navigation difficulties are encountered or suspected.

b. Navigation Errors. Monitoring procedures used during oceanic operations indicate the frequency and course of navigation errors. Considering the thousands of flights that are made, errors are actually rather infrequent. Navigation systems are generally so reliable that there is some concern about overconfidence; therefore, crews should guard against complacency.

(1) Frequent causes of errors include the following:

(a) A mistake of one degree of latitude was made in inserting a forward waypoint.

(b) The crew was recleared by ATC, but forgot to reprogram the navigational system.

(c) The autopilot was left in the heading or decoupled position after avoiding severe weather, or was left in the VOR position after departing the last domestic airspace VOR. In some cases, this occurred after distractions by selective calling (selcal) or flight deck warning indications.

(d) The controller and crew had different understandings of the clearance because the pilot heard what he/she wanted to hear rather than what was actually said.

(2) Rare causes of errors include the following:

(a) The lat/long coordinates displayed at the gate position were incorrect.

(b) Because of a defective chip in an aircraft system, although the correct forward latitude was inserted by the crew, it "jumped" one degree.

(c) The aircraft was equipped with an advanced system that included all waypoint coordinates already on tape. The crew assumed the coordinates were correct, but one was not correct.

(d) Although the crew had the correct coordinates available, the information inserted into the system was from an incorrect company flight plan.

c. Detection of System Failure. In general, system failure is usually considered to have occurred when one of the following situations develops:

(1) a warning indicator is activated and cannot be reset;

(2) self-diagnostic or built-in test equipment (BITE) indicates that the system is unreliable;

systems appear normal, the action most likely to limit gross tracking error may be to position the aircraft so that the actual track is midway between the crosstrack differences for as long as the position uncertainty exists. ATC should be advised that navigation difficulties are being experienced so that separation criteria may be adjusted as necessary. Consideration should be given to abandoning this "split-the-difference" practice if the divergence exceeds the separation criteria currently in effect on the route of flight. If a divergence of this magnitude occurs and the faulty system cannot be isolated, the best course may be to fly by DR using the best known wind information. However, in some cases, the best known information may be flight plan headings and times.

4. PROVING TESTS AND VALIDATION FLIGHTS.

a. Introduction. FAR Parts 121 and 135 require evaluation of an operator's ability to conduct operations safely and in accordance with the applicable regulations before issuing an operating certificate or authorizing a certificate holder to serve an area or route. The testing method used by the FAA to determine an operator's capabilities are proving tests and validation flights. FAR 121.163 and 135.145 require operators seeking authority to operate certain types of aircraft to conduct proving tests before being granted operating authority. Proving tests consist of a demonstration of ability to conduct flights and to maintain the aircraft to the appropriate standards. Proving tests should not be confused with aircraft certification tests, which are tests conducted by the aircraft manufacturer to demonstrate the airworthiness of the aircraft. FAR 121.163 requires an operator to successfully conduct proving tests before the FAA authorizes the operation of each aircraft type. FAR 135.145 requires proving tests before the FAA authorizes the operation of each type of turbojet aircraft or each type of aircraft for which two pilots are required for VFR operations. FAR 121.93, 121.113, and 135.13(a)(2) require an operator to demonstrate the ability to conduct operations over proposed routes or areas in compliance with regulatory requirements before being granted FAA authority to conduct these operations. The FAA requires validation flights for authorization to add any areas of operation beyond the continent of North America and Mexico, and before issuance of operations specifications that authorize special means of navigation. Though proving tests and validation flights satisfy different requirements, it is common practice for operators to conduct both tests simultaneously. However, validation flights are important to consideration of oceanic operations.

b. Validation Flights. FAR 121.93, 121.113, and 135.13(a)(2) require operators to show the capability to conduct line operations safely and in compliance with regulatory requirements before being authorized to conduct those operations in revenue service. The most common method of validating an operator's capability is to observe flight operations. The FAA normally requires validation flights before issuing operations specifications granting authority to conduct operations beyond the populated areas of the North American continent. When the FAA conducts a validation flight, an in-depth review is conducted of the applicable portions of the operator's proposed procedures (especially flight following), training programs, manuals, facilities, and maintenance programs. There are four situations that require validation flights in association with approval of Class II navigation: initial approval; addition of an LRNS or a flight navigator; operations into new areas; and addition of special or unique navigation procedures. Validation flights are required when an operator proposes to conduct operations that require confirmation of the ability to operate an aircraft type within specified performance limitations. These limitations are based on the character of the terrain (or extended overwater areas), the type of operation, and the performance of the aircraft. Validation flights are also required when an operator proposes to conduct in-flight or ground maneuvers that require special operational authorizations.

c. Carriage of Revenue Passengers on Validation Flights. The FAR do not forbid the carriage of revenue passengers on validation flights. The operator may receive FAA authorization to carry revenue passengers during the validation flight when the proposed operation is similar to those in the applicant's previous experience. However, carriage of revenue passengers is normally not permitted during validation flights in the following situations:

(1) when the operator is seeking initial approval to conduct Class II navigation in any airspace designated as a special area of operation;

(2) when the operator is seeking approval to conduct Class II navigation by an LRNS or by using a flight navigator not previously approved for that means of navigation;

(3) when the operator is seeking approval to conduct Class II navigation by means of a long-range navigation procedure that has not previously been approved for that operator; and

(4) when the operator has not previously operated a specific aircraft type in operations requiring special performance authorization.

d. Special Areas of Operation. Certain areas of Class II airspace are considered special operating airspace for purposes of validation. These areas include the following:

(1) extensive areas of magnetic unreliability;

(2) NAT MNPS airspace and Canadian MNPS airspace;

(3) Central Pacific (CEPAC) composite airspace and Northern Pacific (NOPAC) airspace;

(4) Arctic Ocean and Antarctic airspace; and

(5) politically sensitive areas of operation.

e. Special Navigation Procedures. Validation flights are normally required when an applicant proposes to use navigation procedures not previously demonstrated. These procedures include the following:

(1) pilotage, including DR;

(2) flight navigator procedures;

(3) celestial navigation;

(4) pressure pattern and Bellamy drift DR;

(5) free gyro or grid procedures; and

(6) any combination of the preceding procedures.

f. Other Situations Requiring Validation Flights. Validation flights may also be required for special operational authorizations and special performance authorizations. Operators who require additional information on validation flights are encouraged to contact their local FAA flight standards district office (FSDO).

5. DOPPLER NAVIGATION - SPECIAL PROCEDURES.

In addition to the general navigational practices and procedures contained in this Chapter, the following information applies to Doppler navigation systems. A Doppler system (sensor plus computer) is a semiautomatic DR device that is less accurate than an INS or Omega system. A means of updating the Doppler is usually required if acceptable position accuracy is to be achieved on long- range flights. INS, Omega or Loran-C may be used as the updating reference for the Doppler system. The following factors should be considered when using a Doppler navigation system.

a. Compass Accuracy. Most Doppler systems measure groundspeed to an accuracy of about one percent and drift angle to a fraction of a degree. Its directional reference, however, is the aircraft's compass system. If the overall Doppler/compass system is to be usefully accurate, the compass should be swung and compensated so that its error does not exceed one degree on any heading.

b. Preflight. During preflight, the flight plan course and distances for those flight segments where Doppler navigation is required should be verified. Normally, the courses should be determined to the nearest one tenth of a degree and the distances to the nearest NM. This is routinely accomplished by using course and distance tables designed for this purpose. Extreme care and accuracy are important considerations during this cross-check. If the Doppler system is to be used for navigation from takeoff, both "A" and "B" stages should be programmed and the "auto/manual" switch should be placed in "auto." Also, the proper position for the "land/sea" switch should be determined since this affects the accuracy of the groundspeed information.

c. When Approaching the Outbound Gateway. The Doppler system performance records for recent flights over similar routes should be reviewed to determine if a system deviation correction should be applied. If the records indicate that a deviation correction may be necessary, apply the correction to the Doppler system used. Both pilots should verify that the outbound course and distance programmed in the active stage conforms to the currently effective ATC clearance. Unless otherwise required by ATC, the aircraft should be flown directly over the gateway fix to obtain the most accurate starting position practical. When directly over the gateway, both pilots should ensure that the Doppler computers have been activated and that the proper stage is selected. The aircraft should be established on the outbound track by using the gateway navaid. Once this is accomplished, the gross error cross-checks discussed in Section 2 above should be accomplished. Consideration should be given to using an additional cross-check. This is accomplished by applying drift angle to the compass heading and comparing the result (actual track) to the flight planned magnetic course.

d. Updating the Doppler Computer. Since Doppler systems (in a magnetically slaved model) fly a "rhumb line" (curved track) and most navigation charts commonly used reflect "Great Circle" (straight tracks), certain precautions should be observed when updating Doppler systems. Although a great circle course and a rhumb line course begin and end at common points, the two courses diverge between the waypoints. This divergence normally reaches a maximum near the midpoint of the leg, and the magnitude of the divergence increases as the latitude and distance between waypoints increase. Under normal circumstances, position fixes for Doppler updating purposes should be obtained within 75 NM of a waypoint to minimize the possibility of inducing an error into the Doppler system due to the rhumb line effect. This practice should be applied to both manually obtained and automatically obtained position fixes. When Doppler systems are used in the grid (free gyro) mode, the Doppler track will approximate a great circle, and the rhumb line effect is not a factor. Under these conditions, the updating restrictions detailed above are not normally applicable.

6. INS NAVIGATION - SPECIAL PRACTICES AND PROCEDURES.

a. Preflight. Since INS is a DR device and not a position-fixing device, any error induced during alignment will be retained and possibly incremented throughout the flight unless it is removed through updating procedures. Therefore, during preflight, care should be exercised to ensure that accurate present position information is inserted into the INS. Although most INS will automatically detect large errors in present position latitude during alignment, large errors in present position longitude may exist without activating a warning indication. When cross-checking present position coordinates, be alert for the correct hemispheric indicator (i.e., N, S, E, W) as well as the correct numerical values. Since most INS cannot be realigned in flight, special procedures such as ground realignment may be required to correct a significant error in present position. If the INS in use has the capability of "gang-loading" (simultaneous loading) by use of a remote feature, care should be taken so that any data entered by this method is cross-checked separately on each individual INS to detect data insertion errors. The INS software identification and modification status codes should be verified to ensure that the proper equipment is installed and the appropriate operating checklist is used. The operating checklists should include a means of ensuring that the INS is ready to navigate and that the navigation mode is activated prior to moving the aircraft. Any movement of the aircraft prior to activating the navigation mode may induce very large errors that can only be corrected by ground realignment. After the system is placed in the navigation mode, the INS groundspeed should be checked when the aircraft is stationary. An erroneous reading of more than a few knots may indicate a faulty or less reliable unit. If this occurs, a check should be made of the malfunction codes.

b. In-Flight Updating. INS are essentially accurate and reliable, but it is possible to introduce errors in an attempt to improve accuracy by in-flight updating. On the other hand, INS errors generally increase with time and are not self-correcting. If large tracking errors are permitted to occur, aircraft safety and separation criteria may be significantly degraded. These factors should be considered in any decision relative to in-flight updating. As a guide to flightcrews, some operators consider that unless the ground facility provides a precise check and unless the error is fairly significant (e.g., more than 6 NM or 2 NM/hour), it is preferable to retain the error rather than update.

7. OMEGA INFORMATION.

This section addresses only dual Omega installations. However, operators should be aware that if an operation requires two LRNS and one of the systems used is an Omega system, all requirements specified for Omega as the sole means of navigation must be met. 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 individual systems as discussed in other sections of this Chapter.

a. Background. Omega is a radio navigation system that uses a worldwide network of VLF signals from eight ground-based transmitters. The principal attributes of the Omega system are the high degree of signal stability and low signal attenuation that produce reliable position information over great distances. Various methods of signal processing are used by different manufacturers to develop position information and navigation guidance (rho-rho, hyperbolic, single frequency, 3.4 KC tracker, etc.). Because of these variations in processing methods, each design will be evaluated and approved individually. When Omega systems meet the provisions described below, they may be used as the 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 communication stations may be used to supplement Omega navigation systems. 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 AC should be capable of operating on Omega systems alone.

The approval process is divided into two parts. The first part deals with approval under FAR Part 25 and the second part deals with operational approval under FAR Part 121. Guidance concerning compliance with FAR Part 91 regarding NAT MNPS airspace is contained in Chapter 3, Section 1 of this AC.

b. Airworthiness Approval. Applicants desiring airworthiness approval of dual Omega navigation systems in accordance with this AC 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 (CDU), and two antennas.

c. Operational Approval. FAR Part 121 requirements for en route navigation facilities are contained in FAR 121.103 and 121.121. Air carrier applicants desiring operational approval for use of dual Omega systems should contact the FSDO charged with the administration of their operating certificate a minimum of 30 days prior to the proposed start of evaluation flights. FAR Part 91 operators desiring approval of dual Omega systems for flights in MNPS airspace should contact the FSDO nearest their principal base of operations to obtain an LOA. Requests should include evidence of FAA airworthiness approval of the system, a description of the system installation, and the operator's experience with the system. 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 proposed system. The applicant may include previous or related operational experience of other operators who have used the same equipment on the same type aircraft, and operational experience gained during type certification or supplemental type certificate of the aircraft. Once a particular system has received an equipment approval, subsequent evaluation and approval in the same type of 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. A comprehensive summary of any flight experience that establishes a history of adequate signal coverage (during day or night operations), accuracy, lane ambiguity detection/resolution, and in-service reliability should be provided to show competency in the proposed operation and maintenance of the equipment.

The applicant must present proposed revisions to the operation manual, describing all normal and abnormal system operating procedures and flightcrew error protection procedures including cross-checking of data insertion, detailed methods for continuing the navigation function with partial or complete Omega system failure, reacquiring the proper lane after any power outages, and procedures for continuing operation in the event of a divergence between systems. The applicant must also present proposed revisions to the minimum equipment list (MEL) concerning Omega, with appropriate justification. The applicant must present a list of operations to be conducted using the system including an analysis of each operation 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 navaids, and adequacy of gateway facilities to support the system. (For the purpose of this AC, a gateway is a specific navigation fix where the use of LRNS commences or terminates.) The operator must develop a procedure for timely dissemination of Omega NOTAM information to crewmembers. The operator must also develop 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 FAR Part 121, Subpart L.

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 ensure proper operation. Normal flight maneuvering should include 180 degree turns to verify dynamic response. An applicant for airworthiness approval should provide data from sufficient flights in the area of intended use to show that the Omega navigation system can meet the accuracy requirements stipulated for LRNS in FAR 37.205, technical standard order (TSO) C-94, and Radio Technical Commission for Aeronautics (RTCA) DO-164, Section III, paragraph 3.8. Consideration should be given to time of day, season, station outages, station geometry, and poor signal-to-noise ratio.

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

(2) The DR mode should be evaluated to determine the maximum period for which interim use is permissible. The information should be included in the airplane flight manual.

d. Ground Evaluation. 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. The Omega velocity and heading (or track) information presented on the control display unit (CDU) 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 ensure compatibility of input to interfaced equipment. This evaluation may be conducted in-flight. Displays of all data basic to the installed Omega systems should be demonstrated to show no instability or discontinuity utilizing those stations identified by the system as usable and necessary for navigation. This evaluation may be conducted in-flight.

*e. **Evaluation and Final Approval.*** Prior to final approval for the use of Omega as a sole means of long-range navigation, a thorough evaluation of an operator's training program and a flight evaluation by an FAA inspector will be required. This flight evaluation should be requested on the operator's application for the use of Omega as a sole means of long-range navigation.

(1) The evaluation by an FAA inspector will include the adequacy of operating procedures and training programs; availability of terminal, gateway, area, and en route ground-based navaids; 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 flightcrew by use of the Omega equipment in normal and abnormal operations.

(2) After the evaluation is completed, FAA approval is indicated by issuance of operations specifications for air carriers and by an LOA for other operators who desire to fly in airspace where an authorization is required. The 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 by an air carrier will limit the operations to areas where compliance with FAR Part 121 or FAR Part 135 requirements were demonstrated. Requirements for LOA's are detailed in Chapter 3 of this AC.

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

*f. **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 TSO C-94, "Airborne Omega Receiving Equipment" and Section 3 of RTCA Document No. DO-164 titled "Minimum Performance Standards Airborne Omega Receiving Equipment" dated March 19, 1976. When installed, the system should provide a means of entry for at least the following data inputs and functions:

(1) present position (initializing, reinitialization and update);

(2) waypoints;

(3) heading, wind and true airspeed (TAS); or track and groundspeed; or other external information required for operation in the secondary or direct ranging mode;

(4) time;

(5) date;

(6) deselection and reselection of any station (automatic deselection and reselection is acceptable if shown to be effective and reliable); and

(7) lane ambiguity resolution. Automatic lane ambiguity resolution is acceptable if shown to effective and reliable.

*g. **System Displays.*** If the equipment is to be operated by the pilot(s), the system controls and data display should be visible to, and usable by, each pilot seated at a pilot duty station. The system controls should be arranged to provide adequate protection against inadvertent system turnoff. The system should also provide a means of displaying 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 visual or aural warning of system failure, malfunctions, power interruption, lack of synchronization, or operation without adequate signals

(9) waypoint coordinates

(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, TAS and heading; or track and groundspeed

(16) stations currently being installed to determine position

(17) steering information on the horizontal situation indicator (HSI) or equivalent

(18) confirmation of data insertion

h. Failure Protection. Normal operation or probable failure of the airborne Omega navigation system should not derogate the normal operation of interfaced equipment. Likewise, the failure of interfaced equipment should not render an Omega system inoperative.

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

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

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

l. Preflight Test. A preflight test capability should be provided to inform the flightcrew of system status.

m. Aircraft Electrical Power Source. One Omega system should be installed so that it receives electrical power from a bus that provides maximum reliability 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, should not adversely effect the operation of either Omega system. After power interruption of 7 + or - 2 seconds, the Omega equipment should automatically resynchronize and resume normal operation within 3 minutes without operator intervention. 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 provide power for this function. 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.

n. Steering Outputs. The Omega system should provide steering outputs to the autopilot and/or HSI or equivalent so that the equipment interface is compatible.

o. Airplane Flight Manual. The airplane flight manual should contain the following information regarding 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

p. Demonstration of Performance. An applicant for approval of dual Omega navigation system installation should ensure that the installed Omega system can demonstrate adequate performance by a combination of ground and flight evaluations defined in the following two paragraphs.

q. Equipment and Equipment Installation. Omega navigation systems should be installed in accordance with the airworthiness approved system installation requirements. If evaluation flights are made for operations requiring an LRNS, a navigation system already approved for the operator under FAR Part 121 should be used as the primary means of navigation.

r. Omega Training Programs. The training program curriculum must include initial and recurrent training and checking for those crewmembers who will be operating the Omega equipment. Initial training programs should include the following:

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

(2) For the flightcrews who are to operate the Omega equipment, 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 divergence 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 course; and

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

(3) 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.

(4) For flight crewmembers without previous Omega experience, the training and qualification program should include an in-flight qualification check based on the training program. Accomplishment of such training during evaluation flights is acceptable. Sufficient flightcrews considered fully qualified by the applicant should be observed in-flight by an FAA inspector to determine the overall effectiveness of the training and qualification program. Flightcrews possessing current operational experience with the installed Omega equip-

ment need only receive training specifying any differences in procedures created by using Omega as a sole means of long-range navigation, if applicable.

(5) Annual line checks as required by FAR 121.440 should include a check of Omega operating procedures. Required annual checks of flight navigators, if they are to operate the Omega equipment, should also include a check of these procedures.

s. ***Accuracy and Reliability.*** The applicant should show the following:

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

(2) That in the process of proposed operation, the Omega navigation system meets the accuracy requirements stipulated for Omega navigation systems. If the proposed system is to be operated in areas with special navigation requirements (e.g., MNPS airspace), the accuracy required for those areas must also be demonstrated. Systems that become exceedingly inaccurate without displaying a warning indication should be included in the accuracy accounting. Systems that display a failure warning and are subsequently shut down or disregarded should be included in the accounting of failed systems but excluded from the accuracy accounting.

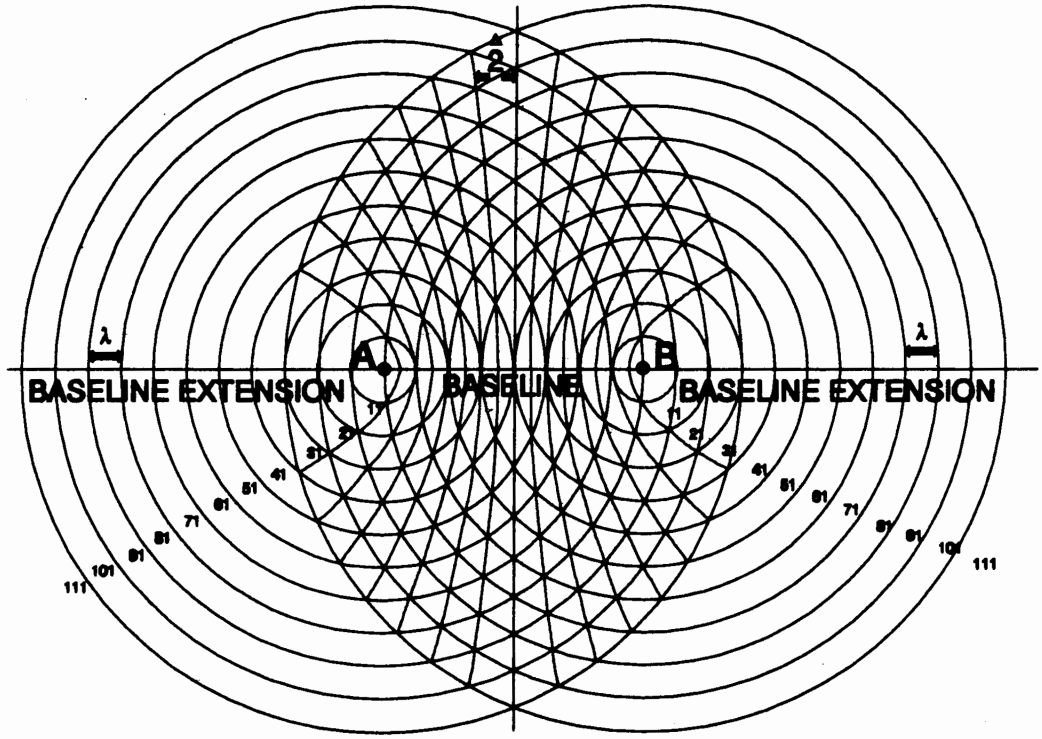
(3) That Omega navigation systems which are subject to lane ambiguity have a reliable means of reacquiring the proper lane.

(4) That the Omega sole means system 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.

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

t. ***Special Practices and Procedures.*** Since the CDU's of most Omega systems are similar in appearance to those used for INS, persons familiar with INS may have a tendency to assume that Omega has similar performance characteristics. This assumption could create significant problems. INS is a precision DR device which is wholly self-contained within the aircraft and has a nominal position degradation of about 1 mile per hour of flight. Omega, in contrast, continuously resolves aircraft position by processing radio signals received from a global network of transmitters. It is therefore possible for Omega to be affected by signal propagation disturbances and abnormally high local radio noise levels. In normal operation, Omega provides a position accuracy of 1 to 3 NM which, unlike INS, does not degrade with increasing flight time. However, most Omega systems compute position in signal "lanes," which are a function of the signal wavelength. A disturbance of sufficient magnitude may force the computed position into an adjacent lane and thereby cause an error which is measured in multiples of the basic lane width. This occurrence is termed a "lane slip." Most Omega systems possess an auxiliary operating mode termed "lane ambiguity resolution" (LAR). The purpose of this mode is to correct the lane slip by returning the present position to the correct lane. Details of lane ambiguity follow.

FIGURE 8-1. OMEGA LANES FORMED BY HYPERBOLIC ISOPHASE CONTOURS



u. Omega Lanes Formed by Hyperbolic Isophase Contours. (Figure 8-1) The set of isophase contours between a station pair forms a series of lanes, each corresponding to one complete cycle of phase difference. In the direct ranging mode, lanes are formed by concentric rings of zero phase with a constant interval of one wavelength (16 NM at 10.2 kilohertz (kHz)). In the hyperbolic mode, one complete cycle of phase difference occurs every one half wavelength. Therefore, 10.2 kHz hyperbolic lanes are 8 NM wide on the baseline, and gradually diverge as the distance from the baseline increases. Each lane, or cycle of the phase, is divided into hundredths of a lane called centilanes (cel). The phase difference between station pairs, measured in hundredths of a cycle or centicycles (cec), gives a hyperbolic line of position (LOP) within an Omega lane. (The term cel refers to the fraction of the charted lane. The term cec refers to the phase measurement as a percentage of a cycle. At 102 kHz, they are numerically equal and often used interchangeably, with cec used most commonly.) For example, in Figure 8-2 phase differences of 20 cec and 50 cec between stations A and B would give LOP's as shown. Twenty cec would indicate an LOP 20 percent of a lane width from the lane boundary; 50 cec would indicate an LOP 50 percent of a lane width from the lane boundary. Fractional lane widths are taken from a given lane boundary toward the direction of the station with the letter designation occurring later in the alphabet (from the "lower" letter to the "higher" letter). Since the same phase difference will be observed at any point on an LOP, a second LOP must be taken using another station pair to obtain a position fix. In Figure 8-3, the phase difference A-B is 50 cec, and the phase difference B-C is 80 cec. The intersection of these LOP's gives a position fix. In actual practice, propagation corrections (PPC) would be applied to the observed phase difference readings before plotting.

FIGURE 8-2. PHASE MEASUREMENT WITHIN AN OMEGA LANE

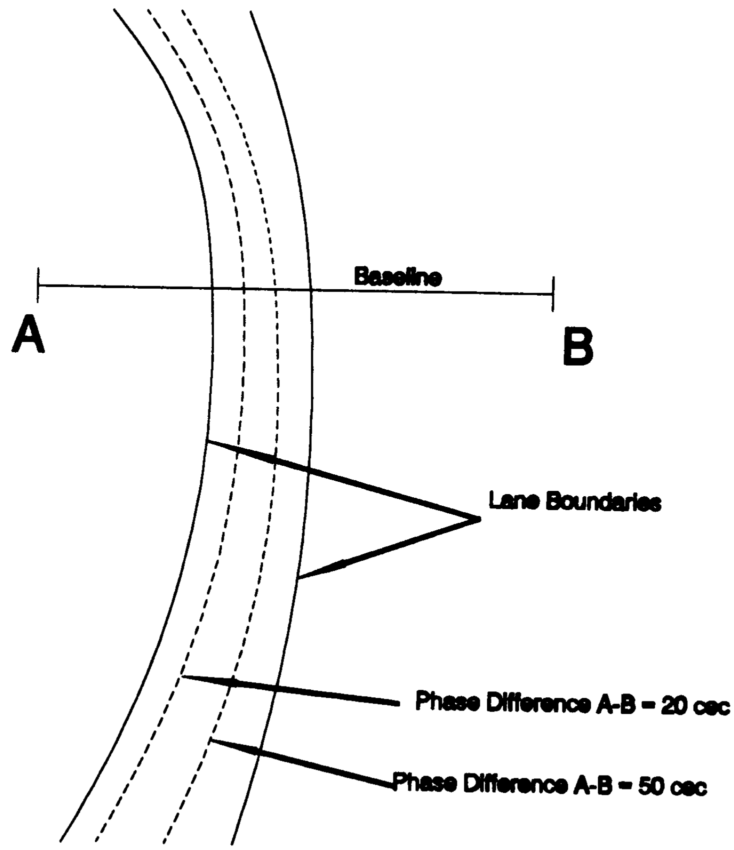
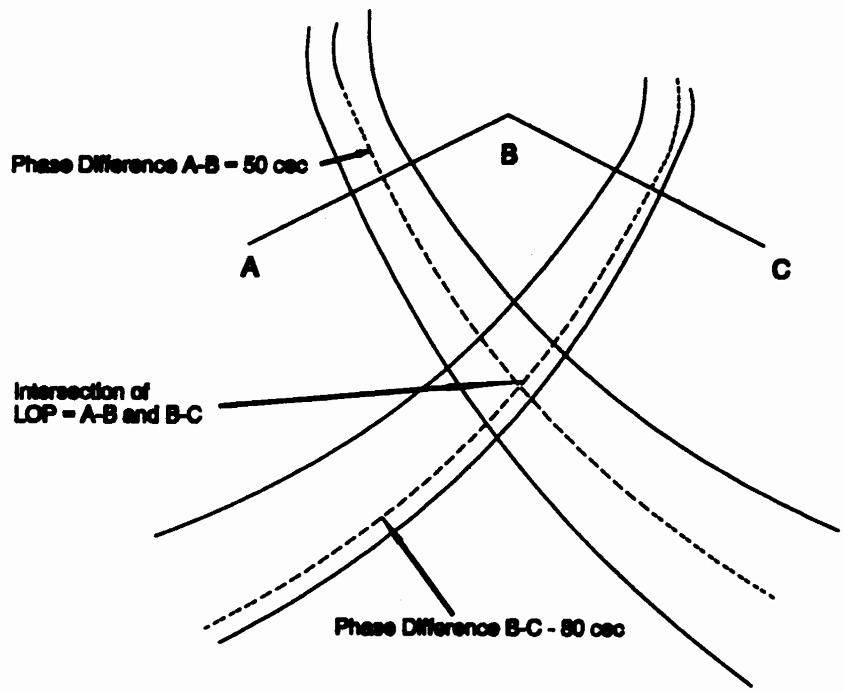


FIGURE 8-3. POSITION FIX BY INTERSECTION OF HYPERBOLIC LOP'S



v. Lane Ambiguity. In the preceding examples, it is assumed that the aircraft's position is known to within a particular set of lanes. Because of the cyclic nature of the phase differences, the same phase difference can be observed in any lane. This is known as lane ambiguity. On the baseline between station pairs, there are about 600 10.2 kHz lanes. Each lane is 8 NM wide on the baseline, and diverges to about 12-15 NM near the limits of coverage. The navigator must know which of these lanes the aircraft is in before plotting a fix. Lane ambiguity can be resolved by three methods. The preferred method is to set the receiver's lane count at a known location, such as the point of departure. As the aircraft moves across lane boundaries, the receiver will automatically update the lane identification numbers, allowing the navigator to plot fixes with phase difference measurements in a known lane. If the lane count is lost, the lane count must be reset based on DR, celestial fix, or other means. The third alternative is to derive a course lane using multiple frequencies.

The preceding examples have considered only 10.2 kHz. Many receivers are capable of using the other Omega frequencies for various purposes. One such purpose is lane ambiguity resolution. There is a 3:4 frequency ratio between 10.2 kHz and 13.6 kHz. This relationship also applies to other wavelengths. Three 10.2 kHz wavelengths are the same length as four 13.6 wavelengths (Figure 8-4), or 24 NM on the baseline in the hyperbolic mode (48 NM in the direct ranging mode). A wavelength of 24 NM would correspond to a frequency of 3.4 kHz, which is the difference between 10.2 and 13.6 kHz. The receiver can synthesize a 3.4 kHz Omega signal by combining the 10.2 and 13.6 kHz signals. The 10.2 kHz lane numbers, which are evenly divisible by 3, form the boundaries of 3.4 kHz course lanes (Figure 8-5). The 3.4 kHz phase differences can be plotted in these course lanes. The resulting fix is then used to reset the 10.2 kHz lane count.

FIGURE 8-4. USING FREQUENCY DIFFERENCES TO DERIVE COURSE LANES

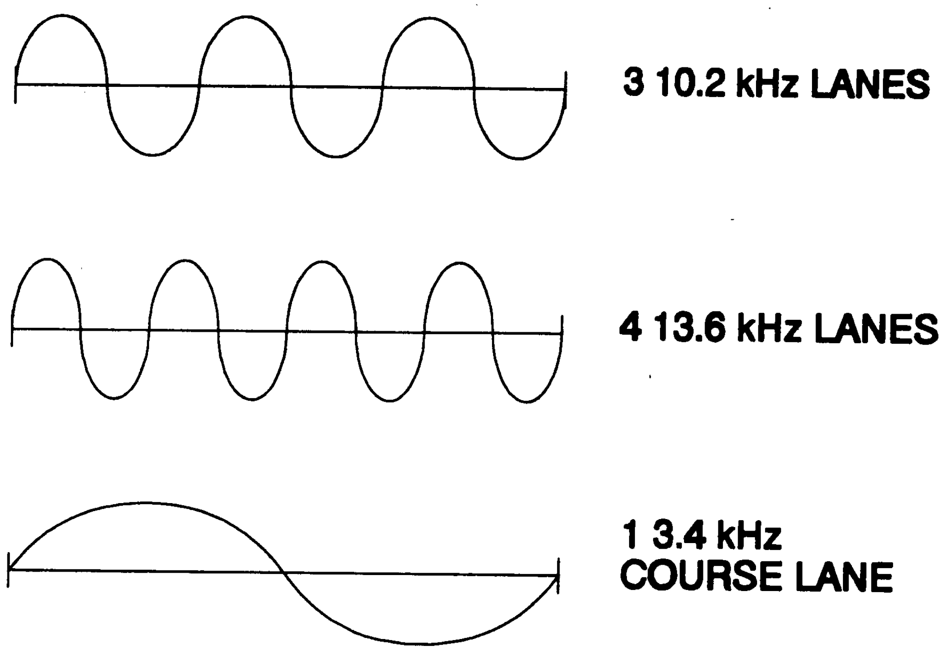
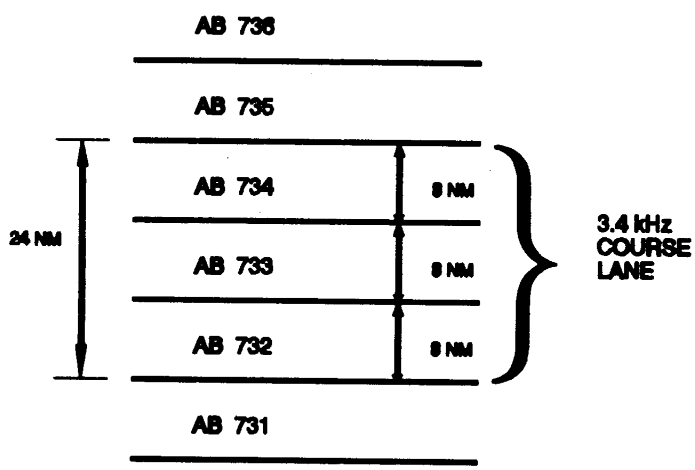


FIGURE 8-5. COURSE LANE BOUNDARIES IN THE HYPERBOLIC MODE



w. ***Omega Navigation System Center.*** The Omega Navigation System Center (ONSCEN) is the Coast Guard unit responsible for the operational control of Omega. ONSCEN is staffed on weekdays between 7:00 a.m. and 3:30 p.m., eastern time. During these hours information on Omega, including the current system status, scheduled off-air periods, and any navigational warnings in effect may be obtained by calling (703) 866-3800. At other times a command duty officer (CDO) is on watch and can be contacted by calling the same number; a recorded message will give the name and telephone number of the CDO. Written inquiries may be addressed to: Commanding Officer, Omega Navigation System Center, 7323 Telegraph Road, Alexandria, VA 22310-3998. A recorded message giving the current status of Omega is available at any time by calling (703) 866-3801. This recording gives the dates and times of scheduled off-air periods, any navigational warnings in effect due to signal disturbances, and any other important system information. Routine Omega status reports and navigational warnings are also available through the following means.

(1) ***Telex/mail.*** Omega status reports are issued weekly by telex or mail to users of Omega equipment. Navigational warnings are not issued by telex or mail. Write to ONSCEN at the address given above.

(2) ***Radio broadcast.*** The U.S. Department of Commerce (DOC), National Institutes of Standards and Technology, broadcasts Omega status advisories on radio stations WWV, Fort Collins, CO and WWVH, Kauai, HA on 2.5, 5, 10, and 15 megahertz (MHz). WWV also broadcasts on 20 MHz. Omega status advisories are broadcast at 16 minutes past each hour on WWV, and at 47 minutes past each hour on WWVH. These advisories contain dates for scheduled off-airs and any navigational warnings in effect. Because each announcement is limited to 40 seconds, the specific times for each off-air period may not be given.

(3) ***NOTAM.*** When alerted by the Coast Guard, the FAA issues NOTAM's to warn of signal disturbances or unscheduled off-air periods. Airmen should consult their local FAA office for details regarding the issuance of Omega NOTAM's.

x. ***Aviation Use of Omega.*** Whereas INS position errors normally accrue gradually with elapsed flight time, most Omega errors occur suddenly and are usually multiples of the basic lane width. Effective cross-checking procedures should be accomplished at regular intervals and LAR or in-flight updating should be initiated when the position accuracy is in doubt. In addition to the general practices and procedures contained in Section 1, above, the following recommendations apply to Omega systems.

(1) ***Preflight.***

(a) Crews should be alert for any NOTAM's affecting the operational status of the individual Omega transmitters, particularly for possible abnormal operation. Deselection of any station reported to be in abnormal operation should be considered at the onset of the flight. Also, crews should be alert for any NOTAM's relating to the propagation disturbances, such as sudden ionospheric disturbances, sudden phase anomalies, or polar cap anomalies, which may affect Omega positioning accuracy. Scheduled Omega status broadcasts on station WWV should be monitored as a means of obtaining current Omega information.

(b) The Omega software and modification status codes should be verified by flightcrews to ensure that the proper equipment is installed and that the appropriate checklist is available and is used.

(c) At certain ground locations, particularly at congested terminals, abnormally high radio noise levels may adversely affect Omega. For example, synchronization may take longer than normal or the inserted ramp coordinates may drift after insertion. Synchronization or DR warning lights usually indicate this situation. This problem normally disappears, if the Omega equipment is serviceable, shortly after the switch to aircraft power or after the aircraft is moved from the gate. Care should be exercised during taxi, since abrupt turns may cause a momentary loss of signals which could affect system accuracy. It is good practice to cross-check present position coordinates or taxi distance before takeoff to detect any errors which may have occurred since initialization.

(2) ***In-Flight Updating.*** The same considerations basic to updating an INS also apply to Omega due to the normal accuracy and reliability of these systems. However, in addition to the capability to update

over a navaid, most Omega systems are capable of performing an LAR if certain signal strength and station geometry requirements are met. Unless an apparent Omega error exceeds 6 NM, a lane slip may not necessarily have occurred and LAR or updating is not normally recommended. If an LAR appears to be necessary, the LAR should be initiated on only one system at a time so that the other system remains unaffected for use as a cross-check. The LAR should be attempted first on the system believed to be the least accurate.

y. Navigation Errors by Omega Equipped Aircraft. If a navigation error is discovered by a crew of an Omega equipped aircraft, or if a crew of an Omega equipped aircraft is notified of a navigation error by ATC, a report containing the information listed in Figure 8-6 should be submitted to the FAA. This information should be sent by mail or facsimile (fax) to the FSDO nearest the aircraft's base of operation or, if applicable, to the FSDO that holds the operator's operating certificate.

9. FAA APPROVAL OF GPS EQUIPMENT.

a. GPS Equipment Classes. GPS equipment is categorized into classes A(), B(), and C() (ref. TSO-C129).

(1) Class A(). Equipment incorporating both the GPS sensor and navigation capability. This equipment incorporates RAIM.

- Class A1 equipment includes en route, terminal, and nonprecision approach navigation capability.
- Class A2 equipment includes en route and terminal navigation capability only.

(2) Class B(). Equipment consisting of a GPS sensor that provides data to an integrated navigation system (i.e., flight management system, multi-sensor navigation system, etc.).

- Class B1 equipment includes RAIM and provides en route, terminal, and nonprecision approach capability.
- Class B2 equipment includes RAIM and provides en route and terminal capability only.
- Class B3 equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to RAIM and provides en route, terminal, and nonprecision approach capability.
- Class B4 equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to RAIM and provides en route and terminal capability only.

(3) Class C(). Equipment consisting of a GPS sensor that provides data to an integrated navigation system (i.e., flight management system, multi-sensor navigation system, etc.), which provides enhanced guidance to an autopilot or flight director in order to reduce flight technical error. Installation of Class C() equipment is limited to aircraft approved under FAR Part 121 or equivalent criteria.

- Class C1 equipment includes RAIM and provides en route, terminal, and nonprecision approach capability.
- Class C2 equipment includes RAIM and provides en route and terminal capability only.
- Class C3 equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to RAIM and provides en route, terminal, and nonprecision approach capability.
- Class C4 equipment requires the integrated navigation system to provide a level of GPS integrity equivalent to RAIM and provides en route and terminal capability only.

NOTE: Operators requiring additional GPS approval information are referred to the following AC's: AC 20-130, "Airworthiness Approval of Multi-Sensor Navigation Systems for Use in the U.S. National Airspace System (NAS) and Alaska," and AC 20-XXX, "Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System" (This AC was formerly FAA Notice N8110.47).

b. Approval Criteria. A GPS installation with a TSO C-129 authorized navigation system in Class A1, A2, B1, B2, C1, or C2 may be used in combination with other approved LRNS for unrestricted operations in NAT MNPS airspace or may be used as the sole means of long-range navigation on the special routes that have been developed for aircraft equipped with only one LRNS and on the special routes developed for aircraft equipped with short-range navigation equipment. The basic integrity for these operations must be provided by RAIM or an equivalent method. A single GPS installation in Class A1, A2, B1, B2, C1, or C2 which provides RAIM for integrity monitoring may also be used on those short oceanic routes which have only one required means of long-range navigation.

FIGURE 8-6. NAVIGATION DEVIATION REPORT FOR OMEGA EQUIPPED AIRCRAFT

1. Details of aircraft and reported error.

   Name of operator:

   Aircraft identification:

   Date/time of observed error:

   Flight level (FL):

   Position (lat/long):

   Approximate cross-track deviation (NM):

2. Was Omega being used as the primary means of navigation and steering guidance?

3. Do you consider failure of, or difficulty with, the Omega system as a contributory cause of the deviation? (If not, do not complete items 5-10)

4. Manufacturer of Omega equipment, type of equipment, most recent modification date.

5. Give details of cleared track within NAT oceanic airspace.

6. Give details of any problems experienced with Omega, together with the approximate geographic location.

7. Give details of Omega/VLF signals used and received signal strength.

8. Have there been previous difficulties with the Omega installation? If so, give details.

9. Have any faults been discovered during general checks/maintenance work?

10. What rectification work has been performed?

11. Please provide any additional information that you feel is relevant.

8. GLOBAL POSITIONING SYSTEMS (GPS) GENERAL INFORMATION.

a. GPS Navigation. The GPS is a satellite-based radio navigation system that uses precise range measurements from GPS satellites to determine a precise position anywhere in the world. The GPS constellation consists of 24 satellites in various orbital planes approximately 11,000 nautical miles (NM) above the earth. The satellites broadcast a timing signal and data message that the airborne equipment processes to obtain satellite position and status data, and to measure how long each satellite's radio signal takes to reach the receiver. By knowing the precise location of each satellite and precisely matching timing with the atomic clocks on the satellites, the receiver can accurately measure the time the signal takes to arrive at the receiver and thus determine the satellite's precise position. A minimum of three satellites must be in view to determine a two-dimensional position. Four satellites are required to establish an accurate three-dimensional position. GPS equipment determines its position by precise measurement of the distance from selected satellites in the system and the satellite's known location. The accuracy of GPS position data can be affected by various factors. Many of these accuracy errors can be reduced or eliminated with mathematics and sophisticated modeling, while other sources of errors cannot be corrected. The following are examples of those errors which cannot be corrected:

(1) Atmospheric propagation delays can cause relatively small measurement errors, typically less than 100 feet. Ionospheric propagation delays can be partially corrected by sophisticated error-correction capabilities.

(2) Slight inaccuracies in the atomic clocks on the satellites can cause a small position error of approximately 2 feet.

(3) Receiver processing (such as mathematical rounding and electrical interference) may cause errors that are usually either very small (which may add a few feet of uncertainty into each measurement) or very large (which are easy to detect). Receiver errors are typically on the order of 4 feet.

(4) Conditions that cause signal reflections before the satellite's transmitted signal gets to the receiver can cause small errors in position determination or momentary loss of the GPS signal. While advanced signal processing techniques and sophisticated antenna design are used to minimize this problem, some uncertainty can still be added to a GPS measurement.

(5) A satellite's exact measured orbital parameters (ephemeris data) can contain a small error of approximately 4 feet.

b. System Operation.

(1) The Department of Defense (DOD) is responsible for operating the GPS satellite constellation and constantly monitors the GPS satellites to ensure proper operation. Every satellite's ephemeris data are sent to each satellite for broadcast as part of the data message sent in the GPS signal. The GPS is a system of cartesian earth-centered, earth-fixed coordinates as specified in the DOD World Geodetic System 1984 (WGS-84). Navigation values, such as groundspeed and distance and bearing to a waypoint, are computed from the aircraft's latitude/longitude and the location of the waypoint. Course guidance is usually provided as a linear deviation from the desired track of a Great Circle course between defined waypoints.

(2) GPS navigation capability from the 24 satellite constellation is available 24 hours a day anywhere in the world. GPS status is broadcast as part of the data message transmitted by the satellites. Additionally, system status is planned to be available through Notices to Airmen (NOTAM). Status information is also available by means of a telephone data service from the U.S. Coast Guard. Availability of suitable navigation capability from the satellite constellation is expected to approach 100 percent.

(3) GPS signal integrity monitoring will be provided by the GPS navigation receiver using receiver autonomous integrity monitoring (RAIM). For GPS sensors that provide position data only to an integrated navigation system (e.g., FMS, multisensor navigation system), a level of GPS integrity equivalent to that

of RAIM may be provided by the integrated navigation system. Availability of RAIM capability to meet nonprecision approach requirements in the United States with the 24 satellite constellation is expected to exceed 99 percent.

c. Selective Availability (SA). SA is essentially a method by which DOD can artificially create a significant clock and ephemeris error in the satellites. This feature is designed to deny an enemy nation or terrorist organization the use of precise GPS positioning data. SA is the largest source of error in the GPS system. When SA is active, the DOD guarantees horizontal position accuracy will not be degraded beyond 100 meters 95 percent of the time, and beyond 300 meters 99.99 percent of the time.

d. Portable Units. All portable electronic systems and portable GPS units must be handled in accordance with the provisions of FAR 91.21. The operator of the aircraft must determine that each portable electronic device will not cause interference with the navigation and communications systems of the aircraft on which it is to be used. Portable GPS units which are attached by Velcro tape or hard yoke mount that require an antenna (internally or externally mounted) are considered to be portable electronic devices and are subject to the provisions of FAR 91.21. All portable GPS equipment attached to the aircraft by a mounting device must be installed in an approved manner and in accordance with FAR Part 43. Questions concerning installation should be referred to an avionics or airworthiness inspector. A critical aspect of any GPS installation is the installation of the antenna. Shadowing by the aircraft structure can adversely affect the operation of the GPS equipment. FAA approval of avionic components, including antennas, requires an evaluation of the applicable aircraft certification regulations prior to approval of an installation. The regulations require that the components perform their intended functions and be free of hazards in and of themselves and to other systems as installed. Pilots should be aware that a GPS signal is weak, typically below the value of the background noise. Electrical noise or static in the vicinity of the antenna can adversely affect the performance of the system. It is recommended that system installations be flight tested in conjunction with other navigation equipment prior to using the system for actual navigation. Unless a portable GPS receiver is TSO C-129 approved, it is not to be used as a basis for approval of operations in the NAT MNPS.

e. Navigation Classes. All navigation performed in flight is either Class I or Class II navigation.

(1) Class I navigation: Any en route flight operation or portion of a flight operation conducted in an area entirely within the officially designated operational service volumes of ICAO standard airways navigation facilities (VOR, VOR/DME, NDB). The two generic types of Class I navigation are navigation by direct reference to ICAO standard navaids and navigation by use of area navigation systems.

(2) Class II navigation: Any operation or portion of an en route operation which takes place outside (beyond) the officially designated operational service volumes of ICAO standard navaids (VOR, VOR/DME, NDB). Any en route flight operation or portion of a flight operation which is not Class I navigation. There are three generic classes of Class II navigation. These are navigation by reference to ICAO standard navaids supplemented by dead reckoning, navigation by use of pilot-operated electronic long-range navigation systems (e.g. INS, Omega, GPS), and navigation by use of a flight navigator.

f. RAIM. A technique whereby a civil GPS receiver/processor determines the integrity of the GPS navigation signals using only GPS signals or GPS signals augmented with altitude. This determination is achieved by a consistency check among a series of satellites being tracked. At least one satellite in addition to those required for navigation must be in view for the receiver to perform the RAIM function.

g. Supplemental Air Navigation System. An FAA-approved navigation system that can be used in addition to a required means of air navigation. May be used as the primary navigation system provided an operational approved alternate means of navigation suitable for the route of flight is installed on the aircraft.

h. System Availability. The percentage of time (specified as 98 percent) that at least 21 of the 24 satellites must be operational and providing a usable navigation signal.

*c. **Avionics.*** Documentation must be provided which validates approval of the installed GPS airborne receiver in accordance with Notices 8110.47, 8110.48, AC 20-129 and AC 20-130A, as appropriate, or other applicable airworthiness criteria established for GPS installations. When it has been established that the airborne system has been certified for GPS IFR operations, the following criteria should be used to determine the operational suitability of airborne systems for GPS IFR use:

(1) Initial Installations and Continued Airworthiness. The operator must ensure that the equipment is properly installed and maintained. No special requirements, other than the standard practices currently applicable to navigation or landing systems, have been identified that are unique to GPS, e.g., Airworthiness Directives, Service Bulletins.

(2) Action. Aviation safety inspectors must evaluate installation (An avionics inspector should evaluate the avionics installation and recommend the approval prior to the issuance of an LOA to operate in NAT MNPS airspace.), crew capabilities, and operational responsibilities relative to GPS oceanic operations prior to issuing an LOA for operation in MNPS. Specific items to check are as follows:

(a) The GPS navigation equipment used must be approved in accordance with the requirements specified in TSO C-129 and the installation must be made in accordance with Notice 8110.47 or 8110.48 or the AFS/AIR joint guidance memorandum dated July 20, 1992.

(b) The basic integrity for these operations must be provided by RAIM or an equivalent method.

(c) The GPS operation must be conducted in accordance with the FAA-approved flight manual or flight manual supplement, if required.

(d) Aircraft using GPS equipment under IFR must be equipped with an approved and operational alternate means of navigation appropriate to the route to be flown. This traditional navigation equipment must be actively used by the flightcrew to monitor the performance of the GPS system.

(e) Procedures must be established for use in the event that significant GPS navigation outages are predicted to occur. In situations where this is encountered, the flight must rely on other approved equipment, delay departure, or cancel the flight.

(f) Aircraft navigating by GPS are considered to be RNAV aircraft. Therefore, the appropriate equipment suffix must be included in the ATC flight plan.

10. GPS OPERATIONS SPECIFICATIONS.

Air carrier operators planning on utilizing GPS are required to have their operations specifications amended prior to performing operations utilizing GPS. The specific operations specifications items that must be considered are as follows:

- En Route authorization for class I navigation.
- En Route authorization for class II navigation using a single GPS.
- En Route authorization for class II navigation using GPS and a second Long Range Navigation System.
- Authorization for use of GPS in Central East Pacific (CEPAC) Airspace.
- Authorization for use of GPS in Northern Pacific (NOPAC) Airspace.
- Authorization for use of GPS in North Atlantic MNPS Airspace.
- Authorization to conduct operations in Areas of Magnetic Unreliability with GPS.
- Authorization for use of GPS to conduct Nonprecision Instrument Approach Procedures in Airplanes.
- Authorization for use of GPS to conduct Nonprecision Instrument Approach Procedures in Rotorcraft.

Approaches using GPS equipment are subject to the following limitations:

(1) The GPS equipment used must be approved for IFR operations, including nonprecision approaches, and the GPS constellation and the required airborne equipment must be providing the levels of accuracy, continuity and integrity required for that operation.

(2) The flightcrew must have successfully completed the approved training program and demonstrated competency in these operations.

CHAPTER 9. HELICOPTER OCEANIC OPERATIONS

1. GULF OF MEXICO.

a. Background. Although helicopter operations in the Gulf of Mexico have had an enviable safety record, recent statistics indicate that a significant rise in weather-related accidents has occurred. It is imperative that pilots performing oceanic (offshore) operations do not exceed the minimum weather criteria for visual flight rules (VFR) and instrument flight rules (IFR) flight or the minimum flight altitude parameters for all phases of flight. The operator must comply with all applicable minimum equipment requirements for the operation.

Two documents that address issues and requirements for improving rotorcraft operations within the National Airspace System are "Rotorcraft Terminal ATC Route Standards" (FAA/RD-90/18) and "Rotorcraft En Route ATC Route Standards" (FAA/RD-90-19). These documents are available to the public through the National Technical Information Service, Springfield, Virginia 22161. All operators should obtain these two documents and ensure that crews are familiar with the operating procedures discussed in these documents.

b. Flight in Environmentally Sensitive Areas. Protection of endangered species and the overflight of environmentally sensitive areas are of increasing concern in the Gulf of Mexico. Infringements by low flying airplanes and/or rotorcraft operating en route to airways in the Gulf of Mexico or to helidecks can be disruptive to wildlife while over the shore or near the shore. Guidelines for flights in these areas are contained in the Airman's Information Manual (AIM), in Advisory Circular (AC) 91-36 "VFR Flight Near Noise-Sensitive Areas," on VFR sectional maps, and on specially designed maps published by Minerals Management Service of the Department of the Interior.

2. IFR OFFSHORE OPERATIONS.

a. General. Any operator that desires to conduct IFR operations in uncontrolled airspace shall submit a letter describing the proposed operation to the certificate holding district office (CHDO). This letter should include the specific routes to be flown, the exact location of the destination, the type of aircraft to be used, the navigation equipment on the aircraft, and the specific navigational aids (navaids) to be used at the offshore facility, if any.

b. Offshore Operators. FAR Part 91 offshore operators are required to obtain a Letter of Authorization (LOA) for IFR operations. The LOA will be issued once all certification requirements are met.

c. FAA Coordination. After reviewing the request, the CHDO will arrange a coordination meeting with air traffic elements that will be involved (such as the center, approach control, flight service station (FSS), etc.). If a navaid exists at the offshore facility, the regional flight procedures branch may also be represented at the coordination meeting. If the proposed operations are to be conducted in a region other than that of the CHDO, the CHDO will coordinate with the FSDO having jurisdiction of the geographic area where operations are to be conducted. The jurisdictional flight standards district office (FSDO) will perform route checks and other required inspections, and forward reports of these inspections to the CHDO. When all requirements have been met, the CHDO approves the operation and issues operation specifications or an LOA.

d. Navigation Requirements and Procedures. Operators will be inspected to ensure that the required navigational equipment, including radar altimeter and mapping radar, is appropriately installed and approved for the proposed operation. If flight routes are predicated on the use of an area navigation (RNAV) system, operators should ensure that they are in compliance with AC 90-45, "Approval of Area Navigation Systems for use in the U.S. National Airspace System." An operator that seeks approval for IFR operations must ensure that the following navigation requirements are met.

*(1) **Route Requirements.*** Operators may develop proposed routes using Class I station-referenced navaids where adequate signal coverage is available. In areas where signal coverage is not available, the operator must provide a suitable means of Class II navigation. The FAA will require a validation test in VFR conditions to ensure that the operator is able to demonstrate adequate navigational performance for the route(s) before granting approval for use of the route(s).

(a) For approval of IFR operations using Class I navaids, appropriate approach plates and operating procedures must be approved by the FAA and published in the operator's manual. Use of the procedures will be authorized through a nonstandard operations specifications paragraph that refers to the operator's manual containing these procedures.

(b) For approval of IFR operations using nonterminal navaid facilities, the operator must submit a written request to the CHDO for a helicopter offshore procedure according to AC 90-80, "Approval of Offshore Helicopter Approaches."

*(2) **Extended Overwater or IFR Operations Equipment.*** All navigation equipment to be used in extended overwater or IFR operations must meet FAR 135.165(b) requirements. If positive course guidance for any portion of the route is obtained through the use of long-range navigation equipment such as very low frequency (VLF), Omega, or Loran-C, two independent receivers for navigation must be installed and be operative before approval is granted.

e. Weather Reporting Requirements. A weather reporting facility approved by the National Weather Service (NWS) or the FAA must be present and operable within 10 nautical miles (NM) of the destination. A remote source may be approved by the FAA (with NWS concurrence) as a deviation from the provisions of FAR 135.213(b) when the operator is able to demonstrate an adequate level of safety for the proposed operations. The approval for this deviation will be published in the operation specifications.

f. Helicopter En Route Descent Areas (HEDA). An operator that desires to establish a HEDA shall submit a written request to its CHDO. If the proposed HEDA is outside the CHDO's geographic area of responsibility, the CHDO will forward the request to the jurisdictional FSDO. The letter of request should include the following information:

(1) A pictorial and/or a written description of the proposed HEDA

(2) The means by which positive course guidance is to be established

(3) Equipment requirements for use in the HEDA

(4) Proposed operations and training manual revisions to incorporate HEDA's, if an initial application for approval of a HEDA

(5) The date of first intended use and the proposed length of service for which authorization is sought

g. HEDA Procedures and Requirements. Prior to granting authorization, the CHDO or jurisdictional FSDO will coordinate with a flight inspection procedures specialist to determine if the proposed HEDA is clear of obstructions and that positive course guidance is available for the entire route, including descent to the lowest authorized altitude (LAA). All required flight and navigation equipment must be installed and operative to utilize the 400-foot minimum. Figures 9-1 and 9-2 portray the en route dimensions contained in FAA Order 8260.3, "U.S. Standards for Terminal Instrument Procedures," that should be used to develop the primary and secondary areas for HEDA use. HEDA's have the profile of Figure 9-3 and the dimensions of the plan view as shown in Figure 9-4. The descent area begins at the descent fix and ends at the descent altitude fix. This area must be located over water and be free of obstacles.

*(1) **Inoperative Equipment.***

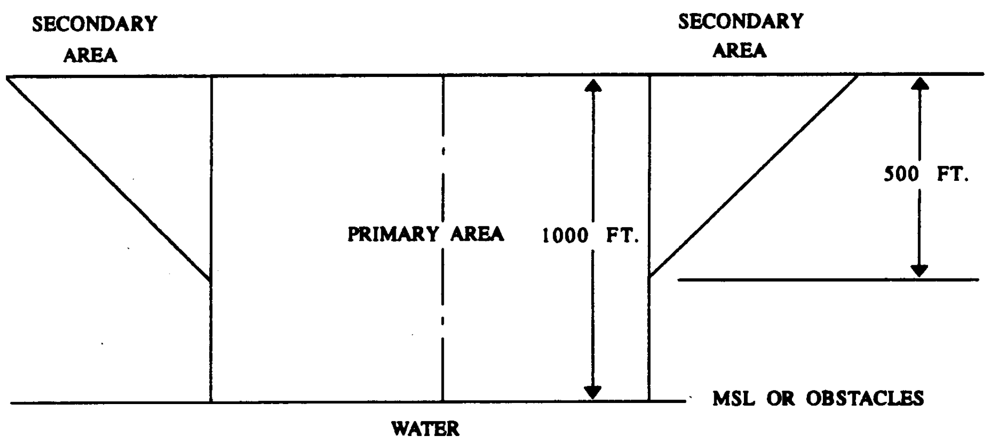
(a) The LAA will be increased to 700 feet as shown in Figure 9-5 with the radar altimeter inoperative.

(b) The LAA will be increased to 700 feet as shown in Figure 9-6 with the mapping radar inoperative.

(c) When the radar altimeter is inoperative, altitude will be adjusted upward 5 feet for each mile over 5 miles from the altimeter setting source to the descent altitude fix.

(2) Operations specifications for HEDA's are valid for 1 calendar year from the date of issue. Operators wishing to obtain HEDA revalidation must submit written confirmation to the CHDO that the HEDA is clear of obstructions and that positive course guidance is available. The operator must provide the means for any on-site inspections requested by the CHDO or FSDO.

FIGURE 9-1. EN ROUTE PROFILE



EN ROUTE PROFILE

FIGURE 9-2. EN ROUTE PLAN VIEW

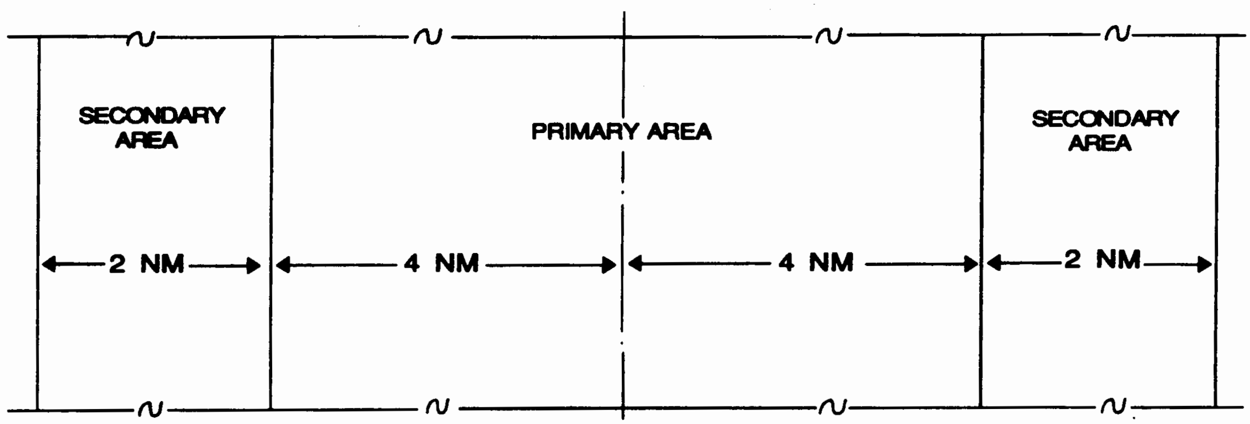


FIGURE 9-3. HEDA PROFILE

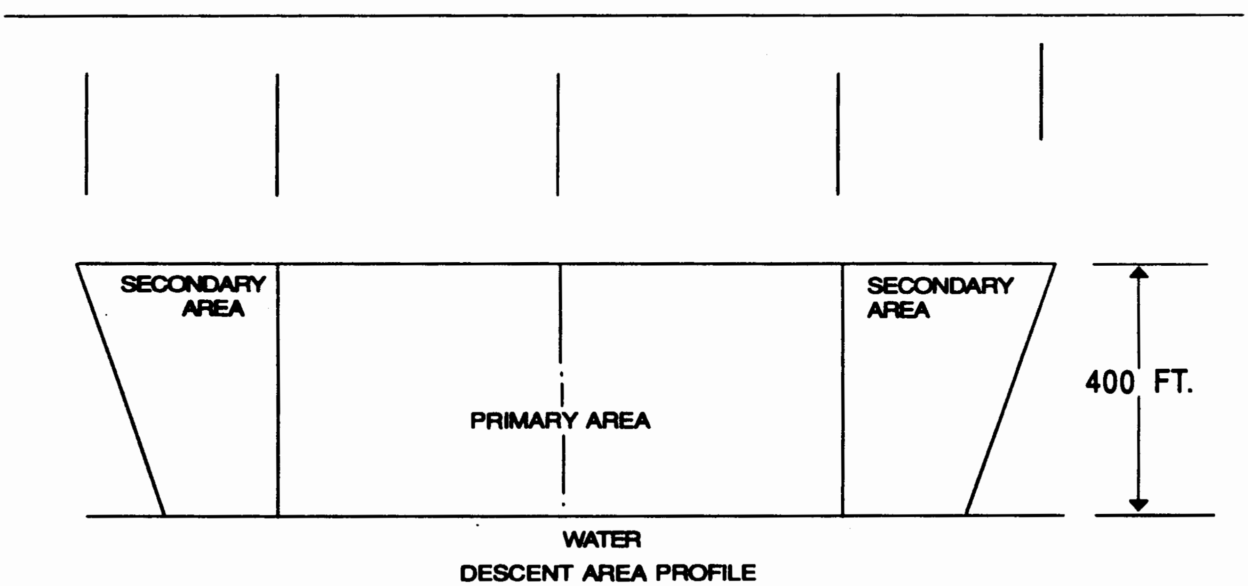
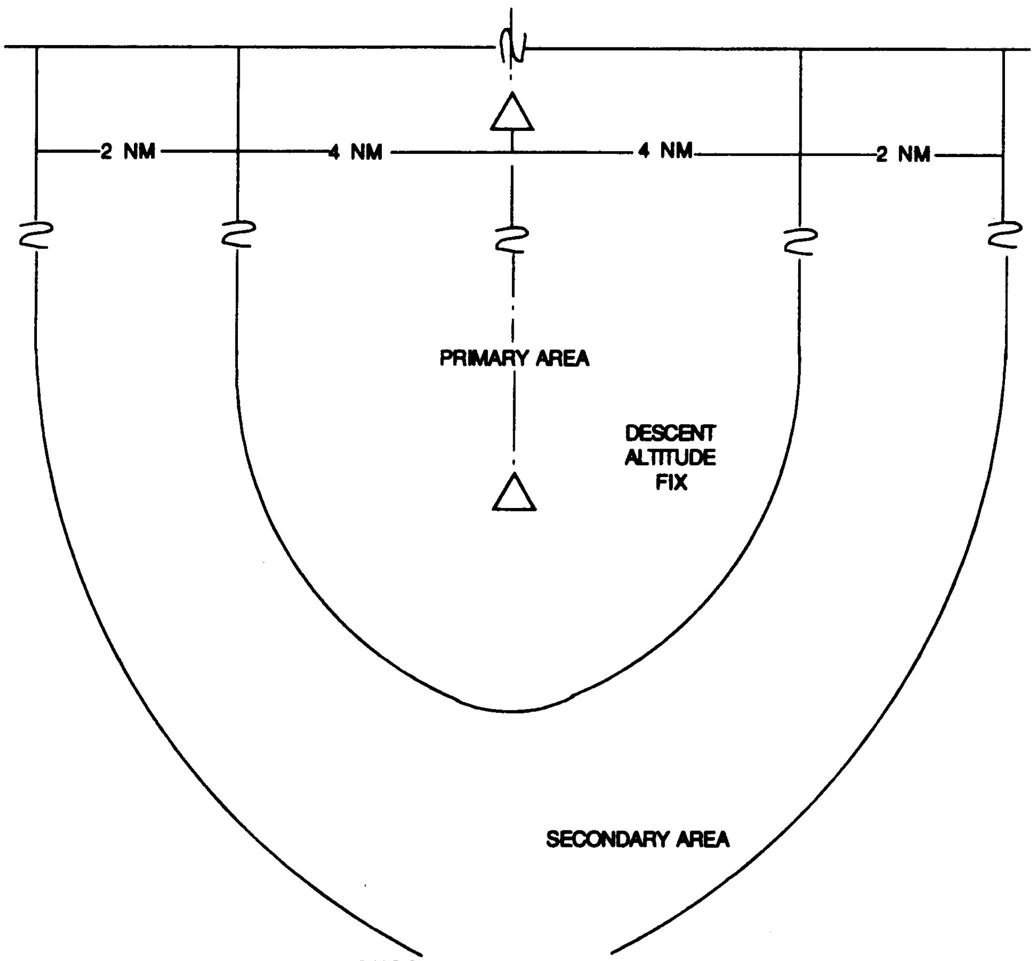
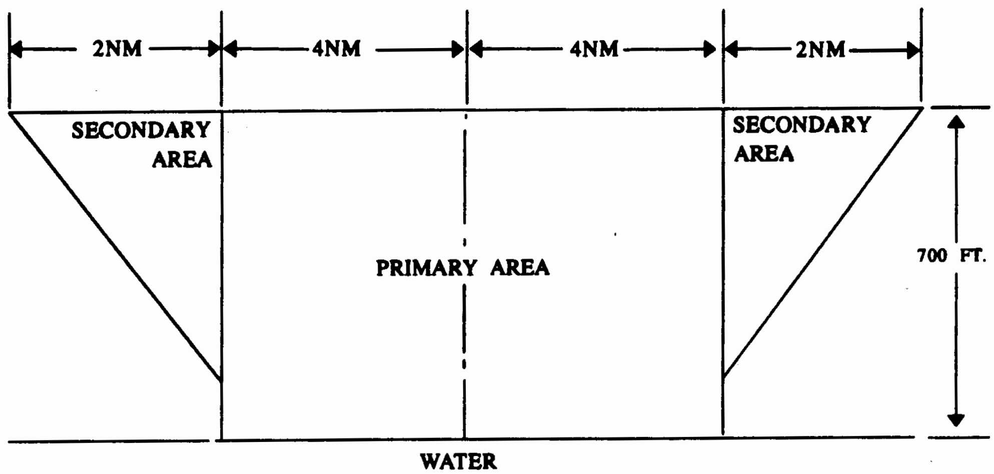


FIGURE 9-4. HEDA DIMENSIONS



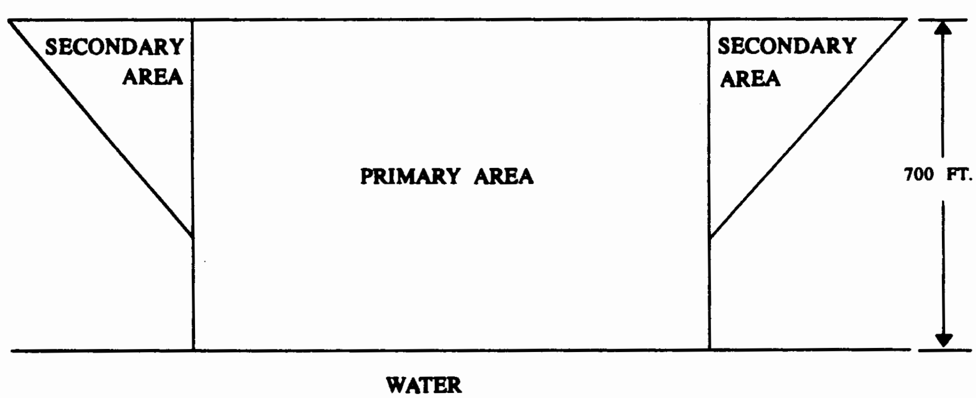
DESCENT AREA PLAN VIEW

FIGURE 9-5. RADAR ALTIMETER INOPERATIVE



DESCENT AREA PROFILE

FIGURE 9-6. MAPPING RADAR INOPERATIVE



DESCENT AREA PROFILE

3. OFFSHORE INSTRUMENT APPROACH PROCEDURES.

a. General. These procedures are to be used by IFR-approved helicopter operators in an offshore environment to conduct instrument approaches to rigs, platforms, or ships that are at least 5 NM offshore in uncontrolled airspace. The helicopter will use the airborne radar approaches (ARA) or the offshore standard approach procedures (OSAP) for conducting instrument approaches in this environment.

b. Approach Approval Procedures. AC 90-80, "Approval of Airborne Radar Approach (ARA) Procedures for Helicopters to Offshore Platforms," contains approval guidance, procedures criteria, and a sample training program for offshore instrument approaches. ARA procedures are special instrument approach procedures approved under the provisions of FAA Order 8260.19, "Flight Procedures and Airspace," and FAA Order 8260.3.

(1) ARA Approval Procedures.

(a) The FSDO with geographic responsibility for the area in which the ARA will be conducted must verify the adequacy of obstacle clearances.

(b) Operators must demonstrate acceptable performance of en route and instrument approach procedures to the CHDO prior to the operator's obtaining approval to use these procedures.

(c) ARA's are documented on FAA Form 8260-7, "Special Instrument Approach Procedures."

(d) The FAA regional flight inspection and procedures (FIP) staff will inspect ARA's prior to approval by the CHDO. Minor changes of rig locations will be made in pen and ink, provided the en route egress point and procedures remain the same and the controlling obstacle does not change. Otherwise, the FIP staff will develop a new procedure.

(2) OSAP Approval Procedures.

(a) Operators that desire to conduct OSAP's must submit a written request to the CHDO according to the procedures stated in AC 90-80, as amended.

(b) The procedures contained in the request for approval will be evaluated and tested by the CHDO. Additionally, the operator's maintenance and training programs will be inspected prior to issuance of the authorization.

(c) Authorization for FAR Part 135 operators to conduct OSAP's will be made as part of the operations specifications.

(d) Authorization for FAR Part 91 operators to conduct OSAP's will be issued in an LOA (Figure 9-6)

FIGURE 9-7. SAMPLE LETTER OF AUTHORIZATION (LOA)

(Figure 9-7 is a sample LOA from AC 90-80, Appendix 5.)

January 20, 1993

Energy Resources, Inc.

1234 Fifth Avenue

Wellhead, LA 98765

Gentlemen:

Energy Resources, Inc. is authorized to conduct helicopter offshore standard approach procedures (OSAP) under Federal Aviation Regulations (FAR) Part 91 within the areas listed in this letter. Energy Resources, Inc. shall conduct all OSAP operations in compliance with the conditions, limitations, and procedures in this letter and shall conduct no other OSAP operations.

(a) Energy Resources, Inc. is authorized to use the following OSAP approach and landing minimums for the helicopters listed in the following table, provided that the conditions and limitations in paragraphs (b) and (e) are met.

HELICOPTER TYPE MAKE/ MODEL	MDA NOT LESS THAN	LOWEST VISIBILITY AU- THORIZED

(b) The flight instruments, radio navigation, and other airborne systems required by the applicable FAR must be installed and must be operational for OSAP operations. The airborne radar, Loran-C, and radar altimeter equipment listed in the following table is also required and, except for the radar altimeter, must be operational for OSAP operations.

HELICOPTER MAKE/MODEL/SERIES	ADDITIONAL EQUIPMENT

(c) Energy Resources, Inc. shall not conduct any OSAP operations unless an approved source of weather observations (including wave height) is located within 10 nautical miles of the approach target to which a particular OSAP is oriented, or extended operations are approved using enhanced weather information systems.

(d) No pilot or airborne radar operator shall conduct any OSAP operations in any helicopter unless that person has successfully completed the Energy Resources, Inc. training program and has been certified by an FAA inspector as qualified for OSAP operations.

(e) No pilot-in-command shall begin or continue the final approach segment of an OSAP unless all of the following conditions and limitations are met:

(1) the maximum indicated airspeed does not exceed 90 knots

(2) the maximum groundspeed does not exceed 70 knots (never slower than Vyse for multiengine helicopters) between the decision point altitude (DPA) and the missed approach point (MAP)

(3) there is no indication on the weather radar display of contouring due to the intensity of precipitation

(4) all obstructions that are observed on radar are avoided by at least 0.5 NM when below 900 feet MSL during a takeoff and departure procedure

(5) whenever a required radar altimeter is inoperative, the MDA must be increased by 5 feet for each NM in excess of 5 NM distance between the approach target and an approved altimeter setting source

(f) A missed approach shall be executed when any of the following conditions exist:

(1) any of the airborne equipment (other than a radar altimeter) required for the OSAP operations becomes inoperative

(2) at least 0.5 NM lateral separation from obstacles cannot be maintained after passing the DPA

(3) the approach target disappears from the radar display

(4) the reliability or accuracy of the Loran-C signal cannot be ascertained

(5) whenever the approach target is not in visual contact at any distance less than 0.7 NM

[Signed by the FSDO or CHDO office manager]

CHAPTER 10. CREW TRAINING FOR OCEANIC OPERATIONS

1. CREW QUALIFICATIONS.

a. Background. In the "International Standards and Recommended Practices - Annex 6, Operation of Aircraft," the International Civil Aviation Organization (ICAO) makes the following stipulations for flights outside the jurisdiction of member states:

(1) An operator shall ensure that all employees, when abroad, know that they must comply with the laws, regulations, and procedures of those states where operations are conducted.

(2) An operator shall ensure that all pilots are familiar with the laws, regulations, and procedures pertinent to the performance of their duties that are prescribed for the areas to be traversed, the airports to be used, and the related air navigation facilities. The operator shall ensure that other members of the flightcrew are familiar with such of these laws, regulations, and procedures that are pertinent to the performance of their respective duties in the operation of the aircraft.

(3) When the operation is conducted by the pilot-in-command (PIC), the PIC must perform the following:

(a) Comply with the relevant laws, regulations and procedures of the United States.

(b) Assume responsibility for the operation and safety of the aircraft and for the safety of all persons aboard during flight time.

(c) If an emergency situation that endangers the safety of the aircraft or persons necessitates action involving a violation of local regulations or procedures, the PIC shall notify the appropriate local authorities without delay. If required by the state in which the incident occurs, the PIC shall submit a report on any such violation to the appropriate authority of that state. In that event, the PIC shall also submit a copy in writing to the FAA Flight Standards National Field Office, AFS-500, P.O. Box 20034, Washington, DC 20041-2297. Such reports shall be submitted within 10 days of the incident.

(d) The PIC shall be responsible for notifying the nearest appropriate authority by the quickest available means of any accident involving the airplane resulting in serious injury or death of any person or substantial damage to the airplane or property.

b. Pilot as PIC. An operator shall not use a pilot as PIC of an aircraft on a route or route segment for which that pilot is not currently qualified until that pilot has demonstrated to the operator an adequate knowledge of the following:

(1) The route to be flown and the airports to be used

(2) The terrain and minimum safe altitudes

(3) The seasonal meteorological conditions

(4) The meteorological, communication, and air traffic facilities, services, and procedures

(5) The search and rescue procedures

(6) The navigational facilities and procedures, including any long-range navigation procedures associated with the planned route

The PIC must also demonstrate an adequate knowledge of procedures applicable to flight paths over heavily populated areas and areas of high air traffic density; obstructions; physical layout; lighting; approach aids and arrival, departure, holding and instrument approach procedures (IAP); and applicable operating minimums.

The PIC shall have made an actual approach into each airport of landing on the route, accompanied by a pilot who is qualified for that aircraft, as a member of the flightcrew or as an observer on the flight deck, unless:

(1) The approach to the airport is not over difficult terrain and the IAP's and aids available are similar to those which the pilot is familiar, and a margin to be approved by the Administrator is added to the normal operating minimums, or there is reasonable certainty that a specific approach can be made in visual meteorological conditions (VMC).

(2) The descent from the initial approach altitude can be made by day in VMC.

(3) The operator qualifies the PIC to land at the airport concerned by means of an adequate pictorial presentation.

(4) The airport concerned is adjacent to another airport at which the PIC is currently qualified to land.

2. TRAINING CONSIDERATIONS.

a. Crews conducting oceanic flights shall be trained in a manner approved by the Administrator. Approval of air carrier's training programs will be granted in conjunction with their certification and subsequent issuance of operations specifications. General aviation aircraft desiring to fly in special use airspace will be granted approval through the issuance of a Letter of Authorization (LOA) (See Chapter 3 of this AC.) Crew qualifications for the issuance of an LOA may be satisfied by one of the following:

(1) Completing an operator's oceanic operations training program

(2) Completing a commercial oceanic operations training program

(3) Submitting military training records indicating prior oceanic operations experience

(4) Using other methods indicating to the operator that the crew can safely conduct oceanic operations (Examples could include written testing, oral testing, or evidence of prior experience)

b. For a crew to be considered as being qualified for oceanic operations, crew members must be knowledgeable in the following subject areas:

(1) ICAO operational rules and regulations

(2) ICAO measurement standards

(3) Use of oceanic flight planning charts

(4) Sources and content of international flight publications

(5) Itinerary planning

(6) FAA international flight plan, ICAO flight plan, and flight log preparation

(7) Route planning within the special use airspace where flights are to be conducted

(8) En route and terminal procedures - different to U.S. procedures

(9) Long-range, air-to-ground communication procedures

(10) Structure of the special use airspace where the flights are to be conducted

(11) Air traffic clearances

(12) International meteorology, including significant weather charts, prognostic weather charts, tropopause prognostic charts, and terminal area forecasts (TAF)

(13) Specific en route navigation procedures for each type of navigation equipment required for use in the special use airspace

(14) Emergency procedures, including required emergency equipment, search and rescue techniques, navigation equipment failure techniques, and communication equipment failure techniques

CHAPTER 11. GENERAL AVIATION SHORT-RANGE AIRCRAFT OCEANIC OPERATIONS

1. INTRODUCTION.

This Chapter provides guidance to the general aviation pilot who is flying a light, general aviation aircraft in oceanic operations, and specifically addresses aircraft with a relatively short range that cannot transverse an ocean without intermediate fuel stops.

Many of the chapters in this advisory circular (AC) contain important information relative to oceanic operations. All pilots should scan each of these chapters and determine the pertinence of each chapter relative to the flight being planned. In addition, the information contained in this Chapter should be read in detail. It is important to note that this Chapter includes International Civil Aviation Organization (ICAO) rules and Canadian departure requirements for transoceanic flights. These requirements become regulatory to U.S. pilots by virtue of the content of FAR 91.703. Most short-range aircraft crossing the North Atlantic (NAT) will, out of necessity, make a Canadian departure. These aircraft are bound by Canadian regulations in addition to U.S. regulations and ICAO rules. Although emphasis in this Chapter is on NAT flights by short-range aircraft, the majority of the information is pertinent to all oceanic operations by short-range aircraft with the exception of operations in minimum navigation performance specifications (MNPS) airspace. MNPS operations are covered in detail in Chapter 3.

2. ICAO GUIDANCE.

A number of incidents have occurred with NAT international general aviation (IGA) flights that were caused by noncompliance with basic requirements for navigation and communication equipment needed for oceanic flights or flights over remote areas. Most of the incidents were potentially hazardous to the aircraft occupants and to aircrew members called upon to conduct the searches. Some of the incidents resulted in needless and expensive alert activities on the part of the air traffic control (ATC) communicators and controllers, and in search activities by rescue facilities. The incidents generally involved flights that were considerably off-course or had not made the required position reports. This Section provides information for flight planning and operation of IGA flights across the NAT, in particular those operations carried out by light aircraft. IGA pilots planning to cross the Atlantic at altitudes between flight level (FL) 275 and FL 400 (the altitude limits of MNPS airspace) must obtain a Letter of Authorization (LOA) for FAR Part 91 operations, or must receive operations specifications approval if conducting an air carrier operation. The approval processes are discussed in Chapter 3, Section 4 of this AC. Pilots planning to cross the Atlantic above MNPS airspace (FL 410 or higher) may wish to take advantage of the special climb-out provision detailed in Chapter 3, Section 2 of this AC.

a. The NAT Environment. The climate affecting NAT flight operations is demanding throughout the year, with storms or other adverse weather likely to be encountered during any season. It is probable that any transatlantic flight will encounter adverse weather on at least a portion of the flight. The scarcity of alternate airports available to transatlantic flights requires that all significant weather systems along the route be considered during the flight planning phase. Flights at higher NAT FL's (FL 275 - FL 400) are required to be equipped and authorized by the FAA for flights in the NAT MNPS airspace. Radio navigation systems available to pilots include Omega/very low frequency (VLF), Loran-C, and global positioning system (GPS). However, Loran-C coverage is incomplete in many areas, Omega equipped aircraft using E-field antennae are likely to suffer prolonged loss of signal reception when in or near a cloud covering, and a GPS system or sensor that meets the requirements specified in TSO-C129 may be approved as a means, but not the sole means, of oceanic navigation in NAT MNPS airspace. Therefore, it is extremely important that pilots understand the capabilities of their equipment and ensure that accurate navigation facilities exist to support their equipment throughout all of their proposed flight route. Several high power non-directional radio beacons (NDB) located in the NAT region are useful to automatic direction finder (ADF)-equipped aircraft. Some of these stations, including commercial band transmitters, are not monitored for outages or interference by transmitters on adjacent frequencies and may be severely affected by atmospheric conditions without warning.

Very high frequency (VHF) communications coverage extends to line-of-sight distance from facilities in Canada, Iceland, Greenland, the Azores and coastal Europe. The Canadian VHF coverage is extended by use of a remote facility in southern Greenland. High frequency (HF) communications are available throughout the NAT region for ATC purposes. Use of HF by pilots on IGA flights permits proper monitoring of the flight's progress. HF-equipped flights should be able to receive HF meteorological information for aircraft in flight (VOLMET) broadcasts, including significant meteorological information (SIGMET) and continuous meteorological updates, at major terminals in Europe and North America. Search and rescue (SAR) vessels and aircraft are stationed at some locations in the NAT region, but SAR aircraft may not always be available. The availability of SAR vessels may depend on the disposition of a nation's civil emergency fleet. These fleets are often composed of a nation's fishing fleet, and their proximity may depend on the current fishing situation.

b. Pilot Qualification Requirements. The minimum pilot qualification for any flight across the NAT is a private pilot certificate. Unless operating below FL 60 (6000 feet mean sea level (MSL)), the pilot-in-command (PIC) must hold an instrument rating. The demanding NAT operational environment requires that the PIC have the following flight experience in addition to cross-country flight time:

(1) The PIC must meet the recency of experience requirements stipulated in FAR Part 91.

(2) The PIC must have adequate recent flight experience in the use of the long-range navigation and communication equipment to be used. It is highly recommended that pilots document training received and their experience using this equipment prior to embarking on any oceanic flights. This documentation will be invaluable should a navigation error report be filed due to equipment difficulties that cause an error.

c. National Regulations. Pilots of U.S.-registered aircraft must comply with all applicable U.S. regulations, ICAO Annex 2, and the regulations of the states in which they land or overfly. In cases when U.S. regulations are more stringent than ICAO rule or vice versa, pilots are bound to adhere to the more stringent regulation or rule.

d. Flight Rules Over the High Seas. ICAO member states have agreed that ICAO flight rules will be in effect for operations over the high seas. However, responsibility for enforcement of these rules rests with the state of registry of the aircraft or the state of registry of the operator. ICAO flight rules are contained in ICAO Annex 2. Procedural aspects are covered in ICAO Document 7030/3-NAT, "Supplementary Procedures Applicable in the NAT Region." Under FAR 91.703, U.S.-registered aircraft must comply with ICAO Annex 2. U.S.-registered aircraft planning to operate in MNPS airspace must also comply with FAR 91.705. Some of the more significant ICAO rules are paraphrased below:

(1) All flights that cross an international border must file a flight plan.

(2) All flights must file an instrument flight rules (IFR) flight plan when intending to fly in NAT airspace at FL 60 and above in New York, Gander, Shanwick, Santa Maria and Reykjavik Oceanic flight information regions (FIR); at FL 60 and above in the Bodo Oceanic FIR beyond 100 nautical miles (NM) seaward from the shoreline; and at FL 200 and above in the Sondrestrom FIR.

(3) While en route, all changes to IFR flight plans shall be reported as soon as practicable to the appropriate air traffic service (ATS) as prescribed.

(4) An arrival report must be sent to the appropriate ATS unit. When the flight plan cannot be closed by means of the aircraft radio, either a telephone or telegraphic message should be sent. Failure to close flight plans may result in a needless search operation.

e. Operation of Aircraft. ICAO member states have agreed that aircraft with their registration mark will comply with the standards concerning the operation of aircraft contained in ICAO Annex 6, as a minimum. Some of the more pertinent standards are paraphrased below:

(1) Before commencing the flight, the pilot must be satisfied that the aircraft is airworthy, duly registered, and that appropriate certificates are on board. Pilots flying U.S.-registered aircraft should be especially concerned with the "duly registered" aspects of this section. FAR 47.3 through 47.11 are specific regulations relative to the legality of U.S.-registered aircraft.

(2) Aircraft instruments and equipment must be appropriate for the operation, considering expected flight conditions. Chapter 2, Section 5 of this AC provides details of required instruments and equipment in addition to the information provided below.

(3) Meteorological information relevant to the flight must be obtained by the PIC and evaluated with regard to the planned route, destination, and alternative courses of action.

(4) Maps and charts that are current, suitable for the flight, and include alternative routes must be available on the aircraft.

(5) SAR information, including location of facilities and procedures to be used, should be obtained by the PIC.

(6) Notices to Airmen (NOTAM) should be checked by the PIC prior to departure to ascertain the status of radio navigational aids (navaids) and airport restrictions.

(7) Night operations can present additional problems that the PIC must consider, such as increased navigation difficulties, fatigue, more demanding pilot skills, and other factors.

(8) The PIC should check the Aeronautical Information Publication (AIP) of states where landings will be made or for states that will be overflown prior to departure. Various chapters in this

AC provide the necessary operational information derived from the AIP's, particularly with respect to the requirements for the carriage of survival equipment.

f. Equipment Requirements. Life rafts will be carried when single-engine aircraft operate more than 100 NM from shore, and when multiengine aircraft operate more than 200 NM from shore. These life rafts will contain at least the following:

(1) Pyrotechnic distress signals

(2) Food and water

(3) A VHF survival radio

g. Navigation Equipment. On transatlantic flights, aircraft shall be equipped with navigation equipment that will enable it to proceed in the following capacities:

(1) In accordance with the flight plan

(2) In accordance with the requirements of the ATS's

(3) In accordance with MNPS requirements when operating in that airspace (also see Chapter 3 for additional information relative to navigation equipment requirements in MNPS airspace)

h. Communication Equipment. In controlled airspace, flights must be able to conduct two-way radio communication on required frequencies. Use of emergency frequencies as a planned operation is in conflict with this rule. The VHF emergency frequency 121.5 megahertz (MHz) is not authorized for routine use. The frequency 131.800 MHz has been designated for use as the air-to-air communication channel in the NAT region. In the Gander, Shanwick, Santa Maria, Reykjavik, Sondrestrom and New York FIR's, HF radios are required to contact ATS units when beyond the range of VHF. Subject to prior arrangement, VHF-only flights may be made via Canada/Greenland/Iceland/Europe, provided the Shanwick FIR is avoided. It is recommended that pilots planning these types of flights obtain and study the individual AIP's pertaining to their route of flight.

*i. **Special Requirements for Flights Transiting Greenland.*** The elevation of the highest point in Greenland is 13,120 feet MSL, and the general elevation of the icecap is 9,000 feet MSL. Due to the low temperatures and high wind speeds, the lowest useable FL under certain conditions may be FL 235 near the highest point, and FL 190 near the icecap. High-capacity cabin heating systems are needed due to the very low in-flight temperatures usually encountered, even in summer. Rapidly changing weather situations involving severe icing, severe turbulence, and heavy precipitation are common and require extra vigilance by pilots. The changes may be so rapid that they are difficult to forecast. An emergency locator transmitter (ELT) is required to transit Greenland due to the very difficult terrain that hampers searches. Regulatory compliance is monitored and states will be informed of any infractions.

Airport flight information is provided at Narssarssuaq Airport, Nuuk/Godthab Airport, Kulusuk Airport and Ilulissat/Jakobshavn Airport at Constable Point. The general locations of these airports are as follows:

- Narssarssuaq is on the southern tip of Greenland at the end of a fjord
- Nuuk/Godthab is on the west coast of Greenland halfway between Narssarssuaq and Sondrestrom
- Kulusuk is on the east coast of Greenland 343 NM northeast of Narssarssuaq
- Ilulissat/Jakobshavn is on the west coast of Greenland 137 NM north of Sondrestrom

Only flight information service and alerting service are provided within the Sondrestrom FIR below FL 195. IFR flights operating within the Sondrestrom FIR below FL 195 must have functional radio equipment capable of operating on the published HF's for Sondrestrom. Flights operating within the Sondrestrom FIR below FL 195 must have functional radio equipment capable of operating on the published HF's for Sondrestrom. Flights operating within the Sondrestrom FIR above FL 195 (i.e., Reykjavik or Gander control areas (CTA)), and outside of VHF coverage of Iceland or Gander, must have functional radio equipment capable of operating on the published HF's for Iceland/Gander.

*j. **Special Requirements for Flights Transiting Iceland.*** The general elevation of mountainous areas in Iceland is approximately 8000 feet MSL. Due to the great difference in pressure and high wind speeds, the lowest useable FL may, under certain conditions, be FL 120. An ELT with an energy supply independent of the aircraft shall be carried. The ELT must be capable of functioning continuously outside the aircraft for at least 48 hours, and of transmitting simultaneously on the frequencies 121.5 and 243 MHz. Aircraft should be equipped with sufficient and appropriate arctic survival equipment. Aircraft operating in the oceanic sector of the Reykjavik FIR must maintain a continuous watch on the appropriate frequency of Iceland Radio. When operations take place outside of VHF coverage of the air-ground station, carriage of an HF transceiver operational on appropriate frequencies is mandatory. However, prior approval may be obtained for flight outside VHF coverage and without HF equipment. Flights operating under this special approval are responsible for obtaining similar approval for operating in the airspace of adjacent ATC units. Flights between FL 80 and FL 195 on the route between Sondrestrom and Keflavik passing through 65N 30W and Kulusuk, and flights above FL 240 operating between the United Kingdom and Iceland that are routed at or north of 61N 10W, are considered adequately covered by VHF and are exempted from HF requirements. Navigation equipment adequate to navigate in accordance with the flight plan and in accordance with ATC clearances will be carried aboard the aircraft. Secondary surveillance radar (SSR) transponders with Mode 3/A and C are required in Iceland. Pilots shall operate SSR transponders continuously on Mode A, Code 2000, except that departing aircraft shall retain the last assigned code for 30 minutes after entry into NAT oceanic airspace unless otherwise instructed by ATC. AIP's and NOTAM information are available on request at all Iceland airports of entry and from the following:

Directorate of Civil Aviation Aeronautical Information Service Reykjavik Airport, Iceland 101 Reykjavik	Telegraph address: CIVILAIR ICELAND TELEX: 2250 FALCON ISLAND AFTN: BICAYN

k. ***Special Requirements for Canadian Departures.*** Canadian Air Regulation S.540 prohibits single-engine aircraft from transoceanic flight departing Canada unless authorization is obtained from the Minister. This regulation also applies to multiengine aircraft that cannot maintain flight after failure of the critical engine. Authorization to commence a transatlantic flight from Canada must be obtained by the PIC of a single-engine or multiengine aircraft as described above after landing at Moncton, New Brunswick, Canada. When the Regional Director, Aviation Regulation (or a representative) is satisfied that requirements are met, the authorization will be granted. At least 48 hours prior to landing at Moncton, the pilot should inform the Regional Director, Aviation Regulation, 95 Foundry Street, Moncton, New Brunswick, Canada, EiC 8K6, Telex 0142 666, of the intended transatlantic flight, stating date and time of arrival at Moncton, aircraft type, registration mark, and pilots' and passengers' names and addresses. Inspections are also possible at other regional offices in Montreal, Toronto, Winnipeg, Edmonton, and Vancouver. However, it is requested that the first contact be made with Moncton to coordinate the details of an alternate inspection site.

(1) At Moncton or the alternate inspection site, the PIC shall satisfy an examining officer of the following:

(a) Certification as a pilot with a valid and current instrument rating

(b) Knowledge of the meteorological, communication, ATC, and SAR facilities and procedures on the route to be flown

(c) Knowledge of radio and other navaids, and ability to use these aids en route

(2) Authorized routes will be those that will provide a minimum of 3 hours fuel reserve at destination considering useable fuel, an appropriate flight manual fuel consumption and true airspeed (TAS) indication (documented or charted), and a ZERO wind component. The PIC must present a complete navigation log for the ocean crossing. The log must show 5 degree longitude checkpoints, tracks, variation, and distances with the capability to recalculate on the basis of the most recent forecast en route winds. In anticipation of equipment problems, pilots should make preparations to complete the flight using dead reckoning (DR) navigation techniques.

NOTE: Some experienced ferry pilots apply the forecast wind to each 5 degree longitude segment of track to the nearest 10 degrees, then add 10 knots if a headwind, or subtract 10 knots if a tailwind. Next they ensure that both wind direction and track are in magnetic units by applying variation to the true course. If the crosstrack wind component is over 20 knots, or the drift angle is over 10 degrees, they wait for a better wind before departing. High speed, unforecast winds can easily increase the flight time to the extent that a short range aircraft cannot comply with the 3 hour fuel reserve regulation.

(3) Upon arrival at the inspection site, the PIC shall present the following documents for inspection:

(a) Certificate of Registration from the state of registry. U.S.-registered aircraft are required to have a permanent registration. Temporary (pink slips) are not satisfactory for oceanic flights.

(b) Certificate of Airworthiness, Flight Permit, or Special Airworthiness Certificate.

(c) Certification and special conditions issued by the state of registry to allow over gross weight operations, if applicable.

(d) Certification issued by the state of registry for fuel tank modifications and/or the installation of temporary long-range tanks. For U.S.-registered aircraft, the certification requirements are satisfied by obtaining a completed FAA Form 337, "Major Repair and Alteration."

(e) Revised weight and balance records in the case of aircraft modified to carry extra fuel.

CAUTION: An export Certificate of Airworthiness does not constitute authority to operate an aircraft. It must be accompanied by one of the authorities listed in (b) above. These documents are not available at Moncton, and Canadian authorities have no authority to issue these documents to U.S.-registered aircraft.

(4) Aircraft are required to carry the following sea survival equipment:

(a) A readily accessible watertight immersion suit for each occupant, including undergarments which provide thermal protection

(b) A readily accessible lifejacket, complete with light, for each occupant

(c) A readily accessible Type W, water-activated, self-buoyant, water-resistant ELT

(d) A readily accessible life raft sufficient to accommodate all persons on board the aircraft. The life raft must be fitted with the following items:

(aa) Water, or a means of desalting or distilling saltwater, sufficient to provide at least one pint of water per person

(bb) A water bag

(cc) Water purification tablets

(dd) Food that:

- is in the form of carbohydrates
- has a caloric value of at least 500 calories per person
- is not subject to deterioration by heat or cold

(e) Flares (at least three per life raft)

(f) Hole plugs

(g) A bail bucket and sponge

(h) A signal mirror

(i) A whistle

(j) A knife

(k) A survival-at-sea manual

(l) Waterproof flashlights (minimum two per life raft)

(m) A first aid kit containing eye ointment, burn ointment, compresses, bandages, merthiolate, and seasick pills

(n) A dye marker

(5) The water and food may be stored and carried in appropriate containers separate from the rafts if the containers can be readily and quickly attached to the raft. In addition to the items listed as "sea survival equipment" (above), aircraft shall carry the following polar survival equipment for flights over Labrador, and for any flight routing north of Prins Christian Sund over Greenland:

(a) A signalling sheet (minimum 1 x 1 meters = 3.28 feet by 3.28 feet) in a reflecting color

(b) A magnetic compass

(c) Winter sleeping bags in sufficient quantity to accommodate all persons carried

(d) Matches in waterproof covers

(e) A ball of string

(f) A stove and supply of fuel or a self-contained means of providing heat for cooking and the accompanying messkits

(g) A snow saw

(h) Candles or some other self-contained means of providing heat with a burning time of about 2 hours per person. The minimum candles to be carried shall not be less than 40 hours of burning time

(i) Personal clothing suitable for the climatic conditions along the route to be overflown

(j) A suitable instruction manual in polar survival techniques

(k) Mosquito netting and insect repellant

(6) Aircraft must be equipped with the following instruments and equipment in serviceable condition:

(a) An airspeed indicator and heated pitot head

(b) A sensitive pressure altimeter

(c) A direct reading magnetic compass that has been swung within the preceding 30 days with the aircraft in the same configuration as for the intended transoceanic flight

(d) A gyroscopic direction indicator or a gyromagnetic compass

(e) A turn and bank indicator

(f) A rate of climb and descent indicator

(g) An outside air temperature gauge

(h) A gyroscopic bank and pitch indicator

(i) Unless another timepiece with a sweep-second hand is available, a reliable, installed timepiece with a sweep-second hand

(j) If there is a probability of encountering icing conditions along the route to be flown, deicing or anti-icing equipment for the engine, propeller, and airframe

(k) If any portion of the flight is to be made at night, the following must be included:

- Navigation lights
- Two landing lights or a single landing light having two separately energized filaments
- Illumination for all instruments that are essential for the safe operation of the aircraft
- An electric flashlight at each required flight crewmember's station

NOTE: All equipment and cargo carried in the cabin shall be secured to prevent shifting in flight and placed in such a position so as to not block or restrict the aircraft's exits.

NOTE: Portable oxygen equipment is recommended. This equipment is useful when trying to avoid icing and/or for the additional altitude required over the Greenland icecap.

(7) In the oceanic control areas (OCA) and FIR's, VHF coverage is not sufficient to ensure continuous two-way communications with ground stations. Although relay through other aircraft is sometimes possible, it is not guaranteed. As mentioned elsewhere in this AC, emergency frequencies are not to be used for planned position relays or any other purposes except for bona fide emergencies. HF radio is mandatory for each aircraft crossing the Atlantic. The only exception is for aircraft flying at FL 250 or above crossing Greenland. Route-specific navigation equipment requirements for navigation in accordance with the flight plan and any ATC clearances are listed below:

(a) Iqualuit [Frobisher Bay] (CFYB) to Greenland: Two independent ADF receivers with BFO/CW capability. Portable ADF's are no longer acceptable.

(b) Goose Bay, Labrador to Narssarssuaq, Greenland: Two independent ADF receivers with BFO/CW capability.

(c) Goose Bay to Reykjavik, Iceland via Prins Christian Sund, Greenland: Two independent ADF receivers as above, or one ADF set and one Loran-C set. Danish CAA strongly recommends two ADF sets because of poor Loran-C reception around Greenland.

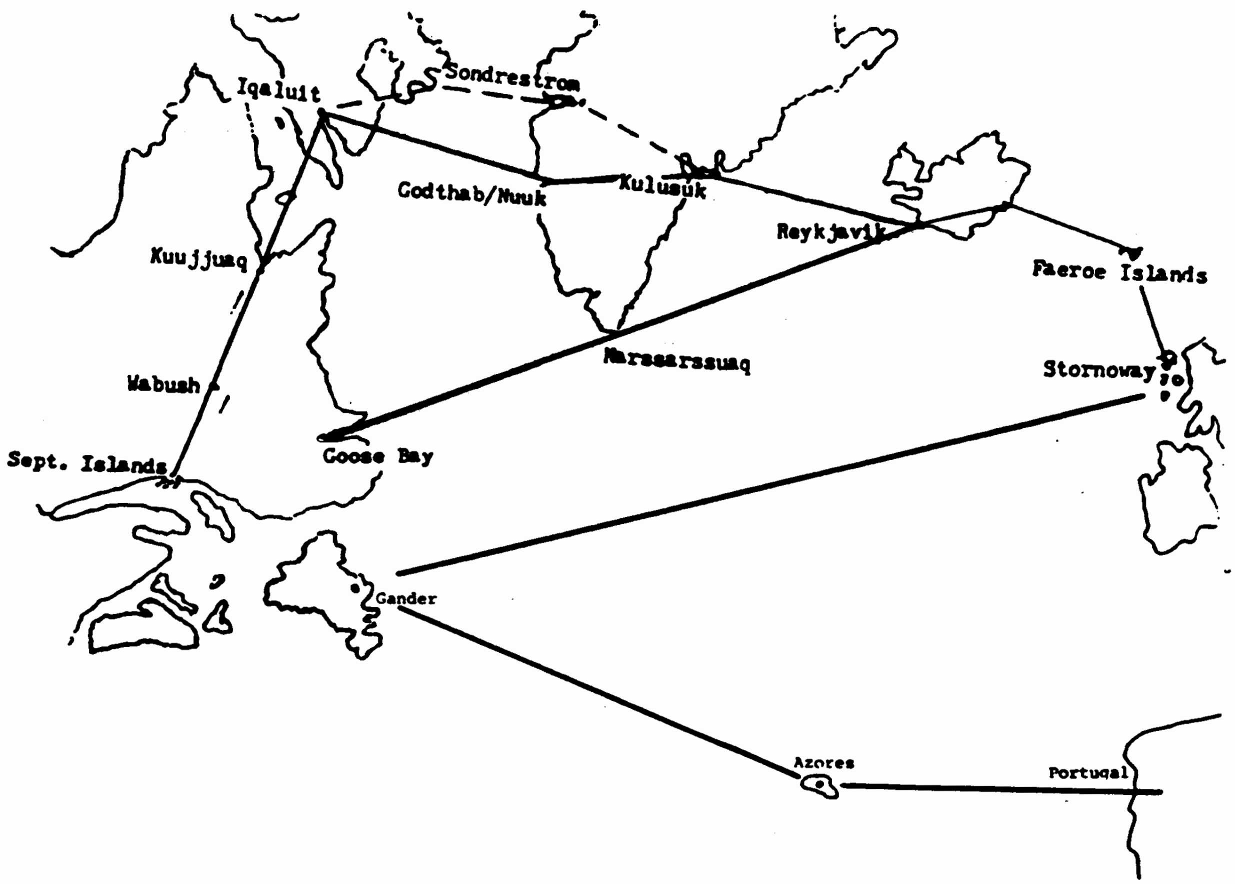
(d) Gander, Newfoundland to Shannon, Ireland: One Loran-C set and one ADF set.

(e) St John's, New Brunswick to Santa Maria (Azores): One Loran-C set and one ADF set. Note that Loran-C reception ends short of the Azores.

NOTE: Extended range mode or X-range will not provide reliable Loran-C reception in Labrador and Greenland, in spite of manufacturer's claims. Appendix 2 depicts the coverage of Loran-C chains. It should be noted that short-range aircraft routes across the NAT are at best only on the fringes of Loran-C coverage if within coverage at all.

(8) Each aircraft shall carry current aeronautical maps, charts, airport data, and IFR Approach Plates covering the area over which the aircraft might be flown and for airports along the route of flight. This includes en route and potential departure diversions as well as destination alternates. Although a flight is planned as a VFR flight, the Canadian government insists that pilots carry IFR publications due to the ubiquitous potential for instrument meteorological conditions (IMC) in the NAT region. Aircraft intending to land or anticipating a possible diversion to Narssarssuaq, Greenland shall carry either the BGBW Visual Approach Chart depicting the fjord approach, or a topographical chart of large enough scale to permit map reading up the fjord. Pilots must have charts in the aircraft at the time of inspection in Moncton. Charts are not for sale at Moncton or at any of the coastal airports in the vicinity of Moncton. It is advisable for pilots who do not have an available source of publication to contact one of the commercial publishers of "Trip Kits" to obtain the necessary publications. Flights should be planned using current aeronautical charts and the latest Class I and Class II NOTAM's. It is extremely important that the PIC be familiar with the nature of the terrain over which the flight is to be conducted. If unfamiliar with the terrain, the PIC should consult with officials at the appropriate local aviation field offices before departure. These officials, as well as local pilots and operators, can provide a great deal of useful advice, especially on the ever-changing supply situation at remote locations such as Frobisher Bay, the location and condition of possible emergency landing strips, potential hazards, and en route weather conditions. During preflight planning, the PIC must ensure that required fuel, food, accommodations, and services are available at intermediate stops and at the destination airport.

FIGURE 11-1. FOUR MAJOR ROUTES USED BY SHORT-RANGE AIRCRAFT CROSSING THE NAT



(9) The four major routes used by short-range aircraft to cross the NAT are depicted in Figure 11-1 above. All except the northern route require the installation of long-range fuel tanks to satisfy the 3 hour reserve fuel requirement. In addition, each of these routes presents its own peculiar set of problems.

(a) The northern route is the longest route, but has the shortest overwater legs. It does, however, transverse long distances over remote, hostile, unpopulated terrain. This route for relatively short-range aircraft normally follows a route that heads almost due north from Moncton to Sept-Isle to Shefferville to Kuujjuaq to Iqualuit (formerly known as Frobisher). At Iqualuit, the flight heads eastbound overwater to Greenland. Pilot reports from Kuujjuaq indicate that there are times when fuel is not available at Kuujjuaq, and that quarters are primitive (if available at all). Once reaching Greenland, the route traverses the icecap, which can mean flying at FL 130 or higher. This presents the potential for cold temperature, icing, and severe weather. Pilots should expect no Loran-C reception; good ADF tracking is essential.

(b) The direct route from Goose Bay, Labrador (CYRR) to Reykjavik, Iceland via Prins Christian Sund, Greenland NDB is one of the best routes with Narssarssuaq a midway alternate, although the NAT storm track can cause problems with wind and weather. This route means potential icing and weather problems over the Davis Straight (between Greenland and Iceland), plus coping with a demanding day-only VFR approach. Loran-C is unreliable at both ends of this approach, and there is steeply rising terrain on both sides and at the end of the approach.

(c) Gander, Newfoundland direct to Shannon, Ireland presents the usual problems of NAT severe weather, plus the significant effect that an unforecast wind shift can have on a slow aircraft flying a 1700 NM leg. In addition, the amount of extra fuel that would be used with even a 5 knot unanticipated headwind would be significant over such a long range. The one positive factor that favors this route is that Loran-C coverage is continuous throughout the route.

(d) The route from St. John's, New Brunswick in Canada to Santa Maria in the Azores has the advantages of generally better weather and higher temperatures. The airport at Flores, located 300 NM west of Santa Maria, is a good alternate. The disadvantages are that Loran-C coverage is not reliable for the whole distance, and an unforecast or unsuspected wind shift coupled with poor ADF equipment and/or procedures could mean missing the Azores altogether.

l. Additional Notes. Since icing is a severe hazard for light aircraft, temperatures should play a significant part in flight planning. June to September is the best time of year for all of the routes. At other times, the St. John's to Santa Maria route is the best choice because it overflies the Gulf Stream. An analysis of the most favored routes by professional ferry companies indicates that the route from Goose Bay direct to Reykjavik is the most popular, with the Santa Maria route being the next in popularity. However, it must be emphasized that most light aircraft need to have long-range tanks installed to traverse these routes.

m. Flight Plans. Flight plans for international flights originating in Canada, flights in Europe, and flights entering Canada from overseas must be filed in the ICAO format. A sample ICAO flight plan is located in Appendix 1 of this AC. IFR (ICAO) flight plans are mandatory at or above FL 60 (6000 feet MSL) in all oceanic CTA's, the Reykjavik FIR, and at or above FL 195 in the Sondrestrom FIR (Greenland and off the coast of Greenland). Although VFR flight under the OCA (5500 MSL and below) is possible, there is little advantage in flying VFR. In fact, the Canadian government predicates their requirements upon the assumption that IFR will be encountered at some time during the flight. Therefore, it is prudent to take advantage of the flexibility, winds, safety factor, and navigation/communication radio reception of the higher altitudes afforded by an IFR flight.

n. Additional Canadian Inspection Notes. Transport Canada will no longer approve for transatlantic flight an aircraft fitted with a "placarded" ferry tank where it is obvious that the intent of the placarding is to avoid regulatory inspection of the installation, and issue of a Special Airworthiness Certificate for over-gross operation. A permanent waiver of the Canadian transoceanic inspection is available providing a pilot has successfully completed at least two inspections and transoceanic flights. However, a waivered pilot is still subject to spot checks by any NAT ICAO Provider State.

o. Canadian Customs Procedures. Pilots must land at a Canadian Customs authorized airport of entry (AOE), and a flight plan must be filed for all transborder operations. It should also be noted that VFR at night is not allowed, nor is VFR-on-top allowed in Canada. Canadian customs must receive notification in sufficient time to enable designated customs officers to inspect the aircraft.

3. OTHER CONSIDERATIONS.

a. Personal Physical Needs. These include nourishment, body comfort, and provisions for biological relief. Certain foodstuffs are required for Canadian departures, but all pilots should familiarize themselves of the caloric content, sugar content, ease of access, digestibility and weight of the food that they intend to use during flight. Foods should be high in calories but low in sugar content. Sweets will provide the body with an immediate energy lift but will dissipate in effectiveness very rapidly and will have a tendency to create thirst. Biological relief is an extremely important factor to consider. A pilot who has overextended his/her human range (HR) can be distracted by pain to the point where intelligent decision making and physical skills will deteriorate to the point of creating a serious safety hazard. Pilots can increase HR by eating and drinking prudently prior to each leg of the flight. Another consideration is that of body comfort. Although watertight immersion suits are required for flights departing Canada, this is only one form of protective clothing that should be considered. The potential need to climb to a high altitude to escape detrimental winds or to fly over the icecap in Greenland demands that the pilot has warm clothing readily available and easily accessible. Glare is also a significant hazard when flying above the clouds or flying over an icecap which indicates that a pair of good sunglasses are an important consideration. Noise creates a fatigue factor and should be reduced as much as possible. If not intending to use a head set for the complete flight, pilots should have a set of ear plugs available. The last consideration is extremely important if flights above 10,000 feet are anticipated (as part of the planned flight or as a possible contingency). This consideration is for oxygen requirements. No matter what a pilot's health status happens to be, prolonged flights above 10,000 feet without oxygen are an invitation to disaster.

b. The Aircraft. Fuel burn and the range of an aircraft are important considerations in the preflight planning stage of any trip, whether, international or domestic, and most pilots will take great care in ensuring that there is adequate fuel for a flight. One consideration, however, that is not quite so evident is oil usage. Domestically, one can make an emergency landing if some indication of excessive oil usage presents itself. On an oceanic flight, the preflight oil level is the maximum oil available for a trip leg unless some ingenious invention is devised to measure oil levels and to replenish the oil in-flight. Because this situation is nearly impossible (early pilots were known to climb out on struts, etc., and replenish oil), it is advisable to make oceanic crossings only with aircraft that have engines which have not exceeded their half-life.

c. Equipment. Various equipment requirements including navigation and communication equipment are discussed in above sections of this Chapter. It is important, however, to make another equipment check: the condition of the magnetic compass, its accuracy, and the extreme variations that can be encountered in various sections of the world. Pilots should also review those turning errors that may have been forgotten since their last check ride.

d. Charts. When making a transoceanic flight, no one type of chart is totally adequate. It is important that the characteristics of various types of charts be known and carried. Some of these characteristics are itemized below.

(1) Jeppesen Plotting Charts. These charts have magnetic variation information, but the NAT charts have no radio navigation or topographic information although the Pacific charts do have the radio navigation frequencies. These charts do have up-to-date OCA boundaries, FIR, air defense identification zone (ADIZ), distant early warning identification zone (DEWIZ), and their required reporting points. The scale of these charts is 1:10,000,000, and their size make them convenient for cockpit use.

(2) Defense Mapping Agency's Global Navigation Chart (GNC). These charts indicate variation, topography, ADIZ, and the location of VHF omnidirectional radio ranges (VOR) and NDB's. They do not have the FIR boundaries shown or the navigation frequencies listed.

(3) Global Loran-C Charts (GLCC). These charts only contain Loran-C information for navigation and isogonic lines. They do not depict topography, and the OCA information is not necessarily up-to-date.

(4) National Oceanic and Atmospheric Administration (NOAA) Route Charts. These charts are primarily designed for planners and controllers. Although not particularly useful to pilots, the charts do depict latitude and longitude information and the frequencies of some VOR's and NDB's. These charts are particularly useful to pilots planning their first transoceanic flight because they cover a large geographical area and provide an excellent overview of the area to be overflown.

(5) Operational Navigation Charts (ONC). These charts are similar to the U.S. World Aeronautical Charts (WAC) and detail topographical features. They are extremely important to a pilot planning routes which have long legs over land masses (such as the route from Moncton to Frobisher).

(6) Approach Plates (Jeppesen or NOAA). On trips of the length required for a transoceanic crossing, the potential for having to make an IFR approach is a real possibility. These plates become a real necessity when one is forced to make an unscheduled landing at an airport with a hazardous NDB approach such as Narssarssuaq, Greenland. It would be nearly impossible, even in an emergency, to try

and make an approach to this airport without any guidance. In fact, a note appears on the Jeppesen version of this approach which states, "Caution: Pilots w/o a good knowledge of the local topographical and met conditions are advised not to make any attempt to approach through the fjords, unless ceiling at least 4000" and visibility 800 m." (2624.67 feet or approximately 1/2 mile). Approach plates should not only be carried for airports of intended landing and alternate airports, but also for every airport along the intended route of flight. Flight information publication (FLIP) charts may be preferred by some pilots, but a word of caution is needed regarding these charts: they do not depict every airport for which an instrument approach is available.

e. Weather. Although pilots are required to have a knowledge of weather, weather charts, and the procedures for accessing weather information, in the United States weather information is readily accessible and easy to decipher. On transoceanic flights weather information is often outdated, difficult to obtain, and is in a format unique to the geographical area in which it is disseminated. Pilots must hone those long-forgotten skills of interpreting charts and making their own prognosis of pending weather. They must also be aware of all of the available sources of weather along the route of their flight. Terminal area forecasts (TAFORS) are similar to the U.S. terminal forecasts, and they are referred to as airport forecasts (TAF). A complete listing of TAF codes is included in Appendix 1 of this AC. It is important that pilots have a knowledge of these codes, and are able to interpret them and apply their meanings to an actual flight situation.

FIGURE 11-2. GENERAL SAFETY NOTES

1. Know your aircraft. Pull cowling and inspect for leaks and check the general condition of the aircraft. The following aircraft components must be reviewed:

- Fuel system and management
- Radio equipment and condition
- Engine condition
- Oil consumption
- Oil pressure
- Oil temperature
- Instruments

2. Check compass on nearest runway heading to your course (use a compass rose if one is available):

- Swing compass with radios and navigation lights **ON**
- Check compass deviation with master switch **OFF**
- Check compass deviation with VHF **OFF**
- Check compass deviation with HF **ON** and then **OFF**
- Check compass deviation with pitot heat **ON**
- Check compass deviation with rotating beacon **ON** and then **OFF**
- Log results of the above deviations
- Keep alternator load at or below 50 percent during compass testing, if possible
- **DO NOT** assume that the compass card is accurate

3. ADF may be affected by the alternator, the VHF, the HF, the pitot heat, the rotating beacon, the autopilot, costal refraction, and atmospheric conditions. Check and recheck all navigation equipment under all operating conditions.

4. En route freezing levels should be 3000 feet AGL or higher to allow room for ridding aircraft of ice. If a departure must be made in below freezing temperature, it is imperative that the flight is in VFR conditions and clear of clouds until an area with higher freezing levels is reached.

5. Significant icing has been encountered at Goose Bay, Narssarssuaq, and Reykjavik as late in the year as early June.

6. The departure alternate should be VFR.

7. Destination weather should be well above IFR minimums and forecast to remain above minimum or improving. It is important to remember that after long flights at altitude, a pilot's capability to handle marginal weather will be in serious doubt. Personal weather minimums should be much higher than published minimums. An alternate airport should be selected with the same minimums criteria.

8. Do not deviate from the flight plan unless the aircraft's position can be positively identified without navigation equipment. This prevents serious consequences in the event of radio failure.

9. Make all position reports when required, and report any problems to ATC as soon as possible. When reporting, it is prudent to provide ATC with a fuel remaining report in hours and minutes. Although not required, this information can be invaluable to ATC in the event of an emergency.

10. If in trouble, report the situation to ATC immediately by HF or VHF on 121.5 MHz and request assistance. Do not wait to report. It might take SAR an extended period of time to reach a troubled aircraft's position. The aircraft should not deviate from its flight plan unless Air/Sea Rescue advises the use of a new heading. If unable to make contact by radio, the ELT should be manually activated.

FIGURE 11-2. GENERAL SAFETY NOTES - Continued

11. Air carrier traffic over the Atlantic is heavy. Do not hesitate to enlist the assistance of these aircraft in relaying a position fix, obtaining weather updates, or reporting an emergency. Air carriers are quite willing to assist anyone having difficulties and often their FL is high enough to relay communications. However, emergency frequencies should only be used for actual emergencies. It is acceptable to utilize emergency frequencies to make an initial contact, but only to request that someone communicate with the caller on another frequency.

12. Fatigue is a "sneaky" killer. A pilot often does not realize that he/she was fatigued until after an accident has taken place. Realistic work loads should be determined prior to commencing a flight and should not be exceeded unless an extreme emergency requires one to do so. The following situation is one in which it is very evident that fatigue contributed to a dual fatality.

> A ferry pilot and his passenger departed Goose Bay in a Bonanza early one morning. They refueled in Reykjavik, then flew on to Scotland. The aircraft crashed 2 miles short of the runway at Glasgow, Scotland during a standard ILS approach. No severe weather existed and no aircraft problems were reported. Investigation revealed that all systems had been operating correctly and that the engine was running at the time of the crash. A synopsis of all factors involved indicated that pilot fatigue was the course of this accident.

No person shall fly an aircraft, nor should an operator require a person to fly an aircraft, when the person is suffering from fatigue or will encounter a workload that will induce fatigue.

13. Pilot reports (PIREPS) are significantly more important in remote areas and in oceanic areas of operation. The absence of weather reporting stations demands that pilots experiencing weather conditions that are likely to affect the safety of other aircraft or other hazardous flight conditions, report these to ATC as soon as possible.

CHAPTER 12. POLAR FLIGHTS

Like most other North Atlantic (NAT) traffic flows, traffic on the Europe-Alaska axis is predominantly unidirectional; in the Reykjavik control area (CTA) the westbound peak is between 1200 - 1800 coordinated universal time (UTC), and the eastbound peak is between 0001 - 0600 UTC. To facilitate the flow of this traffic during the peak period and to avoid a multiplicity of random routes, a polar track structure (PTS) consisting of 10 fixed tracks has been established (see Appendix 2). Although not mandatory, flights planning to operate on the Europe-Alaska axis at flight level (FL) 310 - 390 inclusive during peak periods are strongly recommended to submit flight plans in accordance with one of the promulgated PTS tracks.

Even though equipment has improved greatly since Admiral Byrd's day, the inherent hazardous conditions still exist. Admiral Byrd in his book, "First to the North Pole," which has been excerpted in "Men in the Air," Crown Publishers, Inc., New York. Copyright 1990 by Brandt Aymar, significantly detailed the extreme hazards of operating in this hostile environments. These are some of the points that he made:

1. The utmost attention to detail to flight planning.
2. The importance of survival equipment, including food supplies if a long trek over the ice cap became an eventuality.
3. A means for obtaining food supplies from nature, e.g. rifle, an ice axe and fishing gear.
4. The lack of reliability of the magnetic compass, which in polar regions can point more than a thousand miles south of the North Geographic Pole.
5. The lack of accuracy of the gyroscopic compass, which when nearing the Pole, would have a tendency to point straight up in the air.
6. The severity of wind conditions and its effect on navigation.

It is evident from the above that flight in the far north is difficult. These trips require detailed planning, an abundance of equipment, extensive knowledge, and some luck in not experiencing any undue circumstances such as un-forecast weather, navigation and/or communication failure, engine problems, or airframe problems. Byrd's thoughts are included in this advisory circular (AC) as "food for thought." In spite of the advances in aircraft and navigation/communication equipment, the harsh realities of flight in the far north are ever present. Loss or failure of any equipment reduces the flight to one that relies on the basic and emergency equipment that is carried and the extent of knowledge which the crew has in its use.

The rapidly changing world of Global Positioning System (GPS) navigation is making this an attractive system for use in making trans polar flights. However, caution should be exercised when using GPS. On Thursday February 3, 1994, Transport Canada made a presentation as a part of an FAA GPS Seminar and stated that GPS is being advocated in Canada as much as it is in the United States because of its potential use as an economic navigation system in many of the remote areas served by Canadian operations. They further stated that although GPS can make a significant economical impact on operations in Canada, that their research in the vicinity of Resolute Bay (N74°44.8′ W94°59.7′) indicates a lack of integrity with stand-alone GPS navigation systems. It is therefore recommended that operators intending to utilize GPS as a principal source of navigation in the polar regions, contact transport Canada regarding the latest status of their integrity studies.

CHAPTER 13. OCEANIC OPERATIONS TO THE FORMER SOVIET UNION AND OTHER SOVIET BLOC NATIONS

1. INTRODUCTION. The geopolitical area formerly known as the Soviet Union is now comprised of numerous independent states (IS). This section of the world is undergoing rapid and often unanticipated changes in the field of international and domestic aviation. As updated information becomes available, it will be included in future revisions of this advisory circular (AC).

2. GENERAL. As a result of the new bilateral air transportation agreement between the United States and some of the IS, a significant increase in air transportation between the two countries is expected. Operators of both large and small aircraft will be increasing scheduled and chartered air service. Due to the short distance between the state of Alaska and Russia, significant increases in air traffic are expected in the far eastern portion of this region. This area has traditionally been called the Soviet Far East (SFE).

a. Overview of Regional Differences in the IS. The area comprising the IS is more than twice the size of the United States and is significantly more diverse in terms of aviation infrastructure. Flight operations within the western part of the country (generally west of the Ural mountains) are considerably less challenging than flights within the eastern part of the area. In the east, primarily due to limited facilities, sparse population, and harsh winter weather, routine flight planning can be quite challenging. Communications, navigation, and airport availability require special emphasis when planning flights within this region. Although operating aircraft in the western IS is generally less demanding, many significant operational differences exist. The airports and airways in the IS are divided into two categories: international and domestic.

b. International Airports and Airways. International routes and airports in the IS are generally available for use by foreign aircraft operators, provided the operators have received appropriate flight authorizations. These routes and airports are published in the appropriate Aeronautical Information Publication (AIP). Many of the newly formed countries are currently publishing AIP's and these should be obtained prior to operating in or over any country that was formerly part of the Soviet Bloc. Air traffic control (ATC) communications are provided in English, and airports have customs and immigration services as well as fuel (AVGAS availability is limited). Instrument approach procedures (IAP) are generally available in the International Civil Aviation Organization (ICAO) format and are similar to approach procedures used worldwide.

c. Domestic Airports and Airways. Domestic airports and routes in the IS are generally not usable by foreign aircraft operators unless a local navigator is used to communicate with ATC and to provide instructions to the flightcrew regarding navigation principles and procedures. En route and terminal ATC within the domestic systems are accomplished using Russian, since a large percentage of IS air traffic controllers do not speak English. En route charts and IAP's for the domestic system are not published in English, are generally not available to foreign aircraft operators, and may not meet ICAO requirements. Weather and Notice to Airmen (NOTAM) information is difficult or impossible to obtain, and is not provided in English or in standard format.

d. General Navigational Considerations. Navigation off established airways in the IS is generally not permitted. Foreign aircraft operations are restricted to published international routes and airports, even for refueling stops and alternate airports. Appropriate flight crewmember training on metric conversion and the in-flight availability of conversion charts are necessary to enable crewmembers to convert metric altitudes, weights, and windspeeds. Although operators are technically permitted to conduct flights to or within the IS under visual flight rules (VFR), there are significant IS flight rules differences that normally preclude foreign aircraft operators from conducting flights under VFR. In some areas, ATC procedures have been developed to allow operations off published routings using radar vectors. If clearance is received to operate off airways, the carrier is authorized to accept the clearance. However, due to military concerns, it is possible that the radar vectors received may not be the most expeditious for the carrier.

e. AIP. The U.S.S.R. AIP is the primary document available (at the time of publication of this advisory circular) concerning foreign aircraft operations within most of the IS, but this is rapidly changing and many states are now or will soon be publishing their own AIP's. Because of the rapid change, operators should exercise extreme care in determining the status of the AIP to be used. The U.S.S.R. AIP is published by the Aeronautical Information Service (AIS), which is part of the Ministry of Civil Aviation (MCA) of Russia. It is published in both Russian and English and contains detailed flight operational requirements as well as terminal, airport, and instrument approach charts in ICAO format. It is available from the AIS on an annual subscription basis, including monthly revisions. The navigation charts and standard instrument approach procedures (SIAP) for Russia and other IS's domestic systems are not included in the AIP and are usually not available in English. Further information may be obtained from the following:

The Russian Embassy
1125 16th Street, N.W.
Washington, DC 20035
Telephone (202) 628-7751

f. ATC Communications. The ATC communication system within the IS is generally good. Very high frequency (VHF) is commonly used for en route communications, but high frequency (HF) is required for certain routes. Communication equipment requirements are listed in the U.S.S.R. AIP. However, Russian and other IS air traffic controllers have limited access to weather and NOTAM information.

g. Aeronautical Fixed Telecommunications Network (AFTN) or Society Internationale de Telecommunications Aeronautique (SITA) Networks. Data transmission and reception in the IS is accomplished using the AFTN or SITA networks, although in remote areas only AFTN may be available. Transmitting or receiving messages using the AFTN system within the IS to and from many remote areas, especially in the SFE, may be less timely than desirable. Most messages enter and depart the IS in Moscow, and the manual manipulation of messages is required at many transfer stations before and after reaching Moscow. For example, an AFTN message from Anchorage, Alaska to Magadan, Russia, will be transmitted via Moscow, and then to several switching stations between there and Magadan. At the switching stations, messages must be hand-carried from the receiving area to the transmitting machine.

h. Telephone Service. Telephone service to, from, and within the IS is limited. A variety of systems are used, including an HF troposcatter system which, due to technical limitations, makes communication extremely difficult. Establishing reliable communications to and from line stations within the IS may be more challenging than in other areas.

i. Navigation. Navigation on international routes within the IS is permitted using Class I or Class II navigation systems. Route widths vary from 8 km to 20 km, as indicated in the U.S.S.R. AIP. It is the pilot's responsibility to keep the aircraft within established airway boundaries. Available altitudes also vary from one route to another as identified in the U.S.S.R. AIP. When planning flights, operators must ensure that the desired and required altitudes are available for particular routes. This is especially important in the SFE, where there is usually only one route available for flights. As an example, from the Anadyr nondirectional beacon (NDB) along A-81 on the eastern coast of Russia to the Troitskoye NDB there is no parallel airway for a distance of over 1600 miles. Deviation from this route due to weather requirements may be impossible to obtain. In the SFE, Class I en route navigation on international routes is primarily accomplished using NDB's; however, numerous compatible VHF omnidirectional radio range (VOR) transmitters will be installed in the coming years. In western Russia, compatible VOR transmitters are also used to define international routes. In certain situations, especially in the SFE, it may be necessary to require operators to use Class II navigation receivers to supplement Class I navigation receivers due to the distance between navigational aids (navaids) and the limited width of airways. Class II en route navigation on international routes should be relatively simple, provided two conditions are properly addressed. The first condition is that, depending on the published route widths, length of flight, and type of Class II navigation equipment used, it may not be possible for an operator to maintain the course centerline accuracy required by the IS. Limitations on the operation of some very low frequency (VLF)/Omega systems, as shown in the Flight Manual Supplement, may preclude their use in some areas of the IS. The second condition concerns the lack of VOR/distant measuring equipment (DME) transmitters, especially in the SFE, which means that special consideration must be given by operators to navigation accuracy requirements when using inertial reference systems (IRS) such as B-757, B-767, and A310. Again, it may not be possible to obtain the required navigation accuracy unless, considering the specific route and length of flight, VOR/DME updates are provided to the IRS.

j. Alternate Airports. For flight planning purposes, especially in the SFE, operators must give careful consideration to the location of, and routing to, suitable alternate airports. Fuel planning must be carefully considered due to potential difficulties with communications, diversion airport routings, and the lack of suitable airports in the SFE. It is not uncommon for the closest alternate airport to be over 500 nautical miles (NM) from a given destination.

k. Extended-Range Operations with Two-Engine Airplanes (ETOPS). Operations in the SFE with two engine aircraft may require ETOPS approval due to the lack of adequate/suitable airports within 60 minutes of the operator's route. AC 120-42, "Extended Range Operations with Two- Engine Airplanes," as amended, provides additional information.

l. IS Local Navigator Assistance. Navigation within the IS is the responsibility of the pilot-in-command (PIC). Flights operating off of established international routes, or on the domestic route system, usually are not permitted unless a local navigator is aboard. In unique situations, a radio operator will also be required; however, these two functions are usually performed by the navigator. The assistance of a navigator is also required for flights to or from any IS domestic airport. Although navigators may be required by the IS, they are not required flight crewmembers under the Federal Aviation Regulations (FAR) and are not responsible for the conduct of the flight. The navigator's purpose is to assist in cross-checking course information en route and to assist in cross-checking information on terminal arrivals, departures, and IAP's. FAA approval is required for U.S. operators to carry IS navigators/radio operators. The following information should also be considered when evaluating IS navigator/radio operator requirements:

(1) Due to the lack of informational and technical data pertaining to operations in the IS domestic systems which are needed to meet requirements of FAR Parts 121 and 135, it may not be possible for operators to conduct operations at most IS domestic airports.

(2) IS navigators are required to use a cockpit jumpseat, which may preclude an FAA inspector from accomplishing a required en route inspection or a validation test on a particular flight or series of flights.

(3) The charts for the IS domestic system are usually not available in English.

(4) The Russian MCA charges a substantial fee for the use of navigators and it is expected that other states will do the same when they have established their own Ministry of Civil Aviation.

m. Area of Magnetic Unreliability. Depending on the latitude of the routes flown, operations may be conducted within the IS area of magnetic unreliability.

n. Aeronautical Weather Data and NOTAM's. Aeronautical weather data and NOTAM's should be available in standard ICAO format through normal channels for all international airports within the IS. This data is normally not available for any airport within the domestic system. Within the IS, weather data and NOTAM's for airports within and outside the area is normally available from the weather service office at international airports. Extremely limited data is available at domestic airports within the IS and usually requires translation into English.

o. Terminal IAP's. Terminal IAP's at international airports within the IS are conventional and should not be confusing to foreign operators. Arrival and departure procedures are similar to U.S. standard terminal arrival routes (STAR) and standard instrument departures (SID). Radar vectoring is uncommon, so flight

If an embassy is not available, the Russian Embassy can supply information regarding the procedures to be used.

MCA - Russia
Telegraphic Address:
International Department
Ministry of Civil Aviation
Leningradsky Prospect 37
Moscow
Telex: 411182 AFL SU

It is recommended that a simultaneous request be made to the Central Department of Operational Services (CDOS).

Telegraphic Address:
Central Department of Operational Services
Telex: 412303 CDS SU
ATTN: UUUUYAYW
SITA: MOWZGSU

Operator requests to use nonstandard routings and/or land at airports normally serving domestic traffic should be submitted through the Economic Section of the U.S. Embassy in Moscow, APO, NY, 09862 (Telegraphic address: Amembassy Moscow, Telex: 413160 USGSO SU). Information to be included in the telex is listed in the AIP and IFIM. Recent operator experience indicates that the communication infrastructure may preclude receiving this authority in a timely manner. Personal presentations, including objectives and justification, may be more effective.

r. Validation Flight Requirements. Validation flights are required for all U.S. operators seeking approval to operate within IS airspace. Validation flights are also required for any operator seeking a significant expansion in service or operating area within the IS. Some examples of situations requiring validation flights include the following:

- An air carrier previously serving in the western IS that desires to operate east of the Ural mountains
- An air carrier approved to serve a coastal airport only that desires to expand service to inland airports
- An air carrier that has not operated within the IS within the past 6 months
- Any proposed operation that requires the use of an IS navigator
- Any other situation that the FAA determines is necessary to ensure a safe operation

Validation flights may be conducted with revenue passengers or cargo aboard, unless special situations dictate otherwise. The following items will be considered during validation flights:

- Flight approval
- Adequacy of FAR 121.445 special airport qualification procedures
- Flight planning and flight release/dispatch procedures, when applicable
- Contingency planning - alternate airports for takeoff, en route, and destination
- Communication and navigation procedures
- IAP's
- Data communications with IS (telex, ATTN, SITA)
- Weather and NOTAM availability within the IS

- Fueling and cargo loading procedures

In view of the problems described in the preceding areas of consideration, it may be beyond the capabilities of many operators to conduct operations to most IS domestic airports at this time.

3. OPERATIONS TO THE FORMER REPUBLIC OF YUGOSLAVIA.

Under the provisions of United Nations Security Council (UNSC) Resolution 757 (1992), U.N. member states are required to prohibit takeoffs, landings, and overflight of their territories by aircraft flying to or from the Federal Republic of Yugoslavia, including Slovenia, Croatia, Bosnia-Herzegovina, Macedonia, Serbia (including the provinces of Vojvodina and Kosovo), and Montenegro. Flights which operate into the Federal Republic of Yugoslavia under this operating limitations policy must conform with SFAR No. 66. The PIC must receive an intelligence briefing from the Air Mobility Command (AMC) for each flight to any of the airports located in that geographic area.

Air carriers should observe the following precautions:

(1) Current intelligence information must be obtained from AMC regarding the best arrival and departure routes and the minimum safe altitude (safe from hostile acts) to maintain at various points along the route.

(2) Obtain current intelligence information from AMC regarding safe diversion airports and routes.

(3) If AMC determines that navaid interference and ATC voice communication intrusions can be expected, the air carrier must develop countermeasure procedures and train flightcrews in their use.

(4) If the authority controlling operations into a particular airport has procedures for communicating emergency diversion information over air/ground communication systems, the air carrier must obtain call signs and frequencies for dissemination to flightcrews.

When planning a flight to the hostile area, the flightcrew should check current NOTAM's for the most current information. Flightcrews should also observe the following precautions.

(1) Before each flight into a hostile area airport, the flightcrew must obtain a current intelligence briefing from AMC regarding the best routes and minimum altitudes to avoid known and possible threats.

(2) The briefing must be given at the airport where the flight departs for the hostile area airport, and shall be given when the flightcrew reports for duty to prepare for the final leg of the flight.

(3) Before the flight is authorized to depart, the flightcrew must ensure that the briefer provides at least the following information:

(a) The flightcrew must be informed of known or suspected threats located relatively close to the arrival and departure routes, available diversion routes, and the destination airport.

(b) If known or suspected threats are located relatively close to arrival, departure, or diversion routes, or to the airport, the pilot must be advised whether or not it would be prudent to revise the planned routes and/or altitude.

(c) Any reports of intentional navaid interference or ATC voice intrusions should be communicated to the flightcrew before departure.

(d) The flightcrew must receive updated information on emergency diversion procedures and call signs and frequencies of air/ground communication stations that issue emergency diversion advisories.

U.S. air carriers who have contracted with AMC to conduct operations into the former Yugoslavia must ensure that their operators comply with the preceding information. U.S. air carriers who do not have contracts with AMC to conduct such operations must ensure that the operations conform to SFAR No. 66. Air carrier operations must be conducted in accordance with all pertinent sections of FAR Part 121 and the air carrier's operations specifications at all times. U.S. air carriers who have contracted with AMC to conduct operations to any airport located in the former Republic of Yugoslavia shall amend paragraph C67 of the operations specifications by listing the airports to which such operations are authorized. Also, paragraph C67 must be amended to include a limitation prohibiting operations to such airports unless the requirements of this section have been met.

FIGURE 1-1. INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) FLIGHT PLAN

FLIGHT PLAN

PRIORITY ADDRESSEE(S)

≪≡ FF →

≪≡

FILING TIME ORIGINATOR

→ ≪≡

SPECIFIC IDENTIFICATION OF ADDRESSEE(S) AND/OR ORIGINATOR

3 MESSAGE TYPE 7 AIRCRAFT IDENTIFICATION 8 FLIGHT RULES TYPE OF FLIGHT

≪≡ (FPL — — ≪≡

9 NUMBER TYPE OF AIRCRAFT WAKE TURBULENCE CAT. 10 EQUIPMENT

— / — / ≪≡

13 DEPARTURE AERODROME TIME

— ≪≡

15 CRUISING SPEED LEVEL ROUTE

— →

≪≡

16 DESTINATION AERODROME TOTAL EET HR MIN ALTN AERODROME 2ND ALTN AERODROME

— → → ≪≡

18 OTHER INFORMATION

—

) ≪≡

SUPPLEMENTARY INFORMATION (NOT TO BE TRANSMITTED IN FPL MESSAGES)

19 ENDURANCE EMERGENCY RADIO

HR MIN PERSONS ON BOARD UHF VHF ELBA

— E/ → P/ → R/ U V E

SURVIVAL EQUIPMENT JACKETS

POLAR DESERT MARITIME JUNGLE LIGHT FLUORES UHF VHF

→ S / P D M J → J / L F U V

DINGHIES

NUMBER CAPACITY COVER COLOUR

→ D / → → C → ≪≡

AIRCRAFT COLOUR AND MARKINGS

A/

REMARKS

→ N/ ≪≡

PILOT-IN-COMMAND

C/) ≪≡

FILED BY ACCEPTED BY ADDITIONAL INFORMATION

DEPARTMENT OF COMMUNICATIONS. DUBLIN AC 80 Rev 85

FIGURE 1-2. INTERNATIONAL FLIGHT PLAN FAA FORM 7233-4

INTERNATIONAL FLIGHT PLAN

US Department of Transportation
Federal Aviation Administration

Form Approved: OMB No. 2120-0C

International Standards — Rules of the Air Annex 2 requires the submission of a flight plan containing items 1—19 prior to operating any flight across international waters. Failure to file could result in a civil penalty not to exceed $1000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended)

PRIORITY INDICATOR | ADDRESS INDICATOR(S)

FILING TIME | ORIGINATOR INDICATOR | SPECIFIC ADDRESSEES AND/OR ORIGINATOR IDENTIFICATION(S)

3. DESCRIPTION | 7 AIRCRAFT IDENTIFICATION AND SSR DATA | 8. FLIGHT RULES AND TYPE OF FLIGHT | 9. NO. & TYPE AIRCRAFT AND WAKE TURBULANCE DATA | 10 EQUIPMENT COMM. /NAV /SSR

13. AERODROME OF DEPARTURE AND TIME | FIR BOUNDARIES AND ESTIMATED TIME(S)

15. CRUISING SPEED | LEVEL | ROUTE

17. AERODROME OF DESTINATION AND TIME | ETA | ALTERNATE AIRPORT(S) | 18. OTHER (Control) INFORMATION

SUPPLEMENTAL INFORMATION — Not Transmitted (To Be Completed By Pilot)

19. FUEL/ | POB/ | RDO/121.5 | 243 | 500 | 8364 | POLAR | DESERT | MARITIME | JUNGLE | COLOR OF AIRCRAFT

LIGHT | FLUORESEIN | DINGHIES (Specify No. & Capacity) | COVER (Specify Color) | RMK/

FAA Form 7233-4 (10-83) | NAME OF PILOT-IN-COMMAND | SIGNATURE OF PILOT | **CLOSE FLIGHT PLAN UPON ARRIVAL** (SEE REVERSE)

PRE-FLIGHT PILOT CHECKLIST

AIRCRAFT IDENTIFICATION | TIME OF BRIEFING

		REMARKS
WEATHER (Destination) (Alternate)	☐ PRESENT	
	☐ FORECAST	
WEATHER (En Route)	☐ PRESENT	
	☐ FORECAST	
	☐ PIREPS	
WINDS ALOFT	BEST CRZG. ALT.	
NAV AID & COMM STATUS	☐ DESTINATION	
	☐ EN ROUTE	
AIRPORT CONDITIONS	☐ DESTINATION	
	☐ ALTERNATE	
ADIZ	☐ AIRSPACE RESTRICTIONS	

REPORT WEATHER CONDITIONS ALOFT

Report immediately weather conditions encountered—particularly cloud tops, upper cloud layers, thunderstorms, ice, turbulance, winds and temperature.

POSITION	ALTITUDE	TIME	WEATHER CONDITIONS

☆ U.S. Government Printing Office: 1984—430-693

FIGURE 1-3. NAVIGATION PERFORMANCE DATA

Reporting Period: From: To:

Aircraft Registration:

NAVIGATION PERFORMANCE DATA

Note 1: *Check (V)INS system used for steering where applicable*
Note 2: *Insert relevant data for each system as follows:*
a) For INS: on arrival at the ramp
b) for OMEGA: on ramp, or if preferable, after touch-douwn or on arrival over land-fall point
Note 3: *With INS, give the time in the navigation mode: with OMEGA, give the time in the MNPS area*
Note 4: *Give details of any relevant aspects of up-dating*

				RADIAL ERROR								Did A/c				
				INS System		1	2	3	Note 1			stay				
				Note 2						Time		25 NM of		INS RATE		
				Brg.	Dist.	Brg.	Dist.	Brg.	Dist.	Note 3		cleared	Remarks	NM/HR		
Date	Flight	From	To	DGR	NM	DGR	NM	DGR	NM	H	MIN	track	Note 4	1	2	3
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15	16

NATOMMP3.W51 November 1991

FIGURE 1-4. OMEGA INFORMATION

The International Omega Association, Inc. (IOA): The IOA publishes the "Bibliography of Omega Publications" and the "Proceeding of Annual Meetings," containing papers on Omega use, equipment, research and policy. The address is:

International Omega Association
P.O. Box 2324
Arlington, Virginia 22202-0324

The Institute of Navigation (ION): The ION publishes a quarterly journal, "Navigation," which periodically contains papers on Omega. The Fall 1986 issue of "Navigation" (Volume 33, No. 3), was dedicated to Omega and is a good general reference. The address is:

Institute of Navigation
1026 16th Street, N.W., Suite 104
Washington, DC 20036

Gross navigation errors (GNE) should be reported to the Central Monitoring Agency. The address is:

Central Monitoring Agency
CAA House
45-59 Kingsway
London WC2B6TE
United Kingdom

FIGURE 1-5. NOTAM OFFICES (NOF) THAT EXCHANGE NOTAM'S WITH THE UNITED STATES

The following tabulation is a listing of NOF's that currently exchange NOTAM's with the U.S. NOF:

Country	[City]	Country	[City]	Country	[City]
Afghanistan	[Kabul]	Algeria	[Algiers]	Angola	[Luanda]
Argentina	[Buenos Aires]	Australia	[Sydney]	Austria	[Vienna]
Azores	[Santa Maria]	Bahamas	[Nassau]	Bahrain	[Bahrain]
Bangladesh	[Dacca]	Belgium	[Brussels]	Bermuda	
Bolivia	[LaPaz]	Brazil	[Rio de Janeiro]	Bulgaria	[Sofia]
Burma	[Rangoon]	Canada	[Ottawa]	Cape Verde	[Amilcar Cabral]
Chile	[Santiago]	China	[Beijing]	Columbia	[Bogota]
Cuba	[Havana]	Cyprus	[Nicosia]	Czechoslovakia	[Prague]
Denmark	[Copenhagen]	Dom. Rep.	[Santo Domingo]	E. Germany	[Berlin]
Ecuador	[Quayaquil]	Egypt	[Cairo]	England	[London]
Fiji	[Nandi]	Finland	[Helsinki]	France	[Paris]
Ghana	[Accra]	Greece	[Athens]	Greenland	[Sondre Stromfjord]
Guyana	[Georgetown]	Haiti	[Port au Prince]	Honduras	[Tequecigalpa]
Hong Kong		Hungary	[Budapest]	Iceland	[Reykjavik]
India	[Bombay]	India	[Calcutta]	India	[Madras]
India	[New Delhi]	Indonesia	[Jakarta]	Iran	[Tehran]
Ireland	[Shannon]	Israel	[Tel Aviv]	Italy	[Rome]
Jamaica	[Kingston]	Japan	[Tokyo]	Kenya	[Nairobi]
Lebanon	[Beirut]	Liberia	[Roberts]	Libya	[Tripoli]
Malaysia	[Kuala Lumpur]	Malta	[Luga]	Mexico	[Mexico City]
Morocco	[Casablanca]	Net. Antilles	[Curacao]	Netherlands	[Amsterdam]
New Zealand	[Auckland]	Nigeria	[Lagos]	Norway	[Oslo]
Pakistan	[Karachi]	Panama	[Tocumen]	Papua Nw. Guin.	[Port Moresby]
Paraguay	[Asuncion]	Peru	[Lima]	Philippines	[Manila]
Poland	[Warsaw]	Portugal	[Lisbon]	Romania	[Stockholm]
S. Africa	[Johannesburg]	S. Korea	[Seoul]	Senegal	
Singapore	Solomon Islands	Soviet Union	[Moscow]	Spain	[Port of Spain]
Sri Lanka	[Columbo]	Suriname	[Paramaribo]	Sweden	
Switzerland	[Zurich]	Syria	[Damascus]	Tahiti	[Caracas]
Taiwan	[Taipei]	Thailand	[Bankok]	Trinidad and	[Belgrade]
				Tobago.	[Salisbury]
Turkey	[Ankara]	Uruguay	[Montevideo]	Venezuela	Turkey
W. Germany	[Frankfurt]	Western Samoa	[Faleola]	Yugoslavia	W. Germany
Zaire	[Kinshasa]	Zambia	[Lusaka]	Zimbabwe	Zaire

The following tabulation is a listing of locations from which the U.S. NOF does not receive Class I NOTAM's:

Country	Country	Country
Albania	Botswana	Burundi
Cameroon	Central African Republic	Chad
Comoros	Congo	Equatorial Guinea
Ethiopa	Gabon	Gibraltar
Iraq	Jordan	Kampuchea
Korea (North)	Kuwait	Laos
Madagascar	Malawi	Mauritius
Mongolia	Mozambique	Nepal
Rwanda	Sao Tome & Principe	Saudi Arabia
Seychelles	Somalia	Sudan
Swaziland	Tunisia	Viet-Nam
Yemen Arab Republic	Yemen Democratic Republic	

FIGURE 1-6. DISTANCE CONVERSIONS

DISTANCE CONVERSION
CONVERSIONS

NOTE: CONVERSIONS ARE ROUNDED OFF TO NEAREST WHOLE NUMBER EXCEPT FOR THE FIRST ROW

KILOMETERS			STATUTE MILES			NAUTICAL MILES		
to SM		to NM	to KM		to NM	to KM		to SM
0.62137	1	0.53996	1.6093	1	0.86898	1.8520	1	1.1508
1.24	2	1.08	3.22	2	1.74	3.70	2	2.30
1.86	3	1.62	4.83	3	2.61	5.56	3	3.45
2.49	4	2.16	6.44	4	3.48	7.41	4	4.60
3.11	5	2.70	8.05	5	4.34	9.26	5	5.75
3.73	6	3.24	9.66	6	5.21	11.11	6	6.90
4.35	7	3.78	11.27	7	6.08	12.96	7	8.06
4.97	8	4.32	12.87	8	6.95	14.82	8	9.21
5.59	9	4.86	14.48	9	7.82	16.67	9	10.36
6.21	10	5.40	16.09	10	8.69	18.52	10	11.51
12.43	20	10.80	32.19	20	17.38	37.04	20	23.02
18.64	30	16.20	48.28	30	26.07	55.56	30	34.52
24.85	40	21.60	64.37	40	34.76	74.08	40	46.03
31.07	50	27.00	80.47	50	43.45	92.60	50	57.54
37.28	60	32.40	96.56	60	52.14	111.12	60	69.05
43.50	70	37.80	112.65	70	60.83	129.64	70	80.56
49.17	80	43.20	128.75	80	69.52	148.16	80	92.06
55.92	90	48.60	144.84	90	78.20	166.68	90	103.57
62.14	100	54.00	160.93	100	86.90	185.20	100	115.08
124.27	200	107.99	321.87	200	173.80	370.40	200	230.16
186.41	300	161.99	482.80	300	260.69	555.60	300	345.23
248.55	400	215.98	643.74	400	347.59	740.80	400	460.31
310.69	500	269.98	804.67	500	434.49	926.00	500	575.39
372.82	600	323.97	965.61	600	521.39	1111.20	600	690.47
434.96	700	377.97	1126.54	700	608.28	1296.40	700	805.55
497.10	800	431.97	1287.48	800	695.18	1481.60	800	920.62
559.23	900	485.96	1448.41	900	782.01	1666.80	900	1035.70
621.37	1000	539.96	1609.34	1000	868.98	1852.00	1000	1150.78

METERS to FEET			METERS to YARDS			INCHES to MILLIMETERS (MM)		
Meters	Ft / Meters	Ft	Meters	Yds/ Meters	Yds	Inches	mm / Inches	mm
.3048	1	3.2808	.9144	1	1.0936	.03937	1	25.4
1	2	7	2	2	2	.07874	2	50.8
1	3	10	3	3	3	.11811	3	76.2
1	4	13	4	4	4	.15748	4	101.6
2	5	16	5	5	5	.19685	5	127.0
2	6	20	5	6	7	.23622	6	152.4
2	7	23	6	7	8	.27559	7	177.8
2	8	26	7	8	9	.31496	8	203.2
3	9	30	8	9	10	.35433	9	228.6
3	10	33	9	10	11	.3937	10	254.0
6	20	66	18	20	22	.7874	20	508.0
9	30	98	27	30	33	1.1811	30	762.0
12	40	131	36	40	44	1.5748	40	1016.0
15	50	164	46	50	55	1.9685	50	1270.0
18	60	197	55	60	66	2.3622	60	1524.0
21	70	230	64	70	77	2.7559	70	1778.0
24	80	262	73	80	88	3.1496	80	2032.0
27	90	295	82	90	99	3.5433	90	2286.0
30	100	328	91	100	110	3.9370	100	2540.0
61	200	656	183	200	219	7.8140	200	5080.0
91	300	984	274	300	329	11.8110	300	7620.0
122	400	1312	366	400	438	15.7480	400	10160.0
152	500	1640	457	500	548	19.6850	500	12700.0
183	600	1968	549	600	658	23.6220	600	15240.0
213	700	2296	640	700	767	27.5590	700	17780.0
244	800	2625	732	800	877	31.4960	800	20320.0
274	900	2953	823	900	987	35.4330	900	22860.0
305	1000	3281	914	1000	1096	39.3701	1000	25400.0

FIGURE 1-7. ICAO TERMINAL FORECAST (TAF)

International Terminal Forecasts (TAF) are in an alphanumeric code. They are issued two or four times daily for 24-hour periods beginning at 0000Z, 0600Z, 1200Z and 1800Z. The TAF is a series of groups made up of digits and letters. An individual group is identified by its position in the sequence, by its alpha-numeric coding, by its length, or by a numeric indicator. The following is a St. Louis forecast in TAF code:

KSTL 1212 33025/35 0800 71SN 9//005 INTER 1215 0000 39BLSN 9//000 GRADU 1516 33020 4800 38BLSN 7SC030 TEMPO 1620 85SNSH GRADU 2122 33015 9999 WX NIL 3SC030 RAPID 00 VRB05 9999 SKC The forecast is broken down into the elements lettered "a" to "n" to aid in the discussion.

KSTL 1212 33025/35 0800 71SN 9//005
a b c d e f

INTER 1215 0000 39BLSN 9//000
g

GRADU 1516 33020 4800 38BLSN 7SC030
h

TEMPO 1620 84SNSH
i

GRADU 2122 33015 9999 WX NIL 3SC030
j

RAPID 00 VRB05 9999 SKC
k

680304 590359 02134
l m n

a. ***Station identifier.*** The TAF code uses ICAO 4-letter station identifiers.

b. ***Valid time.*** Valid Time of the forecast follows station identifier. "1212" means a 24-hourforecast valid from 1200Z until 1200Z the following day.

c. ***Wind.*** The wind forecast is usually a 5-digit group showing direction in 3 digits and speed in 2 digits. When the wind is expected to be 100 knots or more, the group is 6 digits with speed shown in 3 digits. When the speed is gusty or variable, peak speed is separated from average speed with a slash. For example, in the KSTL TAF, "33025/35" means wind 330, average speed 25 knots, peak speed 35 knots. A group "160115/130" means wind 160, 115 knots, peak speed 130 knots. "00000" means clam; "VRB" followed by speed indicates direction variable; i.e., "VRB10" means wind direction variable at 10 knots.

d. **Visibility.** Visibility is forecast in meters. Table 1 converts meters to miles. "0800" is 800 meters or ½ mile.

e. **Significant weather.** Significant weather is decoded using Table II. Groups in the table are numbered sequentially. Each number is followed by an acronym suggestive of the weather; you can soon learn to read most of the acronyms without reference to the table. Examples:

FIGURE 1-7. ICAO TERMINAL FORECAST (TAF) - Continued

"17TS," thunderstorm; "18SQ," squall' "31SA," sandstorm; "60RA," rain; "85SNSH," snow shower. "XX" between the number and acronym means "heavy." Examples: "33XXSA," heavy sandstorm; "67XXFZRA," heavy freezing rain. In the KSTL forecast, "71SN" means light snow. The TAF encodes only the single most significant type of weather unlike the U.S. domestic FT which permits encoding of multiple weather types.

f. Clouds. The cloud group is a 6-character group. The first digit is sky coverage in octas (eighths) as shown in Table III. The two letters identify cloud type as shown in the table. The last three digits are cloud height in hundreds of feet. In the KSTL TAF, "9//005" means sky obscured (9), clouds not observed (//), vertical visibility 500 feet (005). The TAF may include as many cloud groups as necessary to describe expected sky condition.

g. and i. Variation from prevailing conditions. Variation from prevailing conditions are identifiedby the contractions INTER and TEMPO as defined below. In the KSTL TAF, "INTER 1215 0000 39BLSN 9//000" means intermittently from 1200Z to 1500Z (1215) visibility zero meters (0000) or zero miles, blowing snow (39BLSN), sky obscured, clouds not observed, vertical visibility zero (9//000). "TEMPO 1620 85SNSH" means between 1600Z and 2000Z, temporary, or brief, snow showers. Omission of other groups imply no significant change in wind, visibility, or cloud cover.

h., j., and k. An expected change in prevailing conditions. An expected change in prevailing conditions is indicated by the contraction GRADU, RAPID, or FRONT as defined below. In the KSTL TAF, "GRADU 1516 33020 4800 38BLSN 7SC030" means a gradual change between 1500Z and 1600Z to wind 330 at 20 knots, visibility 4,800 meters or 3 miles (Table I), blowing snow, 7/8 stratocumulus (Table III) at 3,000 feet. "GRADU 2122 33015 9999 WX NIL 3SC030" means a gradual change between 2100Z and 2200Z to wind 330 at 15 knots, visibility 10 kilometers or more (more than 6 miles), no significant weather, 3/ 8 stratocumulus at 3,000 feet. "RADIP 00 VRB05 9999 SKC" means a rapid change about 0000Z to wind direction variable at 5 knots, visibility than 6 miles, sky clear.

Listed below are a few contractions used in the TAF. Some of the contractions are followed by time entries indicated by "tt" or "tttt" or by probability, "pp":

GRADU tttt	A gradual change occurring during a period in excess of one-half hour. "tttt" are the beginning and ending times of the expected change to the nearest hour; i.e., "GRADU 1213" means the transition will occur between 1200Z and 1300Z.
RAPID tt	A rapid change occurring in one-half hour or less. "tt" is the time to the nearest hour of the change; i.e., "RAPID 23" means the change will occur about 2300Z.
TEMPO tttt	Temporary changes from prevailing conditions lasting less than one hour. "tttt" are the earliest and latest change times during which the temporary changes are expected; i.e., "TEMPO 0107" means the temporary changes may occur between 0100Z and 0700Z.
INTER tttt	Intermittent changes from prevailing conditions are expected to occur frequently and briefly. "tttt" are the earliest and latest times the brief changes are expected; i.e., "INTER 1518" means that the brief changes may occur between 1500Z and 1800Z, the changes to persist for less than one half the time period.

FIGURE 1-7. ICAO TERMINAL FORECAST (TAF) - Continued

CAVOK	Ceiling and visibility OK. No clouds below 5,000 feet or below the highest minimum sector altitude, whichever is greater, and no cumulonimbus. Visibility 6 miles or greater. No precipitation, thunderstorms, shallow fog or drifting snow.
PROB pp	Probability of conditions occurring. "pp" is the probability in percent; i.e., "PROB 20" means a 20% probability of the conditions occurring.
WX NIL	No significant weather or obstructions to vision.
SKC	Sky clear.

l. **Icing.** An icing group may be included. It is a 6-digit group. The first digit is 6, identifying it as an icing group. The second digit is the type of ice accretion from Table IV. The next three digits are height of the base of the icing layer in hundreds of feet. The last digit is the thickness of the layer in thousands of feet. For example, let's decode the group "680304". "6" indicates an icing forecast; "8" indicates severe icing in cloud (Table IV); "030" means the base of the icing is at 3,000 feet; and "4" specifies a layer 4,000 feet thick.

m. **Turbulence.** A turbulence group also may be included. It also is 6-digit group coded the same as the icing group except a "5" identifies the group as a turbulence forecast, and type of turbulence is from Table IV. To decode the group "590359"; "5" identifies a turbulence forecast; "9": specifiesfrequent severe turbulence in cloud (Table IV); "035" means the base of the turbulent layer is 3,500 feet; "9" specifies that the turbulence layer is 9,000 feet thick.

> When either an icing or a turbulent layer is expected to be more than 9,000 feet thick, multiple groups are used; the top specified in one group is coincident with the base in the following group. Let's assume a cloud base at 5,000 feet and the forecaster expects frequent turbulence in thunderstorms from the surface to 45,000 feet; the most hazardous turbulence is at mid-levels. This could be encoded 530005 550509 591409 592309 553209 554104. While you most likely will never see such a complex coding with this many groups, the flexible TAF code permits it.

n. **Temperature.** A temperature code is seldom included in a terminal forecast. However, it may be included if critical to aviation. It may be used to alert the pilot to high density altitude or possible frost when on the ground. The temperature group is identified by the digit "0". The next two digits are time to the nearest hour GMT at which the temperature will occur. The last two digits are temperature in degrees Celsius. A minus temperature is preceded by the letter "M." Examples: "02137" means temperature at 2100Z is expected to be 37C, about 99F; "012M02" means temperature at 1200Z is expected to be minus 2C. A forecast may include more than one temperaturegroup.

FIGURE 1-8. VISIBILITY CONVERSION, TAF CODE TO MILES

METERS	MILES
0000	0
0100	1/16
0200	1/8
0300	3/16
0400	1/4
0500	5/16
0600	3/8
0800	1/2
1000	5/8
1200	3/4
1400	7/8
1600	1
1800	1 1/8
2000	1 1/4
2200	1 3/8
2400	1 1/2
2600	1 5/8
2800	1 3/4
3000	1 7/8
3200	2
3600	2 1/4
4000	2 1/2
4800	3
6000	4
8000	5
9000	6
9999	more than 6

FIGURE 1-9. TAF WEATHER CODES

CODE	DECODE
04FU	SMOKE
06HZ	DUST HAZE
08PO	DUST DEVILS
10BR	MIST
11MIFG	SHALLOW FOG - Patches
12MIFG	SHALLOW FOG - Continuous
17TS	THUNDERSTORMS
18SQ	SQUALL
19FC	FUNNEL CLOUD
30SA	DUSTSTORM or SANDSTORM - Decreased during the preceding hour
31SA	DUSTSTORM or SANDSTORM - No change during the preceding hour
32SA	DUSTSTORM or SANDSTORM - Began or increased during the preceding hour
33XXSA	HEAVY DUSTSTORM or SANDSTORM - Decreased during the preceding hour
34XXSA	HEAVY DUSTSTORM or SANDSTORM - No change during the preceding hour
35XXSA	HEAVY DUSTSTORM or SANDSTORM - Began or increased during the preceding hour
36DRSN	LOW DRIFTING SNOW - Slight or moderate
37DRSN	LOW DRIFTING SNOW - Heavy
38BLSN	BLOWING SNOW - Slight or moderate
39BLSN	BLOWING SNOW - Heavy
40BCFG	FOG PATCHES - Sky visible, has become thinner during the preceding hour
41BCFG	FOG PATCHES
42FG	FOG - Sky visible, has become thinner during the preceding hour
43FGFOG	Sky invisible, has become thinner during the preceding hour
44FG	Fog - Sky visible, no change during the last hour
45FGFOG	Sky invisible, no change during the preceding hour
46FGFOG	Sky visible, has begun or has become thicker during the preceding hour
47FGFOG	Sky invisible, has begun or has become thicker during the preceding hour
48FZFG	FREEZING FOG - Sky visible
49FZFG	FREEZING FOG - Sky invisible
50DZ	DRIZZLE - Intermittent, slight
51DZ	DRIZZLE - Continuous, slight
52DZ	DRIZZLE - Intermittent, moderate
53DZ	DRIZZLE - Continuous, moderate
54XXDZ	HEAVY DRIZZLE - intermittent
55XXDZ	HEAVY DRIZZLE - Continuous
56FZDZ	FREEZING DRIZZLE

FIGURE 1-9. TAF WEATHER CODES—Continued

CODE	DECODE
57XXFZDZ	HEAVY FREEZING DRIZZLE
58RA	RAIN - Drizzle and Rain, slight
59RA	RAIN - Drizzle and Rain, moderate or heavy
60RA	RAIN - Intermittent, slight
61RA	RAIN - Continuous, slight
62RA	RAIN - Intermittent, moderate
63RA	RAIN - Continuous, moderate
64XXRA	HEAVY RAIN - Intermittent, heavy
65XXRA	HEAVY RAIN - Continuous, heavy
66FZRA	FREEZING RAIN
67XXFZRA	HEAVY FREEZING RAIN
68RASN	RAIN and SNOW
69XXRASN	HEAVY RAIN and SNOW
70SN	SNOW - Intermittent, slight
71SN	SNOW - Continuous, slight
72SN	SNOW - Intermittent moderate
73SN	SNOW - Continuous moderate
74XXSN	HEAVY SNOW - Intermittent
75XXSN	HEAVY SNOW - Continuous
77SN	SNOW - Snow grains
79PE	ICE PELLETS
80RASH	SHOWERS
81XXSH	HEAVY SHOWERS - Moderate or heavy
82XXSH	HEAVY SHOWERS - Violent
83RASN	SHOWERS of RAIN and SNOW mixed
84XXRASN	HEAVY SHOWERS of RAIN and SNOW - Mixed
85SNSH	SNOW SHOWERS
86XXSN	HEAVY SNOW SHOWERS
87GR	SOFT HAIL - Moderate or heavy
89GR	HAIL - Not associated with thunder, slight
90XXGR	HEAVY HAIL - Not associated with thunder, moderate or heavy
91RA	RAIN - Slight rain at time of observation, thunderstorm during preceding hour but not at time of observation
92XXRA	RAIN - Moderate or heavy rain at time of observation, thunderstorm during the preceding hour but not at the time of observation
93GR	HAIL, SLIGHT SNOW - Or rain and snow mixed with hail, at time of observation, thunderstorm during preceding hour but not at time of observation
94XXGR	HEAVY HAIL - Moderate or heavy snow, or rain and snow mixed with hail at time of observation, thunderstorm during preceding hour but not at time of observation
95TS	THUNDERSTORM - Thunderstorm, slight or moderate, without hail but with rain and/or snow

FIGURE 1-9. TAF WEATHER CODES—Continued

CODE	DECODE
96TSGR	THUNDERSTORM with HAIL - Thunderstorm, slight or moderate, with hail
97XXTS	HEAVY THUNDERSTORM - Heavy, without hail
98TSSA	THUNDERSTORM with DUSTSTORM or SANDSTORM
99XXTSGR	HEAVY THUNDERSTORM with HAIL

FIGURE 1-10. TAF CLOUD CODE

CLOUD AMOUNT	CLOUD TYPE
0 0 (CLEAR)	CI Cirrus
1 1 octa or less but not zero	CC Cirrocumulus CS Cirrostratus
2 2 octas	AC Altocumulus
3 3 octas	AS Altostratus
4 4 octas	NS Nimbostratus
5 5 octas	SC Stratocumulus
6 6 octas	ST Stratus
7 7 octas or more but less than 8	CU Cumulus CB Cumulonimbus
8 8 octas (overcast)	//Cloud not visible
9 Sky obscured, or cloud amount not estimated	due to darkness or obscuring phenomena

FIGURE 1-11. TAF ICING & TURBULENCE

Fig. Code	Amount of Ice Accretion (TAF group 6)
0	No icing
1	Light icing
2	Light icing in cloud
3	Light icing in precipitation
4	Moderate icing
5	Moderate icing in cloud
6	Moderate icing in precipitation
7	Severe icing
8	Severe icing in cloud
9	Severe icing in precipitation

Fig. Code	Amount of Ice Accretion(TAF group 5)
0	None
1	Light turbulence
2	Moderate turbulence in clear air, infrequent
3	Moderate turbulence in clear air, frequent
4	Moderate turbulence in cloud, infrequent
5	Moderate turbulence in cloud, frequent
6	Severe turbulence in clear air, infrequent
7	Severe turbulence in clear air, frequent
8	Severe turbulence in cloud, infrequent
9	Severe turbulence in cloud, frequent

FIGURE 1-12. CONVERSION OF ALTIMETER SETTING INCHES OF MERCURY - MILLIBARS

1 inch of mercury = 33.863 hectopascals = 33.863 millibars

INCHES	MILLIBARS									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
26.0	880.5	880.8	881.1	881.5	881.8	882.2	882.5	882.8	883.2	883.5
26.1	883.8	884.2	884.5	884.9	885.2	885.5	885.9	886.2	886.6	886.9
26.2	887.2	887.6	887.9	888.3	888.6	888.9	889.3	889.6	889.9	890.3
26.3	890.6	891.0	891.3	891.6	892.0	892.3	892.7	893.0	893.3	893.7
26.4	894.0	864.3	894.7	895.0	895.4	895.7	896.0	896.4	896.7	897.1
26.5	897.4	897.7	898.1	898.4	898.7	899.1	899.4	899.8	900.1	900.4
26.6	900.8	901.1	901.5	901.8	902.1	902.5	902.8	903.2	903.5	903.8
26.7	904.2	904.5	904.8	905.2	905.5	905.9	906.2	906.5	906.9	907.2
26.8	907.6	907.9	908.2	908.6	908.9	909.2	909.6	909.9	910.3	910.6
26.9	910.9	911.3	911.6	912.0	912.3	912.6	913.0	913.3	913.6	914.0
27.0	914.3	914.7	915.0	915.3	915.7	916.0	916.4	916.7	917.0	917.4
27.1	917.7	918.1	918.4	918.7	919.1	919.4	919.7	920.1	920.4	920.8
27.2	921.1	921.4	921.8	922.1	922.5	922.8	923.1	923.5	923.8	924.1
27.3	924.5	924.8	925.2	925.5	925.8	926.2	926.5	926.9	927.2	927.5
27.4	927.9	928.2	928.5	928.9	929.2	929.6	929.9	930.2	930.6	930.9
27.5	921.3	931.6	931.9	932.3	932.6	933.0	933.3	933.6	934.0	934.3
27.6	934.6	935.0	935.3	935.7	936.0	936.3	936.7	937.0	937.4	937.7
27.7	938.0	938.4	938.7	939.0	939.4	939.7	940.1	940.4	940.7	941.1
27.8	941.4	941.8	942.1	942.4	942.8	943.1	943.4	943.8	944.1	944.5
27.9	944.8	945.1	945.5	945.8	946.2	946.5	946.8	947.2	947.5	947.9
28.0	948.2	948.5	948.9	949.2	949.5	949.9	950.2	950.6	950.9	951.2
28.1	951.6	951.9	952.3	952.6	952.9	953.3	953.6	953.9	954.3	954.6
28.2	955.0	955.3	955.6	956.0	956.3	956.7	957.0	957.3	957.7	958.0
28.3	958.3	958.7	959.0	959.4	959.7	960.0	960.4	960.7	961.1	961.4
28.4	961.7	962.1	962.4	962.8	963.1	963.4	963.8	964.1	964.4	964.8
28.5	965.1	965.5	965.8	966.1	966.5	966.8	967.2	967.5	967.8	968.2
28.6	968.5	968.8	969.2	969.5	969.9	970.2	970.5	970.9	971.2	971.6
28.7	971.9	972.2	972.6	972.9	973.2	973.6	973.9	974.3	974.6	974.9
28.8	975.3	975.6	976.0	976.3	976.6	977.0	977.3	977.7	978.0	978.3
28.9	978.7	979.0	979.3	979.7	980.0	980.4	980.7	981.0	981.4	981.7
29.0	982.1	982.4	982.7	983.1	983.4	983.7	984.1	984.4	984.8	985.1
29.1	985.4	985.8	986.1	986.5	986.8	987.1	987.5	987.8	988.2	988.5
29.2	988.8	989.2	989.5	989.8	990.2	990.5	990.9	991.2	991.5	991.9
29.3	992.2	992.6	992.9	993.2	993.6	993.9	994.2	994.6	994.9	995.3
29.4	995.6	995.9	996.3	996.6	997.0	997.3	997.6	998.0	998.3	998.6
29.5	999.0	999.3	999.7	1000.0	1000.4	1000.7	1001.0	1001.4	1001.7	1002.0
29.6	1002.4	1002.7	1003.1	1003.4	1003.7	1004.1	1004.4	1004.7	1005.1	1005.4
29.7	1005.8	1006.1	1006.4	1006.8	1007.1	1007.5	1007.8	1008.1	1008.5	1008.8
29.8	1009.1	1009.5	1009.8	1010.2	1010.5	1010.8	1011.2	1011.5	1011.9	1012.2
29.9	1012.5	1012.9	1013.2	1013.5	1013.9	1014.0	1014.6	1014.9	1015.2	1015.6
30.0	1015.9	1016.3	1016.6	1016.9	1017.3	1017.6	1018.0	1018.3	1018.6	1019.0
30.1	1019.3	1019.6	1020.0	1020.3	1020.7	1021.0	1021.3	1021.7	1022.0	1022.4
30.2	1022.7	1023.0	1023.4	1023.7	1024.0	1024.4	1024.7	1025.1	1025.4	1025.7
30.3	1026.1	1026.4	1026.8	1027.1	1027.4	1027.8	1028.1	1028.4	1028.8	1029.1
30.4	1029.5	1029.8	1030.4	1030.5	1030.8	1031.2	1031.5	1031.8	1032.2	1032.5
30.5	1032.9	1033.2	1033.5	1033.9	1034.2	1024.5	1034.9	1035.2	1035.6	1035.9
30.6	1036.2	1026.6	1036.9	1037.3	1037.6	1037.9	1038.3	1038.6	1038.9	1039.3
30.7	1039.6	1040.0	1040.3	1040.6	1041.0	1041.3	1041.7	1042.0	1042.3	1042.7
30.8	1043.0	1043.3	1043.7	1044.0	1044.4	1044.7	1045.0	1045.4	1045.7	1046.1
30.9	1046.4	1046.7	1047.1	1047.4	1047.8	1048.1	1048.4	1048.8	1049.1	1049.4

FIGURE 1-13. HECTOPASCALS (OR MILLIBARS) TO INCHES OF MERCURY

HECTOPASCALS or MILLIBARS to INCHES (1 hectopascal = 1 millibar = 0.02953 inches of mercury)

hPa or mb	INCHES									
	0	1	2	3	4	5	6	7	8	9
710	20.97	21.00	21.03	21.05	21.08	21.11	21.14	21.17	21.20	21.23
720	21.26	21.29	21.32	21.35	21.38	21.41	21.44	21.47	21.50	21.53
730	21.56	21.59	21.62	21.65	21.67	21.70	21.73	21.76	21.79	21.82
740	21.85	21.88	21.91	21.94	21.97	22.00	22.03	22.06	22.09	22.12
750	22.15	22.18	22.21	22.24	22.27	22.30	22.32	22.35	22.38	22.41
760	22.44	22.47	22.50	22.53	22.56	22.59	22.62	22.65	22.68	22.71
770	22.74	22.77	22.80	22.83	22.86	22.89	22.92	22.94	22.97	23.00
780	23.03	23.06	23.09	23.12	23.15	23.18	23.21	23.24	23.27	23.30
790	23.33	23.36	23.39	23.42	23.45	23.48	23.51	23.54	23.56	23.59
800	23.62	23.65	23.68	23.71	23.74	23.77	23.80	23.83	23.86	23.89
810	23.92	23.95	23.98	24.01	24.04	24.07	24.10	24.13	24.16	24.19
820	24.21	24.24	24.27	24.30	24.33	24.36	24.39	24.42	24.45	24.48
830	24.51	24.54	24.57	24.60	24.63	24.66	24.69	24.72	24.75	24.78
840	24.81	24.83	24.86	24.89	24.92	24.95	24.98	25.01	25.04	25.07
850	25.10	25.13	25.16	25.19	25.22	25.25	25.28	25.31	25.34	25.37
860	25.40	25.43	25.45	25.48	25.51	25.54	25.57	25.60	25.63	25.66
870	25.69	25.72	25.75	25.78	25.81	25.84	25.87	25.90	25.93	25.96
880	25.99	26.02	26.05	26.07	26.10	26.13	26.16	26.19	26.22	26.25
890	26.28	26.31	26.34	26.37	26.40	26.43	26.46	26.49	26.52	26.55
900	26.58	26.61	26.64	26.67	26.70	26.72	26.75	26.78	26.81	26.84
910	26.87	26.90	26.93	26.96	26.99	27.02	27.05	27.08	27.11	27.14
920	27.17	27.20	27.23	27.26	27.29	27.32	27.34	27.37	27.40	27.43
930	27.46	27.49	27.52	27.55	27.58	27.61	27.64	27.67	27.70	27.73
940	27.76	27.79	27.82	27.85	27.88	27.91	27.94	27.96	27.99	28.02
950	28.05	28.08	28.11	28.14	28.17	28.20	28.23	28.26	28.29	28.32
960	28.35	28.38	28.41	28.44	28.47	28.50	28.53	28.56	28.58	28.61
970	28.64	28.67	28.70	28.73	28.76	28.79	28.85	28.85	28.88	28.91
980	28.94	28.97	29.00	29.03	29.06	29.09	29.15	29.15	29.18	29.21
990	29.23	29.26	29.29	29.32	29.35	29.38	29.44	29.44	29.47	29.50
1000	29.53	29.56	29.59	29.62	29.65	29.68	29.74	29.74	29.77	29.80

FIGURE 1-13. HECTOPASCALS (OR MILLIBARS) TO INCHES OF MERCURY—Continued
HECTOPASCALS or MILLIBARS to INCHES (1 hectopascal = 1 millibar = 0.02953 inches of mercury)

hPa or mb	INCHES									
	0	1	2	3	4	5	6	7	8	9
1010	29.83	29.85	29.88	29.91	29.94	29.97	30.03	30.03	30.06	30.09
1020	30.12	30.15	30.18	30.21	30.24	30.27	30.33	30.33	30.36	30.39
1030	30.42	30.45	30.47	30.50	30.53	30.56	30.62	30.62	30.65	30.68
1040	30.71	30.74	30.77	30.80	30.83	30.86	30.92	30.92	30.95	30.98
1050	31.01	31.04	31.07	31.10	31.12	31.15	31.21	31.21	31.24	31.27

FIGURE 1-13. HECTOPASCALS (OR MILLIBARS) TO INCHES OF MERCURY—Continued

HECTOPASCALS or MILLIBARS to INCHES (1 hectopascal = 1 millibar = 0.02953 inches of mercury)

MN	HECTOPASCALS (or MILLIBARS)									
	0	1	2	3	4	5	6	7	8	9
530	706.6	707.9	709.3	710.6	711.9	713.3	714.6	715.9	717.3	718.6
540	719.9	721.3	722.6	723.9	725.3	726.6	727.9	729.3	730.6	731.9
550	733.3	734.6	735.9	737.3	738.6	739.9	741.3	742.6	743.9	745.3
560	746.6	747.9	749.3	750.6	751.9	753.3	754.6	755.9	757.3	758.6
570	759.9	761.3	762.6	763.9	765.3	766.6	767.9	769.3	770.6	771.9
580	773.3	774.6	775.9	777.3	778.6	779.9	781.3	782.6	783.9	785.3
590	786.6	787.9	789.3	790.6	791.9	793.3	794.6	795.9	797.3	798.6
600	799.9	801.3	802.6	803.9	805.3	806.6	807.9	809.3	810.6	811.9
610	813.3	814.6	815.9	817.3	818.6	819.9	821.3	822.6	823.9	825.3
620	826.6	827.9	829.3	830.6	831.9	833.3	834.6	835.9	837.3	838.6
630	839.9	841.3	842.6	843.9	845.2	846.6	847.9	849.3	850.6	851.9
640	853.3	854.6	855.9	857.3	858.6	859.9	861.3	862.6	863.9	865.3
650	866.6	867.9	869.3	870.6	871.9	873.3	874.6	875.9	877.3	878.6
660	879.9	881.3	882.6	883.9	885.3	886.6	887.9	889.3	890.6	891.9
670	893.3	894.6	895.9	897.3	898.6	899.9	901.3	902.6	903.9	905.3
680	906.6	907.9	909.3	910.6	911.9	913.3	914.6	915.9	917.3	918.6
690	919.9	921.3	922.6	923.9	925.3	926.6	927.9	929.3	930.6	931.9
700	933.3	934.6	935.9	937.3	938.6	939.9	941.3	942.6	943.9	945.3
710	946.6	947.9	949.3	950.6	951.9	953.3	954.6	955.9	957.3	958.6
720	959.9	961.3	962.6	963.9	965.3	966.6	967.9	969.3	970.6	971.9
730	973.3	974.6	975.9	977.3	978.6	979.9	981.3	982.6	983.9	985.3
740	986.6	987.9	989.3	990.6	991.9	993.3	994.6	995.9	997.3	998.6
750	999.9	1001.	1002.	1003.	1005.	1006.	1007.	1009.	1010.	1011.
760	1013.	1014.	1015.	1017.	1018.	1019.	1021.	1022.	1023.	1025.
770	1026.	1027.	1029.	1030.	1031.	1033.	1034.	1035.	1037.	1038.
780	1039.	1041.	1042.	1043.	1045.	1046.	1047.	1049.	1050.	1051.
790	1053.	1054.	1055.	1057.	1058.	1059.	1061.	1062.	1063.	1065.
800	1066.	1067.	1069.	1070.	1071.	1073.	1074.	1075.	1077.	1078.

FIGURE 1-14. JET FUEL CONVERSION

LBS - KG - U.S. GAL - LITER

TURBINE FUEL volume/weight
(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

U.S. Gal	U.S. Lbs / Gal	Lbs	Liter	Lbs / Liter	Lbs	Liter	Kg / Liter	Kg
0.15	1	6.7	0.57	1	1.8	1.25	1	0.8
0.3	2	13	1.1	2	3.6	2.5	2	1.6
0.45	3	20	1.7	3	5.4	3.8	3	2.4
0.6	4	27	2.3	4	7.2	5.0	4	3.2
0.75	5	33	2.8	5	9.0	6.2	5	4.0
0.9	6	40	3.4	6	11	7.5	6	4.8
1.05	7	47	4	7	13	8.8	7	5.6
1.2	8	53	4.5	8	14	10	8	6.4
1.35	9	60	5.1	9	16	11	9	7.2
1.5	10	67	5.7	10	18	12	10	8
3	20	130	11	20	36	25	20	16
4.5	30	200	17	30	54	38	30	24
6	40	270	23	40	72	50	40	32
7.5	50	330	28	50	90	62	50	40
9	60	400	34	60	110	75	60	48
10.5	70	470	40	70	130	88	70	56
12	80	530	45	80	140	100	80	64
13.5	90	600	51	90	160	110	90	72
15	100	670	57	100	180	120	100	80
30	200	1300	110	200	360	250	200	160
45	300	2000	170	300	540	380	300	240
60	400	2700	230	400	720	500	400	320
75	500	3300	280	500	900	620	500	400
90	600	4000	340	600	1100	750	600	480
105	700	4700	400	700	1300	880	700	560
120	800	5300	450	800	1400	1000	800	640
135	900	6000	510	900	1600	1100	900	720
150	1000	6700	570	1000	1800	1200	1000	800

FIGURE 1-15. VOLUME CONVERSION

IMP GAL - U.S. GAL - LITER

TURBINE FUEL volume/weight (up to 5 pounds variation per 100 gallons due to fuel grade and temperature)								
Imp Gal	U.S. / Imp Gal / Gal	U.S. Gal	U.S. Gal	U.S. Liter / Gal	Liter	Imp Gal	Imp Liter / Gal	Liter
.83267	1	1.2010	.26418	1	3.7853	.21997	1	4.5460
2	2	2	1	2	8	0.4	2	9
2	3	4	1	3	11	0.7	3	14
3	4	5	1	4	15	0.9	4	18
4	5	6	1	5	19	1	5	23
5	6	7	2	6	23	1	6	27
6	7	8	2	7	26	2	7	32
7	8	10	2	8	30	2	8	36
7	9	11	2	9	34	2	9	41
8	10	12	3	10	38	2	10	45
17	20	24	5	20	76	4	20	91
25	30	36	8	30	114	7	30	136
33	40	48	11	40	151	9	40	182
42	50	60	13	50	189	11	50	227
50	60	72	16	60	227	13	60	273
58	70	84	18	70	265	15	70	318
67	80	96	21	80	303	18	80	364
75	90	108	24	90	341	20	90	409
83	100	120	26	100	378	22	100	455
167	200	240	53	200	757	44	200	909
250	300	360	79	300	1136	66	300	1364
333	400	480	106	400	1514	88	400	1818
416	500	600	132	500	1893	110	500	2273
500	600	721	158	600	2271	132	600	2728
583	700	841	185	700	2650	154	700	3182
666	800	961	211	800	3028	176	800	3637
750	900	1081	238	900	3407	198	900	4091
833	1000	1201	264	1000	3785	220	1000	4546

FIGURE 1-16. LENGTH CONVERSIONS

KILOMETERS - NAUTICAL MILES

KILOMETERS to SM		KILOMETERS to NM
0.62137	1	0.53996
1.24	2	1.08
1.86	3	1.62
2.49	4	2.16
3.11	5	2.70
3.73	6	3.24
4.35	7	3.78
4.97	8	4.32
5.59	9	4.86
6.21	10	5.40
12.43	20	10.80
18.64	30	16.20
24.85	40	21.60
31.07	50	27.00
37.28	60	32.40
43.50	70	37.80
49.71	80	44.20
55.92	90	48.60
62.14	100	54.00
124.27	200	107.99
186.41	300	161.99
248.55	400	215.98
310.69	500	269.98
372.82	600	323.97
434.96	700	377.97
497.10	800	431.97
559.23	900	485.96
621.37	1000	539.96

NAUTICAL MILES to KM		NAUTICAL MILES to SM
1.8520	1	1.1508
3.70	2	2.30
5.56	3	3.45
7.41	4	4.60
9.26	5	5.75
11.11	6	6.90
12.96	7	8.06
14.82	8	9.21
16.67	9	10.36
18.52	10	11.51
37.04	20	23.02
55.56	30	34.52
74.08	40	46.03
92.60	50	57.54
111.12	60	69.05
129.64	70	80.56
148.16	80	92.06
166.68	90	103.57
185.20	100	115.08
370.40	200	230.16
555.60	300	345.23
740.80	400	460.31
926.00	500	575.39
1111.20	600	690.47
1296.40	700	805.55
1481.60	800	920.62
1666.80	900	1035.70
1852.00	1000	1150.78

FIGURE 1-17. LOCAL TIME CHART

LOCAL TIME CHART

PREVIOUS DAY

-9	-5	-3½	UTC	+2	-5½	+7	+9
ALASKA	NEW YORK	GANDER	LONDON	CAIRO	BOMBAY	BANGKOK	TOKYO
1500	1900	2030	0000	0200	0530	0700	0900
1600	2000	2130	0100	0300	0630	0800	1000
1700	2100	2230	0200	0400	0730	0900	1100
1800	2200	2330	0300	0500	0830	1000	1200
1900	2300	0030	0400	0600	0930	1100	1300
2000	0000	0130	0500	0700	1030	1200	1400
2100	0100	0230	0600	0800	1130	1300	1500
2200	0200	0330	0700	0900	1230	1400	1600
2300	0300	0430	0800	1000	1330	1500	1700
0000	0400	0530	0900	1100	1430	1600	1800
0100	0500	0630	1000	1200	1530	1700	1900
0200	0600	0730	1100	1300	1630	1800	2000
0300	0700	0830	1200	1400	1730	1900	2100
0400	0800	0930	1300	1500	1830	2000	2200
0500	0900	1030	1400	1600	1930	2100	2300
0600	1000	1130	1500	1700	2030	2200	0000
0700	1100	1230	1600	1800	2130	2300	0100
0800	1200	1330	1700	1900	2230	0000	0200
0900	1300	1430	1800	2000	2330	0100	0300
1000	1400	1530	1900	2100	0030	0200	0400
1100	1500	1630	2000	2200	0130	0300	0500
1200	1600	1730	2100	2300	0230	0400	0600
1300	1700	1830	2200	0000	0330	0500	0700
1400	1800	1930	2300	0100	0430	0600	0800

NEXT DAY

FIGURE 1-18. RADIO PROPAGATION FORECAST CHART

RADIO-SUISSE SA
TELECOMMUNICATIONS
MOBILE RADIO SERVICES
P.O. BOX
CH-3000 BERNE 14

RADIO PROPAGATION FORECAST
for HF Communications with
BERNA-RADIO

Frequencies in kHz:

WATCH FREQUENCIES: ON REQUEST:

4654.0	H24	3010.0
6643.0	H24	25500.0
8936.0	H24	
10069.0	H24	
13205.0	H24	
15046.0	H24	
18023.0	H24	
21988.0	DAY-TIME	
23285.0	DAY-TIME	

NOTAM:

OWING TO PREDICTED LOW SUNSPOT ACTIVITY, RADIO PROPAGATIONS REMAIN SHAKY. IN CASE OF UNSUCCESSFUL COMMUNICATION ATTEMPT, TRY NEXT HIGHER OR LOWER FREQUENCY.

TIME IN UTC	00	02	04	06	08	10	12	14	16	18	20	22
EUR												
Northern Europe	6	4	6	10	10	10	13	10	10	10	10	8
Central Europe	4	4	4	6	8	10	10	8	8	6	8	6
Balkan/Western and Central Med. Sea	8	6	8	10	13	15	15	13	10	13	13	8
NAT/NAM												
30^0 W (mid-atlantic)/Iceland	8	6	6	8	10	10	13	13	13	13	13	10
U.S. and Canada East Coast	10	6	6	10	15	15	15	15	15	15	13	13
West Coast U.S.A./Brit. Columbia	13	6	6	8	10	13	13	13	15	15	15	15
Alaska/Transpolar	10	6	8	10	10	13	13	13	13	13	13	10
CAR												
Antilles/Gulf of Mexico	10	6	6	8	8	10	15	15	15	15	15	13
Mexico/Latin America	10	8	6	8	8	10	15	15	15	15	15	13
SAM												
South Atlantic	6	6	6	10	15	15	18	15	15	18	15	10
Northern South America	10	6	6	8	10	15	15	18	18	18	15	13

FIGURE 1-18. RADIO PROPAGATION FORECAST CHART—Continued

RADIO-SUISSE SA TELECOMMUNICATIONS MOBILE RADIO SERVICES P.O. BOX CH-3000 BERNE 14	RADIO PROPAGATION FORECAST for HF Communications with BERNA-RADIO
Frequencies in kHz: WATCH FREQUENCIES: ON REQUEST: 4654.0 H24 3010.0 6643.0 H24 25500.0 8936.0 H24 10069.0 H24 13205.0 H24 15046.0 H24 18023.0 H24 21988.0 DAY-TIME 23285.0 DAY-TIME	**NOTAM:** OWING TO PREDICTED LOW SUNSPOT ACTIVITY, RADIO PROPAGATIONS REMAIN SHAKY. IN CASE OF UNSUCCESSFUL COMMUNICATION ATTEMPT, TRY NEXT HIGHER OR LOWER FREQUENCY.

TIME IN UTC	00	02	04	06	08	10	12	14	16	18	20	22
Central South America	10	8	8	10	10	18	18	18	18	18	15	13
Southern South America	10	8	8	10	8	15	18	21	18	18	18	13
AFI												
Northern Africa/Med. Coast	10	6	6	10	13	15	15	15	13	15	15	10
Sahara/Canary Islands/Azeroes	10	8	8	10	13	15	15	15	15	15	15	13
Liberia-Ghana-Nigeria-belt	6	6	6	10	13	13	15	15	15	15	13	10
Angola/Zaire/Zambia/Tanzania	6	6	6	13	15	15	15	15	18	18	13	8
South Africa	6	6	4	13	18	21	21	21	15	10	8	6
Egypt/Sudan	8	6	8	10	15	15	15	15	15	15	13	10
Ethiopia/Kenya	8	6	8	13	15	15	15	15	15	15	10	10
SW Indian Ocean/Seychelles	6	6	13	15	18	18	18	18	15	13	10	8
MID/ASIA/PAC												
Turkey/Eastern Med. Sea	8	6	8	13	13	15	15	18	18	18	15	10
Israel/Jordan/Lebanon/Iraq/Syria	6	6	8	10	13	15	15	18	18	18	10	10
Saudi-Arabia/Oman/Yemen	8	6	10	13	13	15	15	13	15	15	10	10

FIGURE 1-18. RADIO PROPAGATION FORECAST CHART—Continued

RADIO-SUISSE SA
TELECOMMUNICATIONS
MOBILE RADIO SERVICES
P.O. BOX
CH-3000 BERNE 14

RADIO PROPAGATION FORECAST
for HF Communications with
BERNA-RADIO

Frequencies in kHz:

WATCH FREQUENCIES: ON REQUEST:

4654.0	H24	3010.0
6643.0	H24	25500.0
8936.0	H24	
10069.0	H24	
13205.0	H24	
15046.0	H24	
18023.0	H24	
21988.0	DAY-TIME	
23285.0	DAY-TIME	

NOTAM:

OWING TO PREDICTED LOW SUNSPOT ACTIVITY, RADIO PROPAGATIONS REMAIN SHAKY. IN CASE OF UNSUCCESSFUL COMMUNICATION ATTEMPT, TRY NEXT HIGHER OR LOWER FREQUENCY.

TIME IN UTC	00	02	04	06	08	10	12	14	16	18	20	22
Iran/Persian Gulf	8	6	10	13	15	15	15	13	13	13	10	10
Moscow/Tashkent	8	6	10	13	13	15	15	13	13	13	13	10
Pakistan/India/Northern Indian Ocean	8	10	15	15	15	15	15	13	13	13	10	10
Indochina/Indonesia	13	10	15	18	18	18	15	18	15	10	10	8
Philippines/Japan/China/Hong Kong	10	10	13	15	15	15	15	13	13	10	10	8
Australia/New Zealand	10	13	15	18	18	13	10	10	10	10	6	10
Pacific	10	10	10	10	13	10	10	10	13	13	13	13

Period: MAY / JUNE / JULY / AUGUST 1987

FIGURE 1-19.

SPEED, TEMPERATURE, AND WEIGHT CONVERSION
CONVERSIONS

METERS PER SECOND to FEET PER MINUTE (mps = 196.85 fpm)

MPS	FPM	MPS	FPM	MPS	FPM	MPS	FPM
1	197	6	1181	11	2165	16	3150
1.5	295	6.5	1279	11.5	2263	16.5	3248
2	394	7	1378	12	2362	17	3346
2.5	492	7.5	1476	12.5	2460	17.5	3444
3	591	8	1575	13	2559	18	3543
3.5	689	8.5	1673	13.5	2657	18.5	3641
4	787	9	1772	14	2756	19	3740
4.5	886	9.5	1870	14.5	2854	19.5	3838
5	984	10	1969	15	2953	20	3937
5.5	1082	10.5	2067	15.5	3051		

METERS PER SECOND to KNOTS (1 mps = 1.9438 knots)

Meters p/sec.	0	1	2	3	4	5	6	7	8	9
					Knots					
0	-	1.9	3.9	5.8	7.8	9.7	11.7	13.6	15.6	17.5
10	19.4	21.4	23.3	25.3	27.2	29.2	31.1	33.0	35.0	36.9
20	38.9	40.8	42.8	44.7	46.6	48.6	50.5	52.5	54.4	56.4
30	58.3	60.3	62.2	64.1	66.1	68.0	70.0	71.9	73.9	75.8
40	77.8	79.7	81.6	83.6	85.5	87.5	89.4	91.4	93.3	95.2
50	97.2	99.1	101.1	103.0	105.0	106.9	108.8	110.8	112.7	114.7
60	116.6	118.6	120.5	122.5	124.4	126.3	128.3	130.2	132.2	134.1
70	136.1	138.0	140.0	141.9	143.8	145.8	147.7	149.7	151.6	153.6

TEMPERATURES (CELSIUS/FAHRENHEIT)

°C	°F	°C	°F	°C	°F
-40	-40.0	-8	17.6	24	75.2
-39	-38.2	-7	19.4	25	77.0
-38	-36.4	-6	21.2	26	78.8
-37	-34.6	-5	23.0	27	80.6
-36	-32.8	-4	24.8	28	82.4
-35	-31.0	-3	26.6	29	84.2
-34	-29.2	-2	28.4	30	86.0
-33	-27.4	-1	30.2	31	87.8
-32	-25.6	0	32.0	32	89.6
-31	-23.8	1	33.8	33	91.4
-30	-22.0	2	35.6	34	93.2
-29	-20.2	3	37.4	35	95.0
-28	-18.4	4	39.2	36	96.8
-27	-16.6	5	41.0	37	98.6
-26	-14.8	6	42.8	38	100.4
-25	-13.0	7	44.6	39	102.2
-24	-11.2	8	46.4	40	104.0
-23	-9.4	9	48.2	41	105.8
-22	-7.6	10	50.0	42	107.6
-21	-5.8	11	51.8	43	109.4
-20	-4.0	12	53.6	44	111.2
-19	-2.2	13	55.4	45	113.0
-18	-0.4	14	57.2	46	114.8
-17	1.4	15	59.0	47	116.6
-16	3.2	16	60.8	48	118.4
-15	5.0	17	62.6	49	120.2
-14	6.8	18	64.4	50	122.0
-13	8.6	19	66.2	51	123.8
-12	10.4	20	68.0	52	125.6
-11	12.2	21	69.8	53	127.4
-10	14.0	22	71.6	54	129.2
-9	15.8	23	73.4	55	131.0

WEIGHT

Lbs	Kgs / Lbs	Kgs
2.2046	1	.45359
4	2	1
7	3	1
9	4	2
11	5	2
13	6	3
15	7	3
18	8	4
20	9	4
22	10	4
44	20	9
66	30	14
88	40	18
110	50	23
132	60	27
154	70	32
176	80	36
198	90	41
220	100	45
441	200	91
661	300	136
882	400	181
1102	500	227
1323	600	272
1543	700	318
1764	800	363
1984	900	408
2205	1000	454

FIGURE 1-20.

VOLUME AND WEIGHT OF AVIATION FUEL AND OIL CONVERSION

TABLES and CODES

VOLUME

Imp Gal	U.S. Gal/Imp Gal	U.S. Gal	U.S. Gal	Liter/U.S. Gal	Liter	U.S. Gal	Lbs/U.S. Gal	Liter
.83267	1	1.2010	.26418	1	3.7853	.21997	1	4.5460
2	2	2	1	2	8	.4	2	9
2	3	4	1	3	11	.7	3	14
3	4	5	1	4	15	.9	4	18
4	5	6	1	5	19	1	5	23
5	6	7	2	6	23	1	6	27
6	7	8	2	7	26	2	7	32
7	8	10	2	8	30	2	8	36
7	9	11	2	9	34	2	9	41
8	10	12	3	10	38	2	10	45
17	20	24	5	20	76	4	20	91
25	30	36	8	30	114	7	30	136
33	40	48	11	40	151	9	40	182
42	50	60	13	50	189	11	50	227
50	60	72	16	60	227	13	60	273
58	70	84	18	70	265	15	70	318
67	80	96	21	80	303	18	80	364
75	90	108	24	90	341	20	90	409
83	100	120	26	100	378	22	100	455
167	200	240	53	200	757	44	200	909
250	300	360	79	300	1136	66	300	1364
333	400	480	106	400	1514	88	400	1818
416	500	600	132	500	1893	110	500	2273
500	600	721	158	600	2271	132	600	2728
583	700	841	185	700	2650	154	700	3182
666	800	961	211	800	3028	176	800	3637
750	900	1081	238	900	3407	198	900	4091
833	1000	1201	264	1000	3785	220	1000	4546

OIL volume/weight (approximate according to Temp)

U.S. Gal	Lbs/U.S. Gal	Lbs	Liter	Lbs/Liter	Lbs	Liter	Kg / Liter	Kg
.13333	1	7.5000	.50471	1	1.9813	1.1127	1	.89871
.3	2	15	1.0	2	4	2	2	2
.4	3	22	1.5	3	6	3	3	3
.5	4	30	2.0	4	8	4	4	4
.7	5	38	2.5	5	10	6	5	5
.8	6	45	3.0	6	12	7	6	5
.9	7	52	3.5	7	14	8	7	6
1.1	8	60	4.0	8	16	9	8	7
1.2	9	68	4.5	9	18	10	9	8
1.3	10	75	5.0	10	20	11	10	9
3	20	150	10	20	40	22	20	18
4	30	225	15	30	59	33	30	27
5	40	300	20	40	79	44	40	36
7	50	375	25	50	99	56	50	45
8	60	450	30	60	119	67	60	54
9	70	525	35	70	139	78	70	63
11	80	600	40	80	158	89	80	72
12	90	675	45	90	178	100	90	81
13	100	750	50	100	198	111	100	90
27	200	1500	101	200	396	222	200	180
40	300	2250	151	300	594	334	300	270
53	400	3000	202	400	792	445	400	360
67	500	3750	252	500	991	556	500	449
80	600	4500	303	600	1189	668	600	539
93	700	5250	353	700	1387	779	700	629
107	800	6000	404	800	1585	890	800	719
120	900	6750	454	900	1783	1001	900	809
133	1000	7500	505	1000	1981	1113	1000	899

FIGURE 1-20. - Continued

VOLUME AND WEIGHT OF AVIATION FUEL AND OIL CONVERSION

TABLES and CODES

TURBINE FUEL volume/weight
(up to 5 pounds variation per 100 gallons due to fuel grade and temperature)

U.S. Gal	Lbs/U.S. Gal	Lbs	Liter	Lbs / Liter	Lbs	Liter	Kg / Liter	Kg
.15	1	6.7	0.57	1	1.8	1.25	1	.8
.3	2	13	11	2	3.6	2.5	2	1.6
.45	3	20	1.7	3	5.4	3.8	3	2.4
.6	4	27	2.3	4	7.2	5.0	4	3.2
.75	5	33	2.8	5	9.0	6.2	5	4.0
.9	6	40	3.4	6	11	7.5	6	4.8
1.05	7	47	4	7	13	8.8	7	5.6
1.2	8	53	4.5	8	14	10	8	6.4
1.35	9	60	5.1	9	16	11	9	7.2
1.5	10	67	5.7	10	18	12	10	8
3	20	130	11	20	36	25	20	16
4.5	30	200	17	30	54	38	30	24
6	40	270	23	40	72	50	40	32
7.5	50	330	28	50	90	62	50	40
9	60	400	34	60	110	75	60	48
10.5	70	470	40	70	130	88	70	56
12	80	530	45	80	140	100	80	64
13.5	90	600	51	90	160	110	90	72
15	100	670	57	100	180	120	100	80
30	200	1300	110	200	360	250	200	160
45	300	2000	170	300	540	380	300	240
60	400	2700	230	400	720	500	400	320
75	500	3300	280	500	900	620	500	400
90	600	4000	340	600	1100	750	600	480
105	700	4700	400	700	1300	880	700	560
120	800	5300	450	800	1400	1000	800	640
135	900	6000	510	900	1600	1100	900	720
150	1000	6700	570	1000	1800	1300	1000	800

AVIATION GAS volume/weight (approximate according to Temp)

Gal	Lbs/ Gal	Lbs	Liter	Lbs/Liter	Lbs	Liter	Kg / Liter	Kg
.167	1	6.00	.631	1	1.58	1.39	1	.719
.3	2	12	1	2	3	3	2	1
.5	3	18	2	3	5	4	3	2
.7	4	24	2	4	6	6	4	3
.8	5	30	3	5	8	7	5	4
1.0	6	36	4	6	10	8	6	4
1.2	7	42	4	7	11	10	7	5
1.3	8	48	5	8	13	11	8	6
1.5	9	54	6	9	14	12	9	6
1.7	10	60	6	10	16	14	10	7
3	20	120	13	20	32	28	20	14
5	30	180	19	30	48	42	30	22
7	40	240	25	40	63	56	40	29
8	50	300	32	50	79	70	50	36
10	60	360	38	60	95	83	60	43
12	70	420	44	70	111	97	70	50
13	80	480	50	80	127	111	80	58
15	90	540	57	90	143	125	90	65
17	100	600	63	100	158	139	100	72
33	200	1200	126	200	317	278	200	144
50	300	1800	189	300	476	417	300	216
67	400	2400	252	400	634	556	400	288
83	500	3000	315	500	793	695	500	359
100	600	3600	378	600	951	834	600	431
117	700	4200	442	700	1110	974	700	503
133	800	4800	505	800	1268	1113	800	575
150	900	5400	568	900	1427	1252	900	647
167	1000	6000	631	1000	1585	1391	1000	719

FIGURE 2-2. CANADIAN EAST COAST CHAIN - 5930 LORAN-C COVERAGE

LEGEND:
——— LIMITS OF COVERAGE.

ID	● TRANSMITTER	POWER (KW)
M	CARIBOU	790
X	NANTUCKET	400
Y	CAPE RACE	1030
Z	FOX HARBOUR	800

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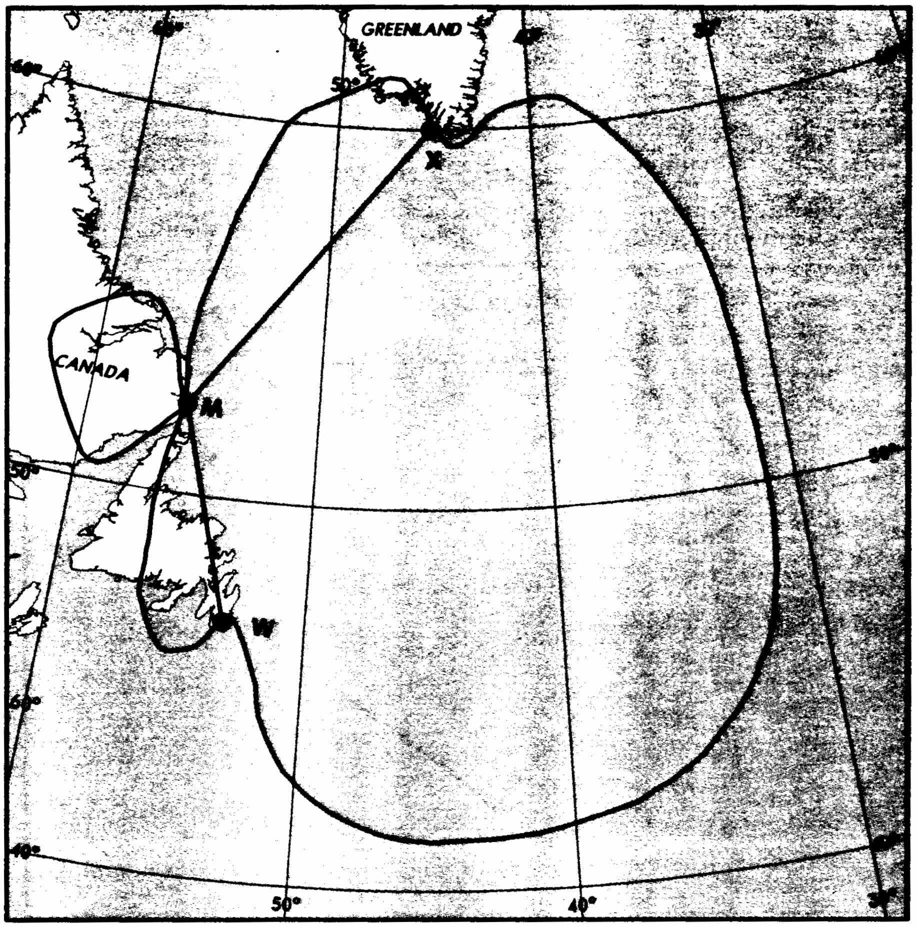
FIGURE 2-3. LABRADOR SEA CHAIN - 7930 LORAN-C COVERAGE



LEGEND:

——— LIMITS OF COVERAGE.

ID	● TRANSMITTER	POWER (KW)
M	FOX HARBOR	800
W	CAPE RACE	1030
X	ANGISSOQ	760

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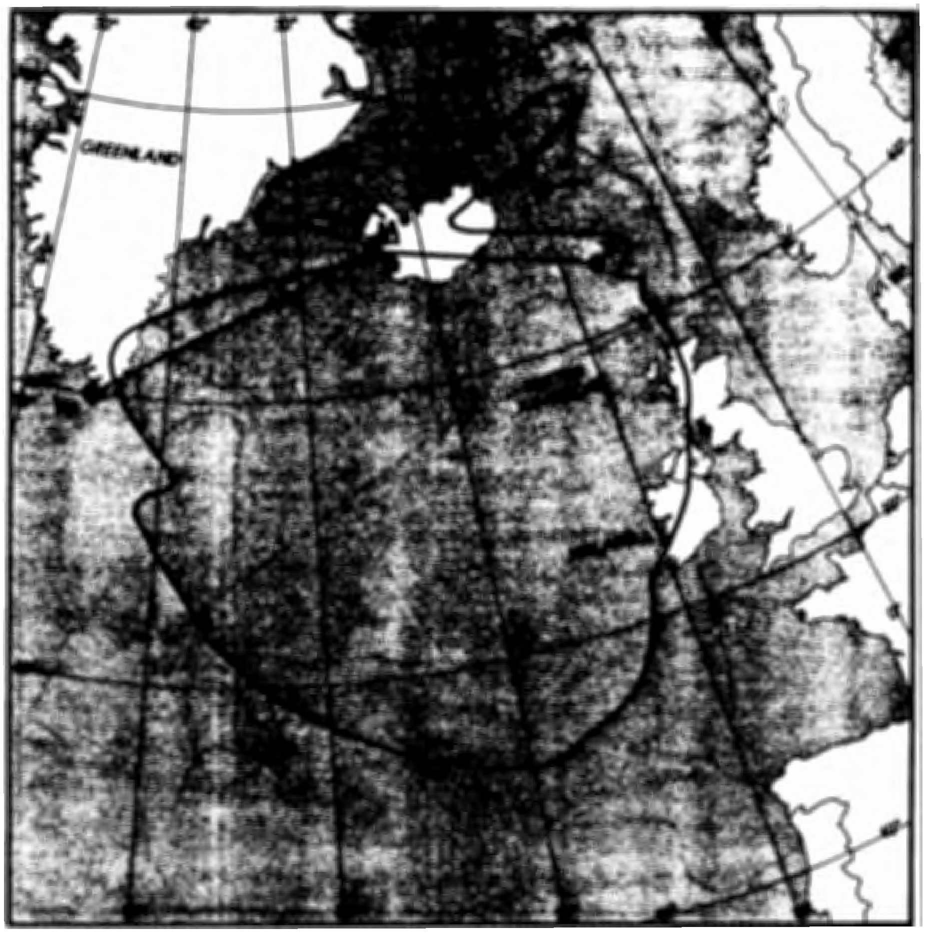
FIGURE 2-4. ICELANDIC CHAIN - 9980 LORAN-C COVERAGE



LEGEND:

——— LIMITS OF COVERAGE.

ID	● TRANSMITTER	POWER (KW)
M	SANDUR	1500
W	ANGISSOQ	760
X	EJDE	400

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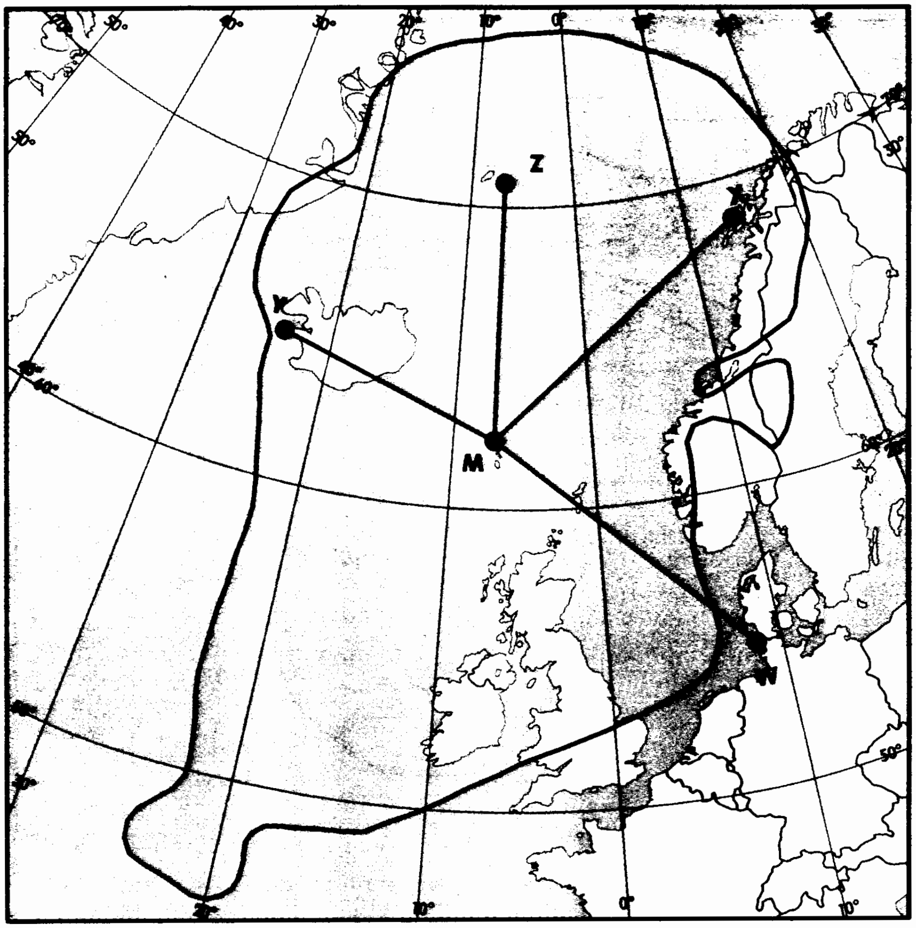
FIGURE 2-5. NORWEGIAN SEA CHAIN - 7970 LORAN-C COVERAGE



LEGEND:

—— LIMITS OF COVERAGE.

ID	● TRANSMITTER	POWER (KW)
M	EJDE	400
W	BO	165
X	SYLT	275
Y	SANDUR	1500
Z	JAN MAYEN	165

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APPENDIX 3. BIBLIOGRAPHY

TITLE	SOURCE
1. Operations of Civil Aircraft of U.S. Registry Outside of the U.S. FAR 91.703	Code of Federal Regulations (CFR) Supt. of Documents, U.S. Government Printing Office (GPO) Washington, DC 20402
2. Operations Within North Atlantic MNPS Airspace FAR 91.705	CFR
3. Survival Equipment for Overwater Operations FAR 91.509	CFR
4. Radio Equipment for Overwater Operations FAR 91.511	CFR
5. Flight Navigator and Specialized Navigation Equipment FAR 121.389	CFR
6. Crewmember Certificate: International Flight Navigator FAR 121.721	CFR
7. Doppler Radar and Inertial Navigation Systems FAR Part 121 Appendix G	CFR
8. Emergency Equipment: Extended Overwater Operations FAR 125.209	CFR
9. Flight Navigator and Long-Range Navigation Equipment FAR 125.267	CFR
10. Crewmembers Certificate: International Operations: Application and Issuance FAR 135.43	CFR
11. Radio and Navigational Equipment: Extended Overwater or IFR Operations FAR 135.165	CFR
12. Emergency Equipment: Extended Overwater Operations FAR 135.167	CFR
13. Flight Operations in Oceanic Airspace AC 90-76B	Advisory Circular (AC) Supt. of Documents, U.S. GPO
14. Recommended Practices and Procedures for the Use of Electronic Long-Range Navigation Equipment AC 90-79	AC

APPENDIX 3. BIBLIOGRAPHY - Continued

TITLE	SOURCE
15. General Aviation Procedures for Flight in North Atlantic Minimum Navigation Performance Specifications Airspace AC 91-49	AC
16. Operational Approval of Airborne Long-Range Navigation Systems for Flight Within the North Atlantic Minimum Navigation Performance Specifications Airspace AC 120-33	AC
17. Emphasis on Long-Range Navigation Procedures as They Relate to Collision Avoidance ACOB 8-87-2	Air Carrier Operations Bulletin (ACOB) FAA - AFS-552 P. O. Box 20034 Washington, DC 20041
18. Canada Aeronautical Information Publication (AIP)	AIP Transport Canada Aeronautical Information Services Publication and Distribution (AANDHD) Ottawa, Canada K1A 0N8
19. Canada Flight Supplement (CFS)	CFS Transport Canada Canada Map Office Dept. of Energy, Mines and Resources 615 Booth Street Ottawa, Canada K1A 0E9
20. Transport Canada International General Aviation (IGA) Aircraft Transatlantic Flight Requirements Pamphlet	IGA Pamphlet Aviation Licensing Branch P. O. Box 42 Moncton, New Brunswick Canada E1C8K6
21. Rules of the Air (ICAO Annex 2)	International Civil Aviation Organization ATT: Document Sales Unit 1000 Sherbrooke Street West, Suite 400 Montreal, Quebec Canada H3A 2R2
22. Operation of Aircraft	ICAO Annex 6
23. Air Traffic Services	ICAO Annex 11
24. Search and Rescue	ICAO Annex 12
25. North Atlantic MNPS Operations Manual	Utilization and Storage Section M-443.2 U.S. Dept. of Trans. 400 7th Street SW. Washington, DC 20590
26. U. S. Airman's Information Manual (AIM)	AIM Supt. of Documents, U.S. GPO
27. U. S. International Flight Information Manual (IFIM)	IFIM Supt. of Documents, U.S. GPO

APPENDIX 3. BIBLIOGRAPHY - Continued—Continued

TITLE	SOURCE
28. U. S. Aeronautical Information Publication (AIP)	AIP Supt. of Documents, U.S. GPO
29. Culturgrams	Brigham Young University David M. Kennedy Center for International Studies Publication Services 280 HRCB Provo, Utah 84602
30. Technical Standards Orders	Department of Transportation Personal Property Operations Branch Utilization and Storage Section M-443.2 Washington, DC 20590

APPENDIX 4. TERMINOLOGY

U.S. GLOSSARY DEFINITIONS

Accuracy - In navigation, the accuracy of an estimated or measured position of a craft (vehicle, aircraft, or vessel) at a given time is the degree of conformance of the measured position with the true position of the craft at that time. Since accuracy is a statistical measure of performance, a statement of the accuracy of a navigation system is meaningless unless it includes a statement of the applicable uncertainty in position.

AFM - Means Federal Aviation Administration (FAA) approved airplane flight manual. This entire document is FAA approved and must be carried on all aircraft certificated under Federal Aviation Regulation (FAR) Part 25. The AFM contains operating procedures and limitations for the airplane and engine combination, as well as for all installed appliances, and must be readily accessible to the flightcrew during all operations.

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

Anywhere fix - The ability of a receiver to start position calculations without being given an approximate location and approximate time.

Area navigation (RNAV) - Application of the navigation process providing the capability to establish and maintain a flight path on any chosen course that remains within the coverage area of the type of navigation sources being used. RNAV utilizing capabilities in the horizontal plane only is called 2D RNAV, while RNAV which also incorporates vertical guidance is called 3D VNAV. Time navigation (TNAV) may be added to either 2D or 3D systems. TNAV added to a 3D system is called 4D.

ARINC - An acronym for Aeronautical Radio Inc., a corporation largely owned by a group of airlines. ARINC is licensed by the Federal Communication Commission (FCC) as an aeronautical station, and contracted by the FAA to provide communication support for air traffic control (ATC) and meteorological services in portions of international airspace.

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

Bandwidth - The range of frequencies in a signal.

C/A code - The standard (course/acquisition) global positioning system (GPS) code - a sequence of 1023 pseudo-random, binary, biphase modulation on the GPS carrier at a chip rate of 1.023 megahertz (MHz). Also known as the "civilian code."

Cabotage - The Standard Dictionary of the English language defines cabotage (for flight purposes) as "air transport of passengers and goods within the same national territory." The definition adopted by International Civil Aviation Organization [ICAO] at the Chicago Convention is, "Each state shall have the right to refuse permission to the aircraft of other contracting states to take on its territory passengers, mail, and cargo destined for another point within its territory."

Capacity - The number of system users that can be accommodated simultaneously.

Carrier - A signal that can be varied from a known reference by modulation

APPENDIX 4. TERMINOLOGY - Continued

U.S. GLOSSARY DEFINITIONS

Carrier aided tracking - A signal processing strategy that uses the GPS carrier signal to achieve an exact lock on the pseudo random code. This is more accurate than the standard approach.

Carrier frequency - The frequency of the unmodulated fundamental output of a radio transmitter.

Channel - A channel of a GPS receiver consists of the circuitry necessary to tune the signal from a single GPS satellite.

Chip - The transition time for individual bits in the pseudo-random sequence. Also, an integrated circuit.

Circular error probable (CEP) - A U.S. Department of Defense (DOD) specification in terms of accuracy. CEP is defined as the radius of a circle containing 50 percent of all possible fixes. Specification of radio navigation system accuracy generally refer to one or more of the following definitions.

a. *Predictable accuracy:* the accuracy (in NM or feet) of a position with respect to geographic or geodetic coordinates of the Earth. Predictable accuracy is also known as geodetic or absolute accuracy.

b. *Repeatable accuracy:* the accuracy (in feet) with which a user can return to a position whose coordinates have been measured at a previous time with the same navigation system.

c. *Relative accuracy:* the accuracy (in feet) with which a user can measure position relative to that of another user of the same navigation system at the same time. This may be expressed also as a function of the distance between two users. Relative accuracy may also refer to the accuracy with which a user can measure position relative to his own position in the recent past. For example, the present position of a craft whose desired track forms a specific geometric pattern on search operations will be measured generally with respect to a previously determined datum.

Class I airspace - Short-range navigation within the limits of the operational service volume of ground-based navigational aids (navaids).

Class II airspace - Long-range navigation beyond the limits of the operational service volume of ground-based navaids.

Clock bias - The difference between the clock's indicated time and true universal time.

Coast-out fix - A navaid (or intersection "fix"), sometimes called a coastal fix or gateway fix, whereby an aircraft transitions between the domestic route structure and the oceanic route structure, such as an organized track system (OTS) or air traffic service (ATS) volume of ICAO standard navaids.

Control segment - A world-wide network of GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks.

Convergence - A term used by controllers relative to the lateral separation of aircraft. Aircraft are determined to be converging if their lateral separation is becoming narrower in width.

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 user to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions, surface conductivity, and other factors affecting signal availability.

Crosstrack error - The perpendicular deviation that the airplane is to the left or right of the desired track.

Cycle slip - A discontinuity in the measured carrier beat phase resulting from a temporary loss-of-lock in the carrier tracking loop of a GPS receiver.

APPENDIX 4. TERMINOLOGY - Continued

U.S. GLOSSARY DEFINITIONS

Data message - A message included in the GPS signal which reports the satellite's location, clock corrections, and health. Included is rough information on the other satellites in the constellation.

db - An abbreviation for decibels. It is a unit of relative power, voltage, or current, plotted on a logarithmic scale. An increase (or decrease) of 10 db means that something is either double (or half) of the original value. Db are used to compare one relative value to another.

Dead reckoning (DR) - Is a method of estimating the position of an aircraft without astronomical observations, based upon a previous known position and an estimate of the course and distance travelled within a given time increment. An estimation of the winds aloft is an integral part of the DR process.

Differential positioning - Precise measurement of the relative positions of two receivers tracking the same GPS signals.

Dilution of precision (DOP) - The multiplicative factor that modifies ranging error. It is caused solely by the geometry between the user and his/her set of satellites. Known as DOP or geometric dilution of precision (GDOP).

Domestic airspace - Airspace overlying the continental land mass of the United States, Alaska, Hawaii, and U.S. possessions. Domestic airspace extends to 12 nautical miles (NM) offshore.

Doppler aiding - A signal processing strategy that uses a measured Doppler shift to help the receiver smoothly track the GPS signal. Allows more precise velocity and position measurement.

Doppler shift - The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver.

Drms - Refers to the "distance root mean square error." This fundamental parameter is the building block to the most common measure of navigation fix accuracy, "two (2) Drms."

En route - A phase of navigation covering operations between departure and arrival terminal phases.

Ephemeris - The predictions of current satellite position that are transmitted to the user in the data message.

Extended overwater - FAR Part 1 defines "extended overwater operation" for airplanes as an operation overwater at a horizontal distance of more than 50 NM from the nearest shoreline; and for helicopters, as an operation overwater at a horizontal distance of more than 50 NM from the nearest shoreline or more than 50 NM from an offshore heliport structure.

Fast-multiplexing channel (FMC) - A single channel which rapidly samples a number of satellite ranges. "Fast" means that the switching time is sufficiently fast (2 to 5 milliseconds) to recover the data message.

Frequency band - A particular range of frequencies.

Frequency spectrum - The distribution of signal amplitudes as a function of frequency.

Fix dimensions - This characteristic defines whether the navigation system provides a linear, one-dimensional line of position, two-dimensional, or three-dimensional position fix. The ability of the system to derive a fourth dimension (e.g., time) from the navigational signals is also included.

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

Gateway fix - See "Coast-out fix."

APPENDIX 4. TERMINOLOGY

U.S. GLOSSARY DEFINITIONS

GDOP - Refers to geometric dilution of precision. The degree of uncertainty of a position fix with respect to the crossing angles of the lines of position (LOP).

Global Positioning System (GPS) - A long-range navigation system based on a constellation of 24 satellites orbiting the earth at a very high altitude that provide signals which through triangulation can identify a precise location.

Gross navigational error (GNE) - Pilots are expected to fly their aircraft along the centerline of their assigned route and to stay within the accuracy limits of their installed navigation systems. (For example, the accuracy tolerance limits for Loran-C equipment used in instrument flight rules (IFR) oceanic navigation is 5.8 NM). If an aircraft becomes off-course, it is usually for one of the following reasons; a ''loop'' (or communications) error between the pilot and the controller, a pilot intentionally entering a waypoint which is not along the assigned route of flight (e.g., a pilot deviation due to weather without prior ATC approval or without declaring an emergency), an unintentionally entered waypoint not along the assigned route, and a navigational equipment error or failure. Navigational errors that are greater than 20 NM are investigated by the various countries that provide ATC service.

Handlers - Individuals within specific countries who may be hired to accompany a flight and take care of the unique regulatory and cultural requirements associated with a flight into a foreign country. These individuals are locals who know the procedures and can assist in clearing customs, immigration, and airport security. These individuals also have varying degrees of expertise on other matters such as lodging, rental cars, flight restrictions, passenger ground travel, local prohibitions, health problems, etc.

High seas - Any body of water outside the 12 NM limit.

Handover word - The word in the GPS message that contains synchronization information for the transfer of tracking from the C/A to P-code.

IFR navigation - Navigation by electronic means or by use of a flight navigator. Navigation techniques may include use of ICAO standard navaids supplemented by accurate DR, pilot- operated electronic long-range navigation equipment, or use of a flight navigator. IFR oceanic (en route) navigation requires that the aircraft adhere to a particular level of navigational accuracy.

Independent fix - An independent fix means that a position does not depend on a previous or following measurement.

Independent receiver function - ''Independent'' means that the function of any part of a receiver does not depend upon the functioning of any part of another unit. Today's receivers can be single-sensor, multisensor, or ''embedded'' as part of a multifunction flight management (and navigation) system (FMS). A combined communication-navigation (com/nav) system meets the requirements for an independent navigation receiver.

Inertial navigation system (INS) - An RNAV system which is a form of self-contained navigation. See ''Area navigation (RNAV).''

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

Ionosphere - The band of charged particles 80 to 120 miles above the earth's surface.

Ionospheric refraction - The change in the propagation speed of a signal as it passes through the ionosphere.

L-band - The group of radio frequencies extending from 390 MHz to 1550 MHz. The GPS carrier frequencies (1227.6 MHz and 1575.42 MHz) are in the L-band.

APPENDIX 4. TERMINOLOGY - Continued

U.S. GLOSSARY DEFINITIONS

Minimum navigation performance specifications (MNPS) - A set of standards which require aircraft to have a minimum navigation performance capability in order to operate in MNPS designated airspace. In addition, aircraft must be certified by their state of registry for MNPS operation.

MNPS airspace - Designated airspace where MNPS procedures are applied between MNPS certified and equipped aircraft. MNPS airspace is located over certain areas of the North Atlantic (NAT) and over Northern Canada. An example is NAT MNPS airspace. This airspace is defined as the volume of airspace between flight level (FL) 275 and FL 400 bounded by certain geographical coordinates. To obtain MNPS approval, each operator must show compliance with the following conditions:

a. each aircraft is suitably equipped and capable of meeting MNPS standards;

b. operating procedures are established which ensure that MNPS standards are met; and

c. flightcrews are capable of operating with sufficient precision to consistently meet MNPS requirements and are aware of the emergency procedure specific to MNPS airspace.

Multichannel receiver - A GPS receiver that can simultaneously track more than one satellite signal.

Multipath error - Errors caused by the interference of a signal that has reached the receiver antenna by two or more different paths. Usually caused by one path being bounced or reflected.

Multiplexing channel - A channel of a GPS receiver that can be sequenced through a number of satellite signals.

Navigation - The means by which an aircraft is given guidance to travel from one known position to another known position.

Navigation guidance - The calculation of steering commands to maintain the desired track from the present aircraft position to a new position.

Navigation information - Aircraft parameters such as position, velocity vector and related data such as track angle, ground speed, and drift angle used for navigation guidance.

Navaids - Are visual or electrical devices which may be used while airborne or on the surface, which provides point-to-point guidance information or position data to an aircraft in flight. Examples of standard ICAO navaids include very high frequency (VHF) omnidirectional range (VOR), with or without distance measuring equipment (DME), and nondirectional ground-based beacons (NDB).

NM or nm - means distance measured in nautical miles. One nautical mile is equivalent to 6,080.27 feet and is the fundamental measurement unit used in both sea and air navigation. It is based on the length of a minute of arc along an arc of a great circle around the Earth.

Oceanic airspace - Airspace over the oceans of the world, considered international airspace, where ICAO oceanic separation and procedures are applied. Responsibility for the provisions of ATC service in this airspace is delegated to various countries based generally upon geographic proximity and the availability of the required resources.

Oceanic airspace - Airspace over the oceans of the world is considered international airspace where aircraft separation and air traffic procedures are standardized by ICAO. The responsibility for ATS in oceanic airspace is delegated to the various ICAO member States according to geographic proximity and availability of the required resources. Specific procedures are defined by ICAO Document 7030.

APPENDIX 4. TERMINOLOGY - Continued

U.S. GLOSSARY DEFINITIONS

Oceanic navigational error report (ONER) - A report filed when an aircraft exiting oceanic airspace has been observed by radar to be off course. ONER reporting parameters and procedures are contained in FAA Order 7110.82, "Monitoring of Navigational Performance in Oceanic Areas."

Offshore airspace - The airspace between the United States' 12 NM limit and the oceanic flight information region (FIR) boundary. An alternate definition is "within the limits of conventional land-based navaids."

Omega - An RNAV system designed for long-range navigation based upon ground-based electronic navaid signals.

Operational service volume - Defines the reception limits of VOR/DME and NDB navaids which are usable for random/unpublished route navigation and which are flight checked periodically to reconfirm these limits of coverage. The operational service volume of NDB's used in oceanic navigation; i.e., beyond the 75 NM standard service volume, must be individually flight checked and identified as such on the appropriate charts before they can be used for navigation.

Overwater - Section 91.511 of the FAR defines "overwater" as more than 30 minutes flying time or 100 NM from the nearest shore. This definition differs from the "extended overwater" definition found in FAR Part 1.

P-code - The precise or protected code. A very long sequence of pseudo-random binary biphase modulations on the GPS carrier at a chip rate of 10.23 MHz which repeats approximately every 267 days. Each 1 week segment of this code is unique to one GPS satellite and is reset each week.

Parallel offset path - A desired track parallel to, and left or right of, the "parent" track specified in nautical miles of offset distance.

Parent track - The planned track between two waypoints.

Parent waypoint - A waypoint used for route definition or progress reporting. The geographical position of a parent waypoint is not altered when RNAV equipment is operating in a parallel offset mode.

Pilotage - Aerial navigation by means of visual identification of landmarks.

POH - Pilot's Operating Handbook. The POH is the result of a 1976 industry-developed specification for the operation of FAR Part 23 certificated aircraft. Only Sections I and II of the POH are FAA-approved. These sections contain operating limitations for the airframe and engine combination. Section IX of the POH also contains additional operating instructions and FAA-approved limitations for all supplemental installed equipment, including Loran-C. Some type certificates issued for airplanes manufactured after 1977-1978 require that the POH be carried on the airplane (and therefore accessible to the pilot during flight) as a condition to meeting its type design.

Precise positioning service (PPS) - The most accurate dynamic positioning possible with GPS, based on the dual frequency P-code.

Primary navigation - See "Sole means of navigation." A "primary means" system is not required to reference a magnetic compass as it is totally independent of all other reference systems.

Pseudolite - A ground-based differential GPS receiver which transmits a signal like that of an actual GPS satellite and can be used for ranging. The data portion of the signal contains the differential corrections that can be used by other receivers to correct for GPS errors.

Pseudorandom code - A signal with random-noise like properties. It is a very complicated but repeated pattern of 1's and 0's.

APPENDIX 4. TERMINOLOGY - Continued
U.S. GLOSSARY DEFINITIONS

Pseudorange - A distance measurement based on the correlation of a satellite transmitted code and the local receiver's reference code, that has not been corrected for errors in synchronization between the transmitter's clock and the receiver's clock.

P-static - Is precipitation static, a form of background noise caused by rain, hail, snow, or dust storms in the vicinity of a receiving antenna, and measured at frequencies less than 10 MHz.

Reliability - The reliability of a navigation system is a function of the frequency that 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 operating conditions. Formally, reliability is one minus the probability of system failure.

Route - A defined path, consisting of a course in the horizontal plane, which aircraft transverse over the surface of the earth.

Satellite constellation - The arrangement in space of a set of satellites.

Selcal - Selective calling, a term used by the chart services on high/low altitude charts and others to indicate specific frequencies available for aircraft with selcal installed to be contacted on demand.

Self-contained navigation - Systems which are not dependent on external navigation sources on a continuous basis to determine position or navigation track. Self-contained navigation systems must be updated periodically with station-referenced or earth-referenced navigation systems to maintain their accuracy.

SNR - Signal-to-noise ratio. SNR is the ratio of the radio field intensity of a received radio wave to the radio noise field intensity received along with that signal.

Sole means air navigation systems - An approved navigation system that can be used for specific phases of air navigation without the need for any other navigation source.

Space segment - The part of the whole GPS system that includes the satellites and the launch vehicles.

Spread spectrum - A system in which the transmitted signal is spread over a frequency band much wider than the minimum band-width needed to transmit the information being sent. For GPS, this is done by modulating the carrier with a pseudo-random code.

Standard positioning service (SPS) - The normal civilian positioning accuracy obtained by using the single frequency C/A code.

State aircraft - Aircraft used exclusively in the service of any government or of any political subdivision thereof, including the government of any state, territory, or possession of the United States or the District of Columbia, but not including any government-owned aircraft engaged in carrying persons or property for commercial purposes.

Static positioning - Location determination when the receiver's antenna is presumed to be stationary in the earth. This allows the use of various averaging techniques that improve accuracy by factors of over 100.

Station referenced navigation - Position determination which is referenced to a stationary source.

Strap-down navigation equipment - Navigation equipment that is temporarily installed in an aircraft, usually for the purpose of ferry flights. The installation is FAA approved for "form, function and fit" and placed on FAA Form 337.

Supplemental air navigation system - An approved navigation system that can be used in conjunction with a sole-means navigation system.

APPENDIX 4. TERMINOLOGY - Continued
U.S. GLOSSARY DEFINITIONS

Standard service volume - Defines the reception limits of VOR/DME and NDB ground-based navaids which are usable for random/unpublished route navigation. Standard service volume is a calculated value that has not been flight checked. Coverage limits for VOR/DME systems are published in the ''Federal Radio-navigation Plan,'' published biennially by the FAA and available to the pilot community.

Statistical measure of accuracy - Navigation system errors generally follow a known error distribution. Therefore, the uncertainty in position can be expressed as the probability that the error will not exceed a certain amount. A thorough treatment of errors is complicated by the fact that the total error is comprised of errors caused by instability of the transmitted signal, effects of weather and other physical changes in the propagation medium, errors in the receiving equipment, and errors introduced by the human navigator. In specifying or describing the accuracy of a system, human errors usually are excluded. Further complications arise because some navigation systems are linear (one-dimensional) while others provide two or three dimensions of position. When specifying linear accuracy, or when it is necessary to specify requirements in terms of orthogonal axes (e.g., along-track or crosstrack), the 95 percent (or two fl) confidence level is used. Vertical or bearing accuracies is specified in one-dimensional terms at the two fl, or 95 percent, confidence level. When two-dimensional accuracies are used, the 2 Drms (distance root mean square) uncertainty estimate is employed. Two Drms is twice the radial error or 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. It is often found by first defining an arbitrarily-oriented set of perpendicular axes, with the origin at the true location point. The variances around each axis are then found, summed, and the square root computed. When the distribution of errors is elliptical, as it often is for stationary ground-based systems, these axes can be taken for convenience as the major and minor ellipse. Then the confidence level depends on the elongation of the error ellipse. The range of confidence levels is from 95 to 99 percent. As the error ellipse collapses to a line, the confidence level of the 2 Drms measurement approaches 95 percent.

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

User interface - The way a receiver conveys information to the person using it. The controls and displays.

User segment - The part of the whole GPS system that includes the receivers of GPS signals.

VFR navigation - Navigation by pilotage (i.e., DR) or electronic means. There are no published accuracy standards for visual flight rules (VFR) oceanic (en route) navigation.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Aircraft - Device(s) that are used or intended to be used for flight in the air, and when used in ATC terminology, may include the flightcrew.

[ICAO] Aircraft - Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

Airport elevation - The highest point of an airport's usable runways measured in feet from mean sea level (MSL). See "Touchdown Zone."

[ICAO] Aerodrome elevation - The elevation of the highest point of the landing area.

Airport rotating beacon - A visual navaid operated at many airports. At civil airports, alternating white and green flashes indicate the location of the airport. At military airports, the beacons flash alternately white and green, but are differentiated from civil beacons by dual-peaked (two quick) white flashes between the green flashes. See "Special VFR operations" and/or "Instrument flight rules." (Refer to Airman's Information Manual (AIM), "Rotating Beacons")

[ICAO] Aerodrome beacon - Aeronautical beacon used to indicate the location of an aerodrome from the air.

Airport traffic control service - A service provided by a control tower for aircraft operating on the movement area and in the vicinity of an airport. See "Movement Area" and/or "Tower."

[ICAO] Aerodrome control service - ATC service for aerodrome traffic.

Air traffic - Aircraft operating in the air or on an airport surface, exclusive of loading ramps and parking areas.

[ICAO] Air traffic - All aircraft in flight or operating on the maneuvering area of an aerodrome.

Air traffic clearance - An authorization by ATC, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace. See "ATC instructions."

[ICAO] Air traffic control (ATC) clearance - Authorization for an aircraft to proceed under conditions specified by an ATC unit.

NOTE 1: For convenience, the term "ATC clearance" is frequently abbreviated to "clearance" when used in appropriate contexts.

NOTE 2: The abbreviated term clearance may be prefixed by the words taxi, takeoff, departure, en route, approach, or landing to indicate the particular portion of flight to which the ATC clearance relates.

Air traffic control (ATC) - A service operated by an appropriate authority to promote the safe, orderly and expeditious flow of air traffic.

[ICAO] Air traffic control (ATC) service - A service provided for the purpose of:

a. preventing collisions
   - between aircraft; and
   - on the maneuvering area between aircraft and obstructions; and

b. expediting and maintaining an orderly flow of air traffic.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Air traffic control (ATC) specialist - A person authorized to provide ATC service. See "Air traffic control" and/or "Flight service station."

[ICAO] Controller - A person authorized to provide ATC services.

Airway - A CTA or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids. See "Federal airways." (Refer to FAR Part 71, AIM)

[ICAO] Airway - A CTA or portion thereof established in the form of corridor equipped with radio navigational aids.

Alternate airport - An airport at which an aircraft may land if a landing at the intended airport becomes inadvisable.

[ICAO] Alternate aerodrome - An aerodrome specified in the flight plan to which a flight may proceed when it becomes inadvisable to land at the aerodrome of intended landing.

NOTE: An alternate aerodrome may be the aerodrome of departure.

Altitude - The height of a level, point, or object measured in feet above ground level (AGL) or from MSL. See "Flight level."

a. MSL altitude is altitude expressed in feet measured from MSL.
b. AGL altitude is altitude expressed in feet measured AGL.
c. Indicated altitude is the altitude as shown by an altimeter. On a pressure or barometric altimeter it is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions.

[ICAO] Altitude - The vertical distance of a level, a point or an object considered as a point, measured from MSL.

Approach control service - ATC service provided by an approach control facility for arriving and departing VFR/IFR aircraft and, on occasion, en route aircraft. At some airports not served by an approach control facility, the air route traffic control center (ARTCC) provides limited approach control service. (Refer to AIM)

[ICAO] Approach control service - ATC service for arriving or departing controlled flights.

Approach sequence - The order in which aircraft are positioned while on approach or awaiting approach clearance.

[ICAO] Approach sequence - The order in which two or more aircraft are cleared to approach to land at the aerodrome.

Apron - A defined area on an airport or heliport intended to accommodate aircraft for purposes of loading and unloading passengers or cargo, refueling, parking, or maintenance. With regard to seaplanes, a ramp is used for access to the apron form the water.

[ICAO] Apron - A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, refuelling, parking or maintenance.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Area navigation (RNAV) - A method of navigation that permits aircraft operation on any desired course within the coverage of station-reference navigation signals or within the limits of a self-contained system capability. Random area navigation routes are direct routes, based on area navigation capability, between waypoints defined in terms of latitude/longitude coordinates, degree/distance fixes, or offsets from published or established routes/airways at a specified distance and direction. The major types of equipment are described below.

a. VORTAC referenced or course line computer (CLC) systems, which account for the greatest number of RNAV units in use. To function, the CLC must be within the service range of a VORTAC.

b. Omega/VLF, although two separate systems, can be considered as one operationally. A long-range navigation system based upon very low frequency radio signals transmitted from a total of 17 stations worldwide.

c. INS are systems that are totally self-contained and require no information in response to signals resulting from internal effects on components within the system.

d. MLS area navigation (MLS/RNAV) provides area navigation with reference to an MLS ground facility.

e. Loran-C is a long-range radio navigation system that uses ground waves transmitted at low frequency to provide user position information at ranges of up to 600 to 1,200 NM at both en route and approach altitudes. The usable signal coverage areas are determined by the signal-to-noise ratio, the envelope-to-cycle difference, and the geometric relationship between the positions of the user and the transmitting stations.

[ICAO] **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.

Automatic terminal information service (ATIS) - The continuous broadcast of recorded non-control information in selected terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of essential but routine information; e.g., "Los Angles information alpha. One three zero zero coordinated universal time. Weather, measured ceiling two thousand overcast, visibility three, haze, smoke, temperature seven one, dew point five seven, wind two five zero at five, altimeter two niner niner six. I-L-S runway two five left approach in use, runway two five right closed, advise you have alpha." (Refer to AIM)

[ICAO] **Automatic terminal information service** - The provision of current, routine information to arriving and departing aircraft by means of continuous and repetitive broadcasts throughout the day or a specified portion of the day.

Blind speed - The rate of departure or closing of a target relative to the radar antenna at which cancellation of the primary radar target by moving target indicator (MTI) circuits in the radar equipment causes a reduction or complete loss of signal.

[ICAO] **Blind velocity** - The radial velocity of moving target such that the target is not seen on primary radars fitted with certain forms of fixed echo suppression.

Broadcast - Transmission of information for which an acknowledgement is not expected.

[ICAO] **Broadcast** - A transmission of information relating to air navigation that is not addressed to a specific station or stations.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Ceiling - The height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as "broken," "overcast," or "obscuration," and not classified as "thin" or "partial."

[ICAO] Ceiling - The height above the ground or water of the base of the lowest layer of cloud below 6,000 meters (20,000 feet) covering more than half the sky.

Clearance limit - The fix, point, or location to which an aircraft is cleared when issued an air traffic clearance.

[ICAO] Clearance limit - The point of which an aircraft is granted an ATC clearance.

Clearance void if not off by (time) - Used by ATC to advise an aircraft that the departure clearance is automatically canceled if takeoff is not made prior to a specified time. The pilot must obtain a new clearance or cancel his IFR plan if not off by the specified time.

[ICAO] Clearance void time - A time specified by an ATC unit at which a clearance ceases to be valid unless the aircraft concerned has already taken action to comply therewith.

Clutter - In radar operations, clutter refers to the reception and visual display of radar returns caused by precipitation, chaff, terrain, numerous aircraft targets, or other phenomena. Such returns may limit or preclude ATC from providing services based on radar. See "Target."

[ICAO] Radar clutter - The visual indication on a radar display of unwanted signals.

Compass locator - A low power, low or medium frequency (L/MF) radio beacon installed at the site of the outer or middle marker of an instrument landing system (ILS). It can be used for navigation at distances of approximately 15 miles or as authorized in the approach procedure.

a. Outer compass locator (LOM) is a compass locator installed at the site of the outer marker of an instrument landing system.

b. Middle compass locator (LMM) is a compass locator installed at the site of the middle marker of an instrument landing system.

[ICAO] Locator - an LM/MF NDB used as an aid to final approach.

NOTE: A locator usually has an average radius of rated coverage of between 18.5 and 46.3 km (10 and 25 NM).

Cruising altitude - An altitude or FL maintained during en route level flight. This is a constant altitude and should not be confused with a cruise clearance. See "Altitude."

[ICAO] Cruising level - A level maintained during a significant portion of a flight.

[ICAO] Danger area - An airspace of defined dimensions within which activities dangerous to the flight of aircraft may exist at a specified times.

NOTE: The term "Danger Area" is not used in reference to areas within the United States or any of its possessions or territories.

Decision height (DH) - With respect to the operation of aircraft, means the height at which a decision must be made during an ILS, MLS, or precision approach radar (PAR) instrument approach to either continue the approach or to execute a missed approach.

APPENDIX 4. TERMINOLOGY - Continued
A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

[ICAO] Decision altitude (DA)/Decision height (DH) - A specified altitude or height (A/H) in the precision approach at which a missed approach must be initiated of the required visual reference to continue the approach has not been established.

NOTE 1: DA is referenced to MSL, and DH is referenced to the threshold elevation.

NOTE 2: The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have an assessment of the aircraft position and rate of change of position, in relation to the flight path.

[ICAO] Estimated elapsed time - The estimated time required to proceed form one significant point to another. See "Total estimated elapsed time."

[ICAO] Estimated off-block time - The estimated time at which the aircraft will commence movement associated with departure.

Final approach - IFR - The flight path of an aircraft which is inbound to an airport on a final instrument approach course, beginning at the final approach fix or point and extending to the airport or the point where a circle-to-land maneuver or missed approach is executed. See "Segments of an instrument approach procedure."

[ICAO] Final approach - That part of an instrument approach procedure which commences at the specified final approach fix or point, or where such a fix or point is not specified,

a. at the end of the last procedure turn, base turn, or inbound turn of a racetrack procedure, if specified; or

b. at the point of interception of the last track specified in the approach procedure; and ends at a point in the vicinity of an aerodrome from which:

   (1) a landing can be made; or

   (2) a missed approach procedure is initiated.

Flight level (FL) - A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, FL 250 represents a barometric altimeter indication of 25,000 feet; FL 255, an indication of 25,500 feet.

[ICAO] Flight level (FL) - A surface of constant atmospheric pressure which is related to a specific pressure datum, 1013.2 Hg " (1013.2mb), and is separated from other such surfaces by specific pressure intervals.

NOTE 1: A pressure type altimeter calibrated in accordance with the standard atmosphere:

a. When set to a en route FL (QNH) altimeter setting, will indicate altitude;

b. When set to a airport altitude (QFE) altimeter setting, will indicate height above QFE reference datum; and

c. When set to a pressure of 1013.2 Hg" (1013.2 mb), may be used to indicate FL's.

NOTE 2: The terms 'height' and 'altitude,' used in Note 1 above, indicate altimetric rather than geometric heights and altitudes.

Flight recorder - A general term applied to any instrument or device that records information about the performance of an aircraft in-flight or about conditions encountered in-flight. Flight recorders may make records of airspeed, outside air temperature, vertical acceleration, engine rotation per minute (RPM), manifold pressure, and other pertinent variables for a given flight.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

[ICAO] Flight recorder - Any type of recorder installed in the aircraft for the purpose of complementing accident/incident investigation. See ICAO Annex 6, Part I, for specifications relating to flight recorders.

General aviation - That portion of civil aviation which encompasses all facets of aviation except air carriers holding certificate of public convenience and necessity from the Civil Aeronautics Board and large aircraft commercial operators.

[ICAO] General aviation - All civil aviation operations other than scheduled air services and nonscheduled air transport operations for remuneration or hire.

Glideslope - Provides vertical guidance for aircraft during approach and landing. The glideslope/glidepath is based on the following:

a. Electronic components emitting signals which provide vertical guidance by reference to airborne instruments during instrument approaches such as ILS/MLS, or

b. Visual ground aids, such as visual approach slope indicator (VASI), which provide vertical guidance for a VFR approach or for the visual portion of an instrument approach and landing.

c. PAR. Used by ATC to inform an aircraft making a PAR approach of its vertical position (elevation) relative to the descent profile.

[ICAO] Glidepath - A descent profile determined for vertical guidance during a final approach.

Holding fix - A specified fix identifiable to a pilot by navaids or visual reference to the ground used as a reference point in establishing and maintaining the position of an aircraft while holding. (Refer to AIM)

[ICAO] Holding point - A specified location, identified by visual or other means, in the vicinity of which the position of an aircraft in flight is maintained in accordance with ATC clearances.

Homing - Flight toward a navaid, without correcting for wind, by adjusting the aircraft heading to maintain a relative bearing of zero degrees.

[ICAO] Homing - The procedure of using the direction-finding equipment of one radio station with the emission of another radio station, where at least one of the stations is mobile, and whereby the mobile station proceeds continuously towards the other station.

Instrument approach procedure (IAP) - A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority. See "Segments of an instrument approach procedure." (Refer to FAR Part 91, AIM)

a. U.S. civil standard instrument approach procedures are approved by the FAA as prescribed under FAR Part 97 and are available for public use.

b. U.S. military standard instrument approach procedures are approved and published by the DOD.

c. Special instrument approach procedure are approved by the FAA for individual operators but are not published in FAR Part 97 for public use.

[ICAO] Instrument approach procedure - A series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en route obstacle clearance criteria apply.

Instrument flight rules (IFR) - Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan. (Refer to AIM)

[ICAO] Instrument flight rules (IFR) - A set of rules governing the conduct of flight under instrument meteorological conditions.

Instrument runway - A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved.

[ICAO] Instrument runway - One of the following types of runways intended for the operation of aircraft using instrument approach procedures:

a. *Nonprecision approach runway* - An instrument runway served by visual aids and nonvisual aid providing at least directional guidance adequate for a straight-in approach.

b. *Precision approach runway, Category I* - An Instrument runway served by ILS and visual aids intended for operations down to 60 m (200 feet) decision height and down to an runway visual range (RVR) of the other of 800 m.

c. *Precision approach runway, Category II* - An instrument runway served by ILS and visual aids intended for operations down to 30 m (100 feet) decision height and down to an RVR of the other of 400 m.

d. *Precision approach runway, Category III* - An instrument runway served by ILS to and along the surface of the runway and:

(1) Intended for operations down to an RVR of the order of 200 miles (no decision height being applicable) using visual aids during the final phase of landing;

(2) Intended for operations down to an RVR of the order of 50 miles (no decision height being applicable) using visual aids for taxing; and

(3) Intended for operations without reliance on visual reference for landing or taxiing.

NOTE 1: See Annex 10 Volume I, Part I Chapter 3, for related ILS specifications.

NOTE 2: Visual aids need not necessarily be matched to the scale of nonvisual aids provided. The criterion for the selection of visual aids is the conditions in which operations are intended to be conducted.

International airport - Relating to international flight, it means:

a. An airport of entry which has been designated by the Secretary of Treasury or Commissioner of Customs as an international airport for customs service.

b. A landing rights airport at which specific permission to land must be obtained from customs authorities in advance of contemplated use.

c. Airports designated under the Convention on International Civil Aviation as an airport for use by international commercial air transport and/or international general aviation. (Refer to Airport/ Facility Directory and/or International Flight Information Manual (IFIM))

[ICAO] International airport - Any airport designated by the contracting state in whose territory it is situated as an airport of entry and departure for international air traffic, where the formalities incident to customs, immigration, public health, animal and plant quarantine and similar procedures are carried out.

APPENDIX 4. TERMINOLOGY - Continued
A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Landing area - Any locality either on land, water, or structures, including airports/heliports and intermediate landing fields, which is used, or intended to be used, for the landing and takeoff of aircraft whether or not facilities are provided for the shelter, servicing, or for receiving or discharging passengers or cargo.

[ICAO] Landing area - That part of a movement area intended for the landing or takeoff of aircraft.

Minimum safe altitudes (MSA) -

a. The minimum altitude specified in FAR Part 91 for various aircraft operations.

b. Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance for emergency use within a specified distance from the navigation facility upon which a procedure is predicated. These altitudes will be identified as minimum sector altitudes or emergency safe altitudes and are established as follows:

(1) *Minimum sector altitudes* - Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance within a 25-mile radius of the navigation facility upon which the procedure is predicated. Sectors depicted on approach charts must be at least 90 degrees in scope. These altitudes are for emergency use only and do not necessarily assure acceptable navigational signal coverage.

(2) *Emergency safe altitudes* - Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance in non-mountainous area and 2,000 feet of obstacles clearance in designated mountainous areas with in 100-mile radius of the navigation facility upon which the procedure is predicated and normally used only in military procedures. These altitudes are identified on published procedures as "Emergency Safe Altitudes."

[ICAO] Minimum sector altitude - The lowest altitude which may be used under emergency conditions which will provide a minimum clearance of 300 miles (1,000 feet) above all obstacles located in an area contained within a sector of a circle of 46 km (25 NM) radius centered on a radio aid to navigation.

Mode - The letter or number assigned to a specific pulse of radio signals transmitted or received by ground interrogator or airborne transponder components of the Air Traffic Control Radar Beacon System (ATCRBS). Mode A (military Mode 3) and Mode C (altitude reporting) are used in ATC. See "Transponder" and/ or "Radar." (Refer to AIM)

[ICAO] Mode (Secondary Surveillance Radar (SSR) Mode) - The letter or number assigned to a specific pulse spacing of the interrogation signals transmitted by an interrogator. There are 4 modes, A, B, C and D specified in Annex 10, corresponding to four different interrogation pulse spacings.

Movement area - The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/ hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At those airports/heliports with a tower, specified approval for entry onto the movement area must be obtained from ATC.

[ICAO] Movement area - That part of an aerodrome to be used for the takeoff, landing and taxiing of aircraft, consisting of the manoeuvreing area and the apron(s).

Night - The time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

[ICAO] Night - The hours between the end of evening civil twilight and the beginning of morning civil twilight or such other period between sunset and sunrise as may be specified by the appropriate authority.

NOTE: Civil twilight ends in the evening when the center of the sun's disk is 6 degrees below the horizon and begins in the morning when the center of the sun's disk is 6 degrees below the horizon.

Notice to Airmen (NOTAM) - A notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations.

a. *NOTAM(D)* - A NOTAM given (in addition to local dissemination) distant dissemination beyond the area of responsibility of the Flight Service Station. These NOTAM's will be stored and available until canceled.

b. *NOTAM(L)* - A NOTAM given local dissemination by voice and other means, such as telegraph and telephone, to satisfy local user requirements.

c. *FDC NOTAM* - A NOTAM regulatory in nature, transmitted by United States NOTAM office (USNOF) and given system wide dissemination.

[ICAO] NOTAM - A notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

a. *Class I Distribution* - Distribution by means of telecommunication.

b. *Class II Distribution* - Distribution by means other than telecommunications.

Precision approach radar (PAR) - Radar equipment in some ATC facilities operated by FAA and/or the military services at joint-use civil/military locations and separate military installations to detect and display azimuth, elevation, and range of aircraft on the final approach course to a runway. This equipment may be used to monitor certain nonradar approaches, but is primarily used to conduct a PAR wherein the controller issues guidance instructions to the pilot based on the aircraft's position in relation to the final approach course (azimuth), the glidepath (elevation), and the distance (range) from the touchdown point on the runway as displayed on the radar scope. (Refer to AIM)--The abbreviation "PAR" is also used to denote preferential arrival routes in ARTCC computers.

[ICAO] Precision approach radar (PAR) - Primary radar equipment used to determine the position of an aircraft during final approach, in terms of lateral and vertical deviations relative to a nominal approach path, and in range relative to touchdown.

NOTE: Precision approach radars are designed to enable pilots of aircraft to be given guidance by radio communications during the final stages of the approach to land.

Prohibited area - See "Special Use Airspace."

[ICAO] Prohibited area - An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is prohibited.

Radar - A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulses.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

a. *Primary radar* - A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at that site for processing and display at an ATC facility.

b. *Secondary radar/Radar beacon (ATCRBS)* - A radar system in which the object to be tested is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the transmitter/ receiver site for processing and display at an ATC facility. See "Transponder." (Refer to AIM)

[ICAO] Radar - A radio detection device which provides information on range, azimuth and/or elevation of objects.

a. *[ICAO] primary radar.* Radar System which uses reflected radio signals.

b. *[ICAO] secondary radar.* Radar system wherein a radio signal transmitted form a radar station initiates the transmission of a radio signal from another station.

Radar approach - An instrument approach procedure which utilizes PAR or Airport Surveillance Radar (ASR). See "Precision approach radar" and/or "Instrument approach procedure." (Refer to AIM)

[ICAO] Radar approach - An approach, executed by an aircraft, under the direction of a radar controller.

Radar contact -

a. Used by ATC to inform an aircraft that it is identified on the radar display and radar flight following will be provided until radar identification is terminated. Radar service may also be provided within the limits of necessity and capability. When a pilot is informed of "radar contact," he automatically discontinues reporting over compulsory reporting points. (Refer to AIM)

b. The term used to inform the controller that the aircraft is identified and approval is granted for the aircraft to enter the receiving controllers airspace.

[ICAO] Radar contact - The situation which exists when the radar blip or radar position symbol of a particular aircraft is seen and identified on a radar display.

Radar identification - The process of ascertaining that an observed radar target is the radar return from a particular aircraft. See "Radar contact" and/or "Radar service."

[ICAO] Radar identification - The process of correlating a particular radar blip or radar position symbol with a specific aircraft.

Radar service - A term which encompasses one or more of the following services based on the use of radar which can be provided by a controller to a pilot of a radar identified aircraft.

a. *Radar monitoring* - The radar flight-following of aircraft, whose primary navigation is being performed by the pilot, to observe and note deviations from its authorized flight path, airway, or route. When being applied specifically to radar monitoring of instrument approaches; i.e., with PAR or radar monitoring of simultaneous ILS/MLS approaches, it includes advice and instructions whenever an aircraft nears or exceeds the prescribed PAR safety limit or simultaneous ILS/MLS no transgression zone.

b. *Radar navigational guidance* - Vectoring aircraft to provide course guidance.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

c. *Radar separation* - Radar spacing of aircraft in accordance with established minima.

[ICAO] Radar service - Term used to indicate a service provided directly by means of radar.

[ICAO] Radar monitoring - The use of radar for the purpose of providing aircraft with information and advice relative to significant deviations from nominal flight path.

[ICAO] Radar separation - The separation used when aircraft position information is derived from radar sources.

Released time - A departure time restriction issued to a pilot by ATC (either directly or through an authorized relay) when necessary to separate a departing aircraft from other traffic.

[ICAO] Release time - Time prior to which an aircraft should be given further clearance or prior to which it should not proceed in case of radio failure.

Reporting point - A geographical location in relation to which the position of an aircraft is reported. (Refer to AIM)

[ICAO] Reporting point - A specified geographical location in relation to which the position of an aircraft can be reported.

Rescue coordination center (RCC) - A search and rescue (SAR) facility equipped and manned to coordinate and control SAR operations in an area designated by the SAR plan. The U.S. Coast Guard and the U.S. Air Force have responsibility for the operation of RCC's.

[ICAO] Rescue co-ordination center - A unit responsible for promoting efficient organization of SAR service and for coordinating the conduct of SAR operations within a SAR region.

[ICAO] Restricted area - An airspace of defined dimensions, above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with certain specified conditions.

Route segment - As used in ATC, a part of a route that can be defined by two navigational fixes, two navaids, or a fix and a navaid. See "Route."

[ICAO] Route segment - A portion of a route to be flown, as defined by two consecutive significant points specified in a flight plan.

Runway - A defined rectangular area on a land airport prepared for the landing and takeoff run of aircraft along its length. Runways are normally numbered in relation to their magnetic direction rounded off to the nearest 10 degrees; e.g., Runway 01, Runway 25.

[ICAO] Runway - A defined rectangular area on a land aerodrome prepared for the landing and takeoff of aircraft.

Segments of an instrument approach procedure - An instrument approach procedure may have many as four separate segments depending on how the approach procedure is structured.

a. *Initial approach* - The segment between the initial approach fix and the intermediate fix or the point where the aircraft is established on the intermediate course or final approach course.

b. *Intermediate approach* - The segment between the intermediate fix or point and the final approach fix.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

c. *Final approach* - The segment between the final approach fix or point and the runway, airport, or missed approach point.

d. *Missed approach* - The segment between the missed approach point or the point of arrival at decision height and the missed approach fix at the prescribed altitude. (Refer to FAR Part 97)

[ICAO] Initial approach segment - That segment of an instrument approach procedure between the initial approach fix and the intermediate approach fix or, where applicable, the final approach fix or point.

[ICAO] Intermediate approach segment - That segment of an instrument approach procedure between either the intermediate approach fix and the final approach fix or point, or between the end of a reversal, race track, or DR track procedure and the final approach fix point or point, as appropriate.

[ICAO] Final approach segment - That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

[ICAO] Missed approach procedure - The procedure to be followed if the approach cannot be continued.

Separation - In ATC, the spacing of aircraft to achieve their safe and orderly movement in flight and while landing and taking off.

[ICAO] Separation - Spacing between aircraft, levels or tracks.

Sigmet (WS) - A weather advisory issued concerning weather significant to the safety of all aircraft. Sigmet advisories cover severe and extreme turbulence, severe icing, and widespread dust or sandstorms that reduce visibility to less than 3 miles. (Refer to AIM)

[ICAO] Sigmet information - Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena which may affect the safety of aircraft operations.

Special VFR operations - Aircraft operating in accordance with clearances within control zones in weather conditions less than the basic VFR weather minima. Such operations must be requested by the pilot and approved by ATC.

[ICAO] Special VFR flight - A controlled VFR flight authorized by ATC to operate within a control zone under meteorological conditions below the visual meteorological conditions.

Target - The indication shown on a radar display resulting from a primary radar return or a radar beacon reply.

[ICAO] Target - In radar:

a. Generally, any discrete object which reflects or retransmits energy back to the radar equipment.

b. Specifically, an object of a radar search or surveillance.

[ICAO] Total estimated elapsed time - For IFR flights, the estimated time required from take off to arrive over that designated point, defined by reference to navigation aids, from which it is intended that an instrument approach procedure will be commenced, or, if no navigation aid is associated with the destination aerodrome, to arrive over the destination aerodrome. For VFR flights, the estimated time required from takeoff to arrive over the destination aerodrome.

APPENDIX 4. TERMINOLOGY - Continued

A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Touchdown -

a. The point at which an aircraft first makes contact with the landing surface.

b. Concerning a PAR, it is the point where the glide path intercept the landing surface.

[ICAO] Touchdown - The point where the nominal glide path intercepts the runway.

NOTE: Touchdown as defined above is only a datum and is not necessarily the actual point at which the aircraft will touch the runway.

Touchdown zone - The first 3,000 feet of the runway beginning at the threshold. The area is used for determination of touchdown zone elevation in the development of straight-in landing minimums for instrument approaches.

[ICAO] Touchdown zone - The portion of a runway, beyond the threshold, where it is intended landing aircraft first contact the runway.

Tower (ATCT) - A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or takeoff at the takeoff at the airport controlled by the tower or to transit the airport traffic area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar). (Refer to AIM)

[ICAO] Aerodrome control tower - A unit established to provide ATC service to aerodrome traffic.

Track - The actual flight path of an aircraft over the surface of the earth. See "Route."

[ICAO] Track - The projection on the earth's surface of the path of an aircraft, the direction of which path any point is usually expressed in degrees from north (true, magnetic, or grid).

Traffic pattern - The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, and final approach.

a. *Upwind leg* - A flight path parallel to the landing runway in the direction of landing.

b. *Crosswind leg* - A flight path at right angles to the landing runway off its upwind end.

c. *Downwind leg* - A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.

d. *Base leg* - A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.

e. *Final approach* - A flight path in the direction of landing along the extended runway centerline. The final approach normally extends from the base leg to the runway. An aircraft making a straight-in approach VFR is also considered to be on final approach (Refer to AIM and/or FAR Part 91).

[ICAO] Aerodrome traffic circuit - The specified path to be flown by aircraft operating in the vicinity of an aerodrome.

Transfer of control - That action whereby the responsibility for the separation of an aircraft is transferred from one controller to another.

[ICAO] Transfer of control - Transfer of responsibility for providing ATC service.

APPENDIX 4. TERMINOLOGY - Continued
A COMPARISON OF U.S. GLOSSARY DEFINITIONS THAT DIFFER WITH ICAO DEFINITIONS

Transferring controller - A controller/facility transferring control of an aircraft to another controller/facility.

[ICAO] Transferring unit/controller - ATC unit/air traffic controller in the process of transferring the responsibility for providing ATC service to an aircraft to the next ATC unit/air traffic controller along the route of flight.

Transponder - The airborne radar beacon receiver/transmitter portion of the ATCRBS which automatically receives radio signal from interrogators on the ground, and selectively replies with a specific reply pulse or pulse group only to those interrogations being received on the mode to which it is set to respond (Refer to AIM).

[ICAO] Transponder - A receiver/transmitter which will generate a reply signal upon proper interrogation; the interrogation and reply being on different frequencies.

Urgency - A condition of being concerned about safety and of requiring timely but not immediate assistance; a potential distress condition.

[ICAO] Urgency - A condition concerning the safety of an aircraft or other vehicle, or of person on board or in sight, but which does not require immediate assistance.

Vector - A heading issued to an aircraft to provide navigational guidance by radar.

[ICAO] Radar vectoring - Provisions of navigational guidance to aircraft in the form of specific headings, based on the use of radar.

Vertical separation - Separation established by assignment of different altitudes or FL's.

[ICAO] Vertical separation - Separation between aircraft expressed in units of vertical distance.

[ICAO] Visibility - The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent objects by night.

a. *[ICAO] Flight visibility* - The visibility forward from the cockpit of an aircraft in flight.

b. *[ICAO] Ground visibility* - The visibility at an aerodrome as reported by an accredited observer.

c. *[ICAO] Runway visual range (RVR)* - The range over which the pilot of an aircraft on the center line of a runway can see the runway surface markings or the lights delineating the runway or identifying its center line.

Visual approach - An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of an ATC facility and having an ATC authorization, may proceed to the airport of destination in VFR conditions.

[ICAO] Visual approach - An approach by an IFR flight when either part or all of an instrument approach procedure is not completed and the approach is executed in visual reference to terrain.

APPENDIX 4. TERMINOLOGY - Continued

GPS ACRONYMS

The following acronyms are listed to assist the reader referencing technical documents relating to Global Positioning Systems (GPS). This list does not claim to be all inclusive, but it will assist interested readers in understanding the extensive amount of literature being written concerning this relatively new navigation concept.

2-D	Two-Dimensional
2DRMS	2 Distance Root Mean Square
3-D	Three-Dimensional
A-S	Anti Spoof
AEEC	Airlines Electronic Engineering Committee
AFSPACECOM	Air Force Space Command
AOC	Auxiliary Output Chip
AOPA	Aircraft Owners and Pilots Association
ATA	Air Transport Association
AVCS	Attitude and Velocity Control Subsystem
BPSK	Binary Phase-Shift Keying
C/A-CODE	Course Acquisition Code
CCMDR	Crew Commander
CDU	Control/Display unit
CEP	Circular Error Probable
CONUS	Conterminous United States
CPCI	Computer Program Configuration Item
DGIC	Differential GPS Integrity Channel
DGPS	Differential GPS
DOD	Department of Defense
DOP	Dilution of Precision
ECEF	Earth Centered, Earth Fixed
EPS	Electric Power System
f	Frequency
FAA	Federal Aviation Administration
FAATC	FAA Technical Center - Atlantic City, New Jersey
FANS	Future Air Navigation System
FCMDR	Flight Commander
FOC	Full Operational Capacity
FRP	Federal Radionavigation Plan
GA	Ground Antenna
GDOP	Geometric Dilution of Precision
GIB	GPS Integrity Broadcast
GIC	GPS Integrity Channel
GLOSNASS	Global Navigation Satellite System (Russian System)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSO	Ground Systems Officer
HDOP	Horizontal Dilution of Precision
HOW	Handover Word
Hr	Hour
Hz	Hertz

APPENDIX 4. TERMINOLOGY - Continued

GPS ACRONYMS

ICAO	International Civil Aviation Organization
ICD	Interface Control Document
ILS	Instrument Landing System
INS	Inertial Navigation System
LBS	L-Band System
LDGPS	Local-area Differential GPS
LOP	Line of Position
m	Meter(s)
m/s	Meters/Second
MCS	Master Control Station
MHz	Megahertz
MOPS	Minimum Operational Performance Standards
MS	Monitor Station
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NDS	Nuclear Detection Subsystem
NPD	Navigation Payload Subsystem
OASD/C31	Office of the Assistant Secretary of Defense (Communications, Command, Control and Intelligence)
OIS	Orbital Insertion System
P-CODE	Precise-Code
PCS	Prelaunch Checkout Station
PDOP	Position Dilution of Precision
POC	Point of Contact
PPS	Precise Positioning Service
PPS-SM	Precise Positioning Service Security Module
PR	Pseudo Range
PRN	Pseudo Random Noise
RAIM	Receiver Autonomous Integrity Monitoring
RCS	Reaction Control System
RMS	Root Mean Square
RNP	Required Navigation Performance
RSS	Root Sum Square
SA	Selective Availability
SAO	Satellite Analysis Office
sec	Second(s)
SEO	Satellite Engineering Office
SEP	Spherical Error Probability
SF	Sub Frame
SOIT	Satellite Operational Implementation Team
SOO	Satellite Operations Officer
SPS	Standard Positioning Service
SS	Support Structure
SV	Space Vehicle
TCS	Thermal Control Subsystem
TDOP	Time Dilution of Precision

APPENDIX 4. TERMINOLOGY - Continued

GPS ACRONYMS

TERPS	U.S. Standard for Instrument Procedures (FAA Order 8260.3B)
TLM	Telemetry Word
TOA	Time of Arrival
TSO	Technical Standard Order
TT&C	Telemetry, Tracking and Command Subsystem
UERE	User Equivalent Range Error
UTC	Coordinated Universal Time
VDOP	Vertical Dilution of Precision
VLF	Very Low Frequency
VOR/DME	Very High Frequency Omnidirectional Range/Distance Measuring Equipment
WAAS	Wide-Area Augmentation System
WADGPS	Wide-Area Differential GPS (NOTE: Some references use WDGPS in lieu of WADGPS.)
Wx	Weather

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