



GLOBAL POSITIONING SYSTEM
A GUIDE FOR THE APPROVAL OF
GPS RECEIVER INSTALLATION AND OPERATION



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SATELLITE OPERATIONAL IMPLEMENTATION TEAM
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ENGLISH TO METRIC	METRIC TO ENGLISH
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<p>For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures. Price \$2.50. SD Catalog No. C13 10286.</p>	

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ACRONYMS AND ABBREVIATIONS

A&P	Airframe and Power Plant
AC	Advisory Circular
ACO	Aircraft Certification Office
AFM	aircraft flight manual
ASI	Aviation Safety Inspector
CDI	course deviation indicator
CDL	configuration deviation list
CEPAC	Central East Pacific (Airspace)
CFR	Code of Federal Regulations
CHDO	Certificate-Holding District Office
DER	designated engineering representative
DGPS	differential global positioning system
DME	distance measuring equipment
DOD	Department of Defense
DOT	Department of Transportation
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FDE	fault detection and exclusion
FIR	Flight Information Region
FMS	Flight Management System
FSAS	Flight Standards Automation System
FSAT	Flight Standards Information Bulletin for Air Transportation
FSAW	Flight Standards Information Bulletin for Airworthiness
FSDO	Flight Standards District Office
FTE	Flight Technical Error
GPS	global positioning system
HBAT	Flight Standards Handbook Bulletin for Air Transportation
HSI	horizontal situation indicator
IAP	instrument approach procedure
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
INS	Inertial Navigation System
LAAS	local area augmentation systems
LDA	Localizer-type Directional Aid
LOA	letter of authorization
LOC	localizer
MAA	maximum authorized altitude
MEA	minimum en route altitude
MEL	minimum equipment list

MCS	master control station
MLS	microwave landing system
MMEL	master minimum equipment list
MNPS	Minimum Navigation Performance Specification
MS	multi-sensor
MU	magnetic unreliability
NAS	National Airspace System
NAT	North Atlantic Track
NAVAID	navigational aid
NDB	nondirectional beacon
NM	nautical mile
NOPAC	North Pacific
OpSpecs	operations specifications
OPSS	operations specifications subsystem
PAI	Principal Avionics Inspector
PMI	Principal Maintenance Inspector
POI	Principal Operations Inspector
PPS	precise positioning service
PTRS	program tracking & reporting subsystem
RAIM	receiver autonomous integrity monitoring
SCAT-I	Special Category I
SDF	simplified directional facility
SFAR	Special Federal Aviation Regulation
SPS	standard positioning service
STC	Supplemental Type Certificate
TC	Type Certificate
TSO	Technical Standard Order
US NAS	United States National Airspace System
VFR	visual flight rules
VOR	very high frequency omni-directional range
WAAS	wide area augmentation systems

1. INTRODUCTION

1.0 INTRODUCTION

This guide is designed to assist FAA Aviation Safety Inspectors (ASIs) in their evaluation of Global Positioning Systems (GPS) installations and operations. Because there are many documents providing information, regulations, and guidelines for various types of GPS approvals, this document has been created to provide one source for most FAA GPS approvals. This document contains aids such as flow charts and checklists to provide Principal Operations Inspectors (POIs) and Principal Avionics Inspectors (PAIs) with a consistent process for performing approvals. In addition, the relevant excerpts from regulatory documents and advisory material are included in the references so that inspectors have immediate access to the basis for design requirements and guidelines without the need for carrying the bulky parent reference material. It should be fully appreciated that the material presented is incomplete. It is assumed that the person using this material has read the complete version of the orders. Important details regarding the use or policies covering the application of the information in the excerpts may be available only in the complete reference from which the excerpts were taken. This document will be updated periodically to maintain currency.

The contents of this document do not reflect changes in requirements that are specified or allowed by Special Federal Aviation Regulations (SFARS). The document contents were current as of October 26, 1995. Changes in requirements and procedures occurring after that date are not included herein. Questions concerning this document should be directed to: Hank Cabler, AFS-400, (202) 267-3752.

Chapter 1 of this document is an introduction to GPS. It contains a description of the basics of the global positioning system, TSO-C129 GPS equipment classifications, descriptions of differential GPS (DGPS), including both wide area augmentation systems (WAAS) and local area augmentation systems (LAAS); an explanation of the current and expected future policies on special Category I instrument approaches using DGPS; and some frequently asked questions on GPS approval.

Chapter 2 of this document provides a description of the general GPS approval process and a flow diagram displaying the steps in both the airworthiness and the operations approval process. Chapter 2 also describes the major differences between the different types of GPS approvals including:

- (1) FAR Part differences,
- (2) initial vs. follow-on,
- (3) VFR vs. IFR with or without nonprecision approaches,
- (4) multi-sensor GPS equipment,
- (5) special (not for navigation) use,
- (6) portable GPS equipment,
- (7) areas of operation/Class II navigation,
- (8) primary vs. supplemental means of navigation,
- (9) differential GPS, and
- (10) special Category I instrument approaches.

Chapter 3 contains the procedures and checklists required for performing GPS airworthiness approvals. Chapter 3 provides the information needed for determining when a field approval is possible. A detailed description of the process required for field approval, including checklists for each of the major phases of the approval process, is also provided. This guide covers only approvals that can be completed via field approval by PAIs (generally follow-on approvals).

Chapter 4 contains procedures and checklists for performing GPS operations approvals. General operations requirements are listed for all operators using GPS. Specific approval requirements and recommendations are provided for Part 121, 125 and 135 operators.

Finally, references A and O contain relevant excerpts from FAA Orders and Advisory Circulars.

1.1 HOW TO USE THIS DOCUMENT

This document is designed to provide information that can be easily accessed at different levels of detail. Inspectors who are new to GPS should read chapter 1. Inspectors who are familiar with GPS but uncertain about various FAA rules and regulations concerning different GPS equipment and approvals may want to review tables 1.3.1 and 1.3.2 in chapter 1.

The flow diagrams in chapter 2 provide a quick overview of the approval process for airworthiness and operations approvals. These diagrams should be reviewed the first time through a GPS approval.

Chapter 3 is specifically for airworthiness (avionics or maintenance) inspectors, and chapter 4 is designed for operations inspectors. The steps in these chapters should be followed for each approval. Checklists are provided for each phase of the approval. The checklists indicate which items are required and which items are recommended for the various types of approvals.

Throughout the document there are references to the applicable FAA documents. The relevant excerpts of these documents are provided in the references if more information is needed. The references are identified as bold numbers (e.g., **(1)**) in the text of the document or within checklists. These bold numbers are cross referenced to reference page numbers and item numbers at the end of each section. For example, **(1)** in the text of the chapter will be cross-referenced at the end of the chapter as:

(1) pp. A2•(4, 9, 12); 7c(2)(i), 8c(2)(i), 1c.

This indicates that the reference information can be found in reference 2 on page A2•4, item 7c(2)(i), page A2•9, item 8c(2)(i), and on page A2•12, item 1c.

As inspectors become familiar with the GPS approval process, they should be able to use only the checklists to ensure that they follow all the required procedures for each GPS approval.

1.2 GLOBAL POSITIONING SYSTEM (GPS) BASICS

1.2.1 System Description

The Navstar Global Positioning System (GPS) is a satellite-based radionavigation system deployed and operated by the Department of Defense (DOD). GPS was originally developed as a military system. It is subject to limitations imposed by the DOD for national security reasons. However, the DOD and the Department of Transportation (DOT) have undertaken a cooperative effort to make GPS available for use as an integral part of the civil radionavigation system.

GPS consists of three functional segments -- space, control, and user. The space segment is a constellation of 24 satellites -- 21 active and three spares. The satellites orbit the earth at an altitude of about 10,900 nautical miles with four satellites in each of six different orbital planes. This constellation guarantees that at least four satellites will be in view (greater than 5 degrees above the horizon with respect to the user) anywhere in the world, at any time.

The control segment controls satellite operations. A Master Control Station (MCS) is located at Falcon Air Force Base in Colorado. A worldwide network of five signal monitoring stations and three uplink ground antennas complete the control segment. Monitor stations collect and send GPS navigation signal data to the MCS for evaluation and determination of required corrections. Corrections to satellite atomic clocks or orbital parameters are relayed to the satellites from the ground antennas. Other satellite subsystems including power, thermal balance, and attitude are also monitored by the MCS.

The user segment is the GPS receiver that receives data from the satellite to compute position. GPS compares the time it takes to receive radio signals from satellites to compute position. Data from four satellites are needed to solve an equation with four unknowns -- latitude, longitude, altitude, and time. The time computation is required due to receiver clock error.

1.2.2 System Performance

Important GPS performance characteristics are accuracy and integrity. Accuracy refers to the degree of conformity of a GPS calculation to the true value. Government policy defines two levels of GPS accuracy: 1) Precise Positioning Service (PPS) for military use and 2) Standard Positioning Service (SPS) for civil use. A process called selective availability is used to degrade the GPS signal for SPS. PPS is available only to DOD and other authorized users and is denied to nonauthorized users through cryptography. The DOD guarantees a SPS peacetime signal accuracy of 100 meters with a 95% probability (95% of the time) and 300 meters with a 99.99% probability for latitude and longitude. Altitude (above mean sea level) can be determined to within 140 meters with 95% probability. Only under dire circumstances and by decision of the President, will the SPS accuracy be degraded beyond these values.

Even with selective availability, GPS accuracy is much greater than any other en route navigation system. The benefits of GPS due to this increased accuracy are great. In the future, GPS will allow reduced separation en route, optimized routes and shorter flight paths, and improved access to remote airports that do not support radionavigation by aids such as VOR. However, GPS accuracy is not great enough for precision approach and departure (and would not be even if selective availability were turned off). A correction to GPS known as differential GPS (DGPS) may provide lateral and vertical accuracy of around 5-10 meters and may be developed to allow for precision approach and departure. DGPS is discussed further in the following section.

Integrity refers to the ability of the system to provide timely warnings to users when GPS data should not be used. Users must remain aware of the integrity of the GPS data. Since four satellites are required for operation of the GPS, users must know if they are not accessing four satellites or if a satellite is not operational.

There are several ways a user can monitor the integrity of the GPS data. One method is for the pilot to continuously monitor and compare data from a second navigation source. A second method is known as receiver autonomous integrity monitoring (RAIM). Using RAIM, the receiver monitors its own integrity and alerts the user if integrity is lost. However, **RAIM requires five operational satellites**. A third method is automatic monitoring through the use of other navigation sources or perhaps differential ground stations (see section 1.3). Flight management systems may be designed to be equivalent to RAIM using other methods to monitor integrity and alert users when integrity is lost. The FAA requires one of these three methods to be implemented in operations of GPS. For IFR use, the FAA currently requires automatic integrity monitoring -- either RAIM or RAIM equivalent.

1.2.3 Differential GPS

Differential techniques may be applied to GPS to achieve substantial improvements in position accuracy and to provide integrity information (which should eliminate RAIM requirements in the future). DGPS uses information obtained from a land-based receiver at a surveyed site to determine and transmit corrections to users. DGPS systems have three basic components: 1) a land-based receiver that monitors and collects satellite data and compares the data with known survey position data, 2) a method of transmitting corrections determined at the site (or at a central control station) to users, and 3) user equipment that has hardware and software necessary to receive and apply the corrections to information received from GPS satellites.

There are several methods of transmitting DGPS data to users. Data can be transmitted over a fairly small geographic area (up to about 150 miles) or over a broad geographic area (beyond 150 miles). DGPS systems that transmit data over a fairly small area are known as local area augmentation systems (LAAS). LAAS data is normally transmitted from a ground-based site (such as an airport). DGPS systems that transmit over a broad area are referred to as wide area augmentation systems (WAAS). WAAS broadcasts can be transmitted via satellite to cover an area that is nearly hemispheric.

The accuracy of DGPS systems is dependent on the distance from the user to the reference site. An aircraft 1 mile from the reference site may expect an accuracy of 3 to 5 meters. The required accuracy for a Category I precision landing is 17.1 meters horizontal and 4.1

meters vertical. As of 1996, DGPS is not approved for use by the general public as a navigation aid. A few DGPS ground stations have been built. Research on the use of DGPS is continuing and public use is expected to be allowed in the future. The FAA does allow approval of DGPS for special Category I instrument approaches on a case by case basis, generally for research and development purposes.

1.3 GPS RECEIVERS AND EQUIPMENT CLASSIFICATION

Several different types of GPS receivers are available to the aviation public and allowed for different aviation applications. Handheld or portable GPS receivers may be used as a supplement to VFR only. Airworthiness approval is required for anything that is structurally mounted to the aircraft, including antennas for portable GPS receivers.

Panel mounted GPS receivers that use only GPS data and provide their own data display are often referred to as stand-alone GPS receivers. GPS receivers also may be integrated within a multi-sensor navigation unit or within a flight management system (FMS) and they may be coupled with an autopilot. Any of these types of equipment may be approved for VFR and IFR (oceanic, en route, terminal, and non-precision approach) if they meet specified performance criteria. Operations approval, as well as airworthiness approval, is required for air carrier IFR operations and for some general aviation long-range IFR operations.

TSO-C129 specifies the performance criteria that must be met for the above equipment if it will be used for IFR. Table 1.3.1 provides the equipment classification given by TSO-C129. GPS receivers should be approved with the appropriate TSO-C129 class before airworthiness and operations approval is given.

All equipment that will be used for IFR must have RAIM or a system monitoring function that is equivalent to RAIM. IFR approvals also require an approved and operational alternate navigation system appropriate for the route flown.

Some GPS receivers are capable of operating as either GPS receivers or DGPS receivers. DGPS receivers can be approved for installation for certain special use applications, such as agricultural spraying, aerial firefighting, search and rescue, aerial photography, etc. Under special circumstances, mainly for research and development purposes, DGPS may be approved for IFR including special Category I precision instrument approaches.

Table 1.3.1 - IFR GPS Equipment Classification From TSO-C129

GPS IFR EQUIPMENT CLASSES/CATEGORIES (TSO-C129)				
Equipment Class	Integrity function:		Approved for use in:	
	RAIM	Integrated Navigation System RAIM Equivalent	Oceanic, En Route, and Terminal	Non-Precision Approach
Class A - GPS sensor and navigation capability (stand-alone receiver)				
A1	yes		yes	yes
A2	yes		yes	no
Class B - GPS sensor data to an integrated navigation system (i.e., FMS, multi-sensor, navigation system, etc.)				
B1	yes		yes	yes
B2	yes		yes	no
B3		yes	yes	yes
B4		yes	yes	no
Class C - GPS sensor data to integrated navigation system (as in Class B) which provide enhanced guidance to an autopilot, or flight director, to reduce flight technical errors				
C1	yes		yes	yes
C2	yes		yes	no
C3		yes	yes	yes
C4		yes	yes	no

Table 1.3.2 summarizes the allowable GPS uses, approval requirements, and equipment requirements.

**Table 1.3.2 - GPS and DGPS Uses, Required Equipment,
and Required FAA Approval**

GPS and DGPS Uses	Equipment Required	Approval Required
Special Use, Not for Navigation	Any GPS or DGPS receiver (for portable/handhelds - see section 2.2.6)	Airworthiness
VFR	Any GPS receiver (for portable/handhelds - see section 2.2.6)	Airworthiness
IFR Part 91, 137 (En Route, Terminal, Oceanic)	Panel mounted stand-alone or Multi-sensor GPS receiver, any TSO-C129 Class	Airworthiness
IFR Part 91, 137 (special use airspace, primary means)	Panel mounted stand-alone or Multi-sensor GPS receiver, any TSO-C129 Class	Airworthiness Operations
IFR Part 91, 137 (Nonprecision approach)	Panel mounted stand-alone or Multi-sensor GPS receiver, TSO-C129 Class A1, B1, B3, C1, C3	Airworthiness
IFR Part 121, 125, 135 (Oceanic, En Route, Terminal)	Panel mounted stand-alone or Multi-sensor GPS receiver, any TSO-C129 Class	Airworthiness Operations
IFR Part 121, 125, 135 (Nonprecision approach)	Panel mounted stand-alone or Multi-sensor GPS receiver, TSO-C129 Class A1, B1, B3, C1, C3	Airworthiness Operations
Category I Precision Approaches	Special DGPS receivers (not for public use)	Must be approved by division
<p>Note: IFR operations generally require alternate navigation systems appropriate to the route flown. See questions 6 and 7 on pages 1-11 to 1-12 for details.</p>		

1.4 FREQUENTLY ASKED QUESTIONS

1. *What is a follow-on approval? How do I know if a GPS installation can be field approved?*

A follow-on approval refers to an approval of a GPS installation that is based on data (normally a TC or an STC) from a previous installation of the same GPS receiver. The aircraft make and model does not have to be the same as the aircraft from the original approval if the installation is similar.

Generally, an installation can be field approved if it is a follow-on approval. However, there are some exceptions. Answer the questions in section 3.2 (page 3-6) to determine whether any specific installation can be field approved.

2. *When is a GPS installation considered a minor alteration and when is it considered a major alteration?*

Persons wishing to obtain original airworthiness certification of a GPS installation shall obtain approval by TC or STC. “VFR use only” follow-on approvals for GPS are considered major unless the installer has determined and can show that the installation of the GPS navigation equipment, including the antenna installation, does not impact the certificated properties of the aircraft design, i.e., does not meet the definition of a major alteration per FAR 1. IFR GPS installations are major alterations requiring an FAA Form 337.

3. *What are the flight test requirements for GPS field approvals? When can the flight test be performed by the owner, operator, or repair shop and when is an FAA designated representative required?*

VFR installations will be functionally ground and flight checked (results will be recorded) to ensure correct operation and accuracy, in VFR conditions, by an appropriately FAA-certificated person or repair station, or an appropriately rated pilot.

IFR installations will be functionally ground and operationally flight checked, in VFR conditions, to verify proper functioning of all equipment installed by the repair station. Ground and flight tests will be conducted by an appropriately FAA-certificated person or repair station or by an appropriately rated pilot. The

results will be recorded. Both installations will be checked to ensure that the equipment and its installation satisfies all interference immunity requirements and that mutual compatibility with other equipment and systems is maintained.

4. *What are the currency requirements for operators using GPS for IFR?*

Except for the normal currency requirements, there are no specific requirements for Part 91 or Part 137 operators using GPS for IFR.

For Part 121, 125, and 135 operators, the pilot in command must complete a proficiency check using GPS every 6 months. To be used for nonprecision approach, pilot in command must perform a proficiency check on GPS approaches every 6 months. GPS can be used to replace another nonprecision approach navigation system but not vice versa. Both pilots must be current in their qualifications using GPS for a crew to complete a GPS nonprecision approach.

5. *What's the difference between TSO-C-129 class B() approved equipment and TSO-C129 class C() equipment?*

TSO-C129 class B and class C equipment both provide data to an integrated navigation system. The difference is that class C equipment also provides enhanced guidance to an autopilot or flight director to reduce flight technical error.

6. *What alternate navigation equipment is required if GPS is to be used for IFR?*

For en route and nonprecision approach navigation, at least one alternate navigation system that is appropriate (FAA approved) to the route being flown must be installed and operational on the aircraft. In addition, for Part 121 and Part 135 operators, the navigation equipment requirements of FARs 121.349 and 135.165 must be met. For example, air carriers may be approved for GPS nonprecision approaches if they are equipped with two operational VORs in addition to the GPS equipment.

For long-range navigation, an alternate navigation system that is different from GPS (e.g., INS or Omega) is required unless the operator is approved for use of GPS as primary means Class II navigation. Operators may be approved for single GPS or dual GPS as the “primary means” of navigation depending on the desired area of operations. For Part 121, 125, and 135 operators, this approval must be specified in their OpSpecs. Part 91 and 137 operators are required to have an FAA letter of authorization for use of GPS as primary means long-range navigation. See section 2.2.8 (p. 2-11) for more details on approval of GPS as primary means Class II navigation.

7. *When will DGPS be available for use in IFR? Will operators be able to use DGPS for precision approaches?*

DGPS is currently available for use in IFR, however not to the general public. The installation and the use of DGPS for IFR in the domestic U.S. require special approval that must be completed at the regional airways facility. DGPS also can be approved for use in Special Category I Instrument Approaches. FAA Order 8400.11 describes the requirements for these approvals. References A7 and O6 to this guide list the responsibilities of POIs and PAIs in these approvals.

8. *What type of instrument approaches may be flown using GPS and what are the airport ground-based equipment requirements?*

Unless special approval has been given to fly SCAT-I approaches using DGPS, only nonprecision approaches may be flown. A three phase GPS “overlay” program has been implemented to allow GPS instrument approaches. The first phase has been completed and is no longer applicable.

The second phase of the “overlay” program allows operators to use GPS to overlay nonprecision approaches (excluding LOC, LDA, or SDF procedures). If an operator is using another nonprecision approach procedure and using GPS to overlay that procedure, the ground-based navigation equipment at the destination airport must be operational at the time the approach is flown. Ground-based navigation equipment needed to navigate to, and land at, an alternate airport also must be operational.

The third phase of the GPS approach “overlay” program involves the development of new IAPs that either combine GPS with other nonprecision approaches or are strictly for GPS use. These IAPs will have GPS in the title. If an operator is flying one of these approaches, the destination airport is not required to have operational ground-based equipment for the approach. However, ground-based navigation equipment needed to safely navigate to, and land at, an alternate airport is still required.

FAA approval for nonprecision approaches using GPS is limited to U.S. NAS unless specific authorization has been given for foreign airspace.

2. APPROVAL PROCESS & PRACTICES

2.0 APPROVAL PROCESS AND PRACTICES

This section describes the process that should be followed by POIs and PAIs in the approval of GPS receiver installation and operation. The general approval process is described and a flow diagram is provided to clarify the steps in the process. There will be differences in the process depending on the type of approval given. These differences are described in section 2.2.

2.1 GENERAL APPROVAL PROCESS

2.1.1 Description

The approval of the installation and operation of GPS should follow the same general five phase process described in the airworthiness inspector's handbook, FAA Order 8300.10, and in the operations inspector's handbook, FAA Order 8400.10. The application of this five-phase process to GPS installations is shown in table 2.1.1.

Section 2.1.2 presents a process flow diagram that provides detail beyond the five phase process that is specific to the approval of GPS installations and operations. The process is separated into airworthiness approval and operations approval. Some applicants may initiate the process through their operations inspector (probably Part 121 or Part 135 operators) while other applicants will initiate the process through their airworthiness inspector (probably Part 91 and Part 135 small operators).

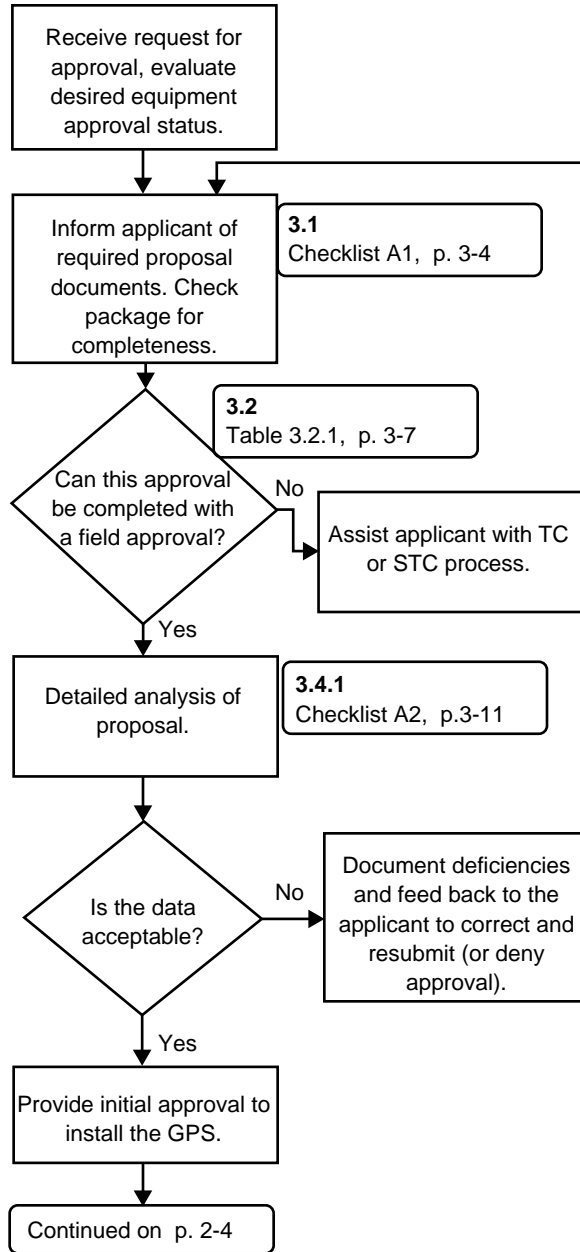
The flow diagram provides a high level view of the approval process and should be used **in conjunction with the detailed information provided in chapters 3 and 4.** The steps in the process are general and may not apply to special situations or approvals. Bold numbers placed next to the steps in the flow diagram indicate the section of this document that describes the step in more detail.

**Table 2.1.1 - General Process for Approval or Acceptance
Applied to GPS Approvals**

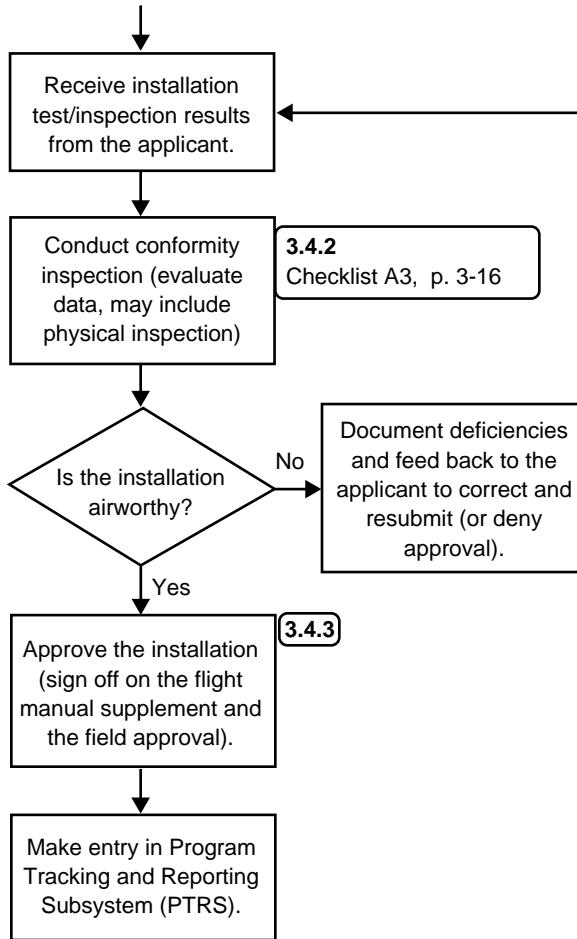
	Airworthiness	Operations
Phase One	Receive request from applicant for approval of GPS installation	Receive request from applicant for approval of GPS operations
Phase Two	Inform applicant of required proposal documents. Check proposal for completeness.	Inform applicant of required proposal documents/validation test plan. Check for completeness.
Phase Three	Analyze installation proposal documents for initial approval	Analyze operations proposal for initial approval
Phase Four	Conformity inspection of installation	Demonstration of capability to conduct GPS operations
Phase Five	Sign off on flight manual supplement and on Form 337 or other field approval document	Update Operational Specifications, sign off on training program

2.1.2 Approval Process Flow Diagram

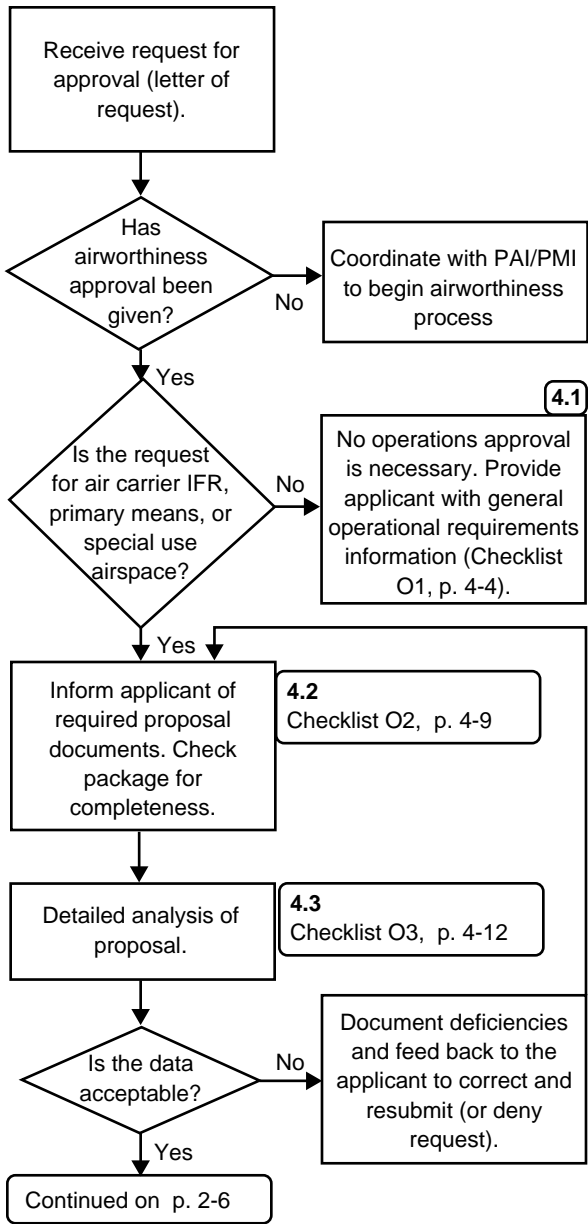
GPS AIRWORTHINESS APPROVAL PROCESS



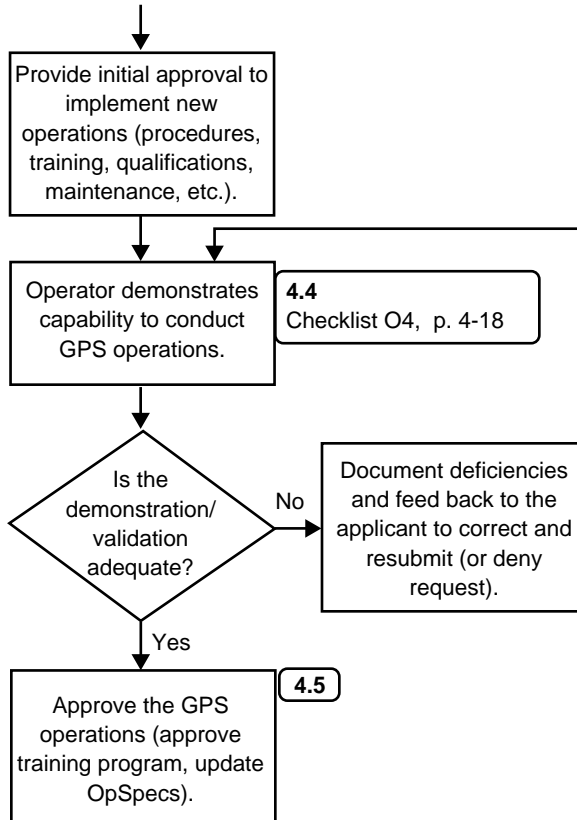
GPS AIRWORTHINESS APPROVAL PROCESS (Cont'd)



GPS OPERATIONS APPROVAL PROCESS



GPS OPERATIONS APPROVAL PROCESS (Cont'd)



2.2 DIFFERENCES IN APPROVALS AND PRACTICES

2.2.1 Federal Aviation Regulation Part Differences

Airworthiness approval is consistent across different Federal Aviation Regulation (FAR) Parts. There are differences in airworthiness approval depending on the types of operations and the systems used (described below) but there are no differences specific to FAR Part categories.

Operations approval of GPS equipment is slightly different across FAR Parts. The main difference is that operations approval is not required for Part 91 or Part 137 operations (unless the operations are for MNPS airspace or for primary means Class II operations). Part 91 and Part 137 operators are, however, required to meet GPS operations requirements in their use of GPS. So, while inspectors dealing with Part 91 and Part 137 operators (airworthiness or operations) do not need to approve the operational use of the systems, they may want to recommend that the operators read the relevant FAA documents. Checklist O1 (page 4-4) provides a list of the general GPS operations requirements.

In general, the operations approval requirements are the same for Part 121, 125 and Part 135 operators. The operations approval requirements are provided in detail in chapter 4.

2.2.2 Initial Versus Follow-on Airworthiness Approvals

Much of the FAA regulation documentation on GPS airworthiness approvals distinguishes between initial and follow-on approvals. An initial approval is the first airworthiness approval for a given GPS make and model. Except for GPS installations that will not be used for navigation (special use), initial airworthiness approvals (both VFR and IFR) must be completed by the TC or STC process and are completed at the ACO level. **This guide does not cover initial airworthiness approvals.**

Follow-on approvals are approvals of the same make and model GPS equipment on another aircraft using data from the original installation. The make and model of the aircraft may be different if the installation is similar. For a follow-on approval, the GPS hardware must be the same as the equipment from the original system. The GPS software and sensor mix must also be the same as the original system for field

approval without engineering assistance. In some cases, where the software or sensor mix differences are minor, the installation may be considered a follow-on installation, however, ASIs should consult their ACO before completing a field approval in these situations.

Most follow-on approvals may be completed by field approvals. This guide covers field approvals only. Table 3.2.1 in section 3.2 (p. 3-7) may be used to determine specifically whether a field approval is possible and if engineering or ACO contact is necessary.

2.2.3 VFR, IFR, and Nonprecision Approaches

GPS airworthiness approvals differ for VFR and IFR use. In general, there are more stringent airworthiness requirements for IFR use than for VFR use. The checklists in chapter 3 identify the differences in the specific approval requirements with a “V” to indicate a VFR item and an “I” to indicate an IFR item.

Operations approvals also are different depending on whether a system is for VFR use, for IFR use to include nonprecision approaches, or for IFR use without nonprecision approaches. First, there is no requirement for operations approval for VFR use of GPS systems. Second, the operations approval requirements for IFR approvals is slightly different depending on whether the approval is to include non-precision approach capabilities. The TSO-C129 equipment class requirements are different as are training and check ride requirements. The checklists in chapter 4 specify the requirements that are unique to approvals that include nonprecision approach capabilities.

2.2.4 Multi-sensor GPS Receivers

There are two types of GPS equipment -- stand-alone GPS and multi-sensor GPS. Multi-sensor GPS equipment receives input from more than one navigation sensor, such as Loran and GPS. The general requirements for airworthiness and operations approval of GPS equipment is similar for both stand-alone and multi-sensor equipment. However, there are a few additional airworthiness requirements for multi-sensor equipment.

Since multi-sensor installations may be more complex, the likelihood that an airworthiness field inspection can be completed for a follow-on installation is higher for stand-alone systems than for multi-sensor systems. This difference is taken into account in table 3.2.1 in section 3.2 for determining the method of airworthiness approval.

The TSO-C129 classifications also are different for multi-sensor equipment than for stand-alone GPS equipment. Specific airworthiness requirements that are unique to multi-sensor systems are described within the checklist items in chapter 3. With multi-sensor systems, aviation safety inspectors should pay close attention to issues such as effects on other equipment, pilot workload, autopilot coupling, and equipment operating environment.

2.2.5 Special Use - Not for Navigation

A special category of approval for GPS equipment is "Special Use -- Not for Navigation." Systems that are installed for special use (e.g., agricultural uses, search and rescue, etc.) that will not be used for aircraft navigation do not require operations approval and have less strict airworthiness approval requirements. The differences in airworthiness requirements for special use systems are noted in the checklists in chapter 3 with an "S". PAIs evaluating GPS installations for special use should ensure that the flight test includes performance of maneuvers that will normally be undertaken while the GPS is in use.

2.2.6 Portable GPS Receivers

Portable GPS receivers are becoming more common, especially in general aviation aircraft. Anyone using a portable hand-held GPS receiver is governed by FAR Section 91.21 which deals with portable electronic devices on aircraft. GPS yoke-mounted holders normally sold with the portable GPS receiver are not to interfere with the operation of the control of the aircraft or block the vision to primary instruments. A permanent, exterior GPS antenna can be installed with acceptable data.

2.2.7 Area of Operations

Class I operations are operations that occur within the operational service volume of ICAO standard airway navigation facilities (VOR, VOR/DME, NDB). Aircraft must be within one hour of a ground based NAVAID. Class II operations are operations that occur outside of the ICAO standard airways. There are several special navigation areas of operation within Class II airspace that require specific operations approval.

An operator requesting approval to use GPS may also want to expand the area of operations. In this situation, ASIs will have to approve the expansion in the area of operations in addition to approving the use of GPS. The details of these additional steps are not provided in this guide.

The main difference between approval to use GPS for Class I versus Class II airspace is the requirement for alternate navigation systems. The requirement is that the alternate be appropriate to the route flown. Class I GPS operations (en route and terminal) always require an approved alternate (different from GPS) appropriate to the route flown. Generally, Class II operations require an alternate long range system different from GPS (approved by the FAA). For example, the aircraft may operate with one GPS and one other FAA approved long-range navigation system such as INS or Omega. However, GPS can be approved for “primary means” Class II navigation using either dual GPS or single GPS as the only long-range navigation system. This approval requires evaluation of special fault detection and exclusion (FDE) systems and prediction programs. This issue is discussed in more detail in the following section.

Another difference between operations approval for Class I versus Class II airspace is that approvals for Class II require validation flights as part of the validation testing/demonstration while Class I approvals do not. Details are provided in section 4.4.

2.2.8 Primary Means Versus Supplemental Means Navigation

Using GPS as the “primary means” of navigation refers to the use of either single or dual GPS as the navigation equipment that provides the only means (other than dead reckoning) of satisfying the levels of accuracy and integrity of a particular area, route, procedure or operation.

While GPS may not meet full availability and continuity of service requirements for an area, safety is achieved by limiting flights to specific time periods and through appropriate procedural restrictions.

FAA documentation states that GPS may be approved for use as a supplemental means of navigation (but not as primary means) for most IFR operations. This does not mean that operators can’t use GPS as their main navigation system or that they must always be monitoring a different navigation system. Rather, it means that there must be a **different** alternate navigation system appropriate to the route flown that is installed and operational in the aircraft. Specific requirements about when and how this alternate navigation system must be used are described in Checklist O1 (p. 4-4) on general operations requirements.

The only exception to this is for IFR en route long-range navigation in Class II airspace. If operators are approved for use of GPS as primary means of Class II navigation, a different alternate navigation system appropriate to the route flown is **not** required, long-range navigation in Class II airspace may be completed with dual GPS. In addition, long-range navigation may be completed with single GPS in certain areas of operation (Caribbean Sea, Gulf of Mexico, Atlantic Ocean West of MNPS airspace, and/or special contingency routes in MNPS airspace) if operations approval has been given.

There are differences in both airworthiness and operations approval if an operator desires approval to operate GPS as primary means in Class II airspace. In this situation, the GPS system must meet extra requirements for detecting satellite problems and excluding them from the navigation solution. GPS operators must have a prediction program that predicts both satellite outages that will affect navigation and satellite outages that will affect the receivers ability to detect and exclude faults. **Equipment to be used in this manner requires coordination with the ACO for airworthiness approval.**

Operations approval also requires extra steps. The checklists in chapter 4 identify these requirements and make reference to the details described in references O4 and O9.

For air carriers, the requirements described for both Class I and Class II operations do not preclude the requirements called out in FAR 135.165 and FAR 121.349 which require two independent receivers for navigation and a marker beacon receiver. These requirements also must be met (though the alternate may be the same receivers that meet these requirements (e.g., VOR)).

2.2.9 Differential GPS Airborne Receivers for Special Use Applications

Currently, DGPS, as described in section 1.3, can be approved by ASIs for special use applications. These types of installations are considered nonessential and for special use, therefore, the criteria for equipment performance is to be determined by the GPS/DGPS equipment manufacturers. The flight crews are not to predicate navigation on the GPS/DGPS equipment. GPS/DGPS receivers and optional features, such as data logging, must be installed in accordance with FAA-approved data.

2.2.10 Special Category I Instrument Approaches

Special Category I (SCAT-I) Precision Approaches are specially authorized approaches made to MLS/ILS Category I minima (300') using DGPS. FAA Order 8400.11 lists the requirements for IFR approval of DGPS SCAT I approaches. If an FSDO receives a request for an operator to conduct SCAT-I approaches, the request should be forwarded to Flight Standards Technical Programs Division (AFS-400) through the regional flight standards division. In addition, there are responsibilities for the POI and PAI in the SCAT-I approval process. These requirements are not covered in this document but are provided in FAA Order 8400.11 (references A7 and O6). As approvals for SCAT-I operations using DGPS become more common, changes to this document will integrate these requirements into the checklists provided in chapters 3 and 4.

3. AIRWORTHINESS

3.0 AIRWORTHINESS APPROVAL

This chapter covers the requirements for the airworthiness approval of GPS. Three checklists and one decision table are provided for the airworthiness approval process.

The checklists are coded with capital letters (I, V) to indicate **required** items and lower-case italicized letters (*i, v, s*) to indicate **recommended** items. As a conservative approach, inspectors should include all of the items in the approval process. This is especially true for the first follow-on approval of a GPS unit by a given repair shop.

Important: The applicant must complete all items in the checklists. The “recommended” category is provided so that an inspector with a high degree of confidence in an applicant can choose whether or not to review each item. For example, flight test procedures are recommended as part of the initial data package. This means the inspector can choose whether or not to request flight test procedures from the applicant before providing initial approval to complete the installation. This does not mean that a flight test is optional -- a flight test is required, whether or not the inspector reviews the procedures.

There are five main sections associated with the airworthiness approval:

- 1) Section 3.1 covers the required proposal documents or data. This section corresponds to Phase II of the FAA 8300.10 airworthiness approval process (pp. A1-2-10, Vol 1 Ch. 3).
- 2) Section 3.2 includes a decision table to help the airworthiness inspector determine whether the inspection can be completed as a field approval (with or without coordination with the ACO) or if it must be completed as a TC or STC by the ACO.
- 3) Section 3.3 covers the steps that should be taken if a TC or STC is required.
- 4) If the approval can be completed via field approval, section 3.4 covers the remainder of the airworthiness field approval process.
 - Section 3.4.1 covers the detailed proposal analysis that corresponds to Phase III of the FAA 8300.10 approval process.

- Section 3.4.2 covers the conformity inspection (corresponds to Phase IV of the FAA 8300.10 approval process).
 - Section 3.4.3 covers the actual approval of the installation (corresponds to Phase V of the FAA 8300.10 approval process).
- 5) Finally, section 3.5 provides requirements for ensuring continued airworthiness of GPS installations.

3.1 REQUIRED PROPOSAL DOCUMENTS

Purpose:

Provide applicant with a list of required installation data. Verify receipt of all required data in the installation proposal package (5).

Procedure:

- A) Review the following checklist to determine what proposal data will be needed for the given airworthiness approval scenario.
- B) Inform applicant of required proposal documents or data.
- C) Verify that the received proposal package contains all of the required data by checking off the items in the checklist.
- D) Document deficiencies and inform the applicant if the package is incomplete.
- E) Deny the request for approval if the applicant fails to provide the required information.
- F) Continue with section 3.2 when the package is complete.

3.1 CHECKLIST A1 - REQUIRED DOCUMENTS

- I** Required for IFR installations
- i* Recommended for IFR (especially first follow-on of a type GPS by a particular repair shop)
- V** Required for VFR installations
- v* Recommended for VFR (especially first follow-on)
- s* Recommended for special use (not for navigation) systems

#	Req'd	Proposal Documents	Date Rec'd
1	I, V	Copy of STC or TC from originally approved aircraft (1)	
2	I	Sample (or copy of original approved) flight manual supplement (1)	
3	V	Sample (or copy of original) flight manual supplement if multiple navigation sources, composite roll steering, or unusual limitations (1)	
4	I	Verification of equipment TSO-C129 approval status (including antenna, software, autopilot, integration, etc.) (1)	
5	<i>i, v</i>	GPS environment specifications as provided by the manufacturer (maximum operating speed, temperature, pressure, etc.) (1, 2)	
6	<i>i, v</i>	Environment specifications for proposed GPS installation location as provided by the installer (maximum aircraft speed, temperatures, and pressures, etc.) (1, 2)	
7	<i>i, v, s</i>	Installation drawings (incl. antenna) (2)	
8	<i>i, v, s</i>	Proposed cockpit layout of the installation (2)	
9	<i>i, v</i>	Structural analysis of proposed installation, including antenna (2)	
10	<i>i, v, s</i>	Flight test program (3)	
11	<i>i</i>	Wiring diagrams, descriptive wiring routing (2)	
12	<i>i, v</i>	Data flow diagram (recommended for multi-sensor VFR installations) (2)	
13	<i>s</i>	Ground test procedures (4)	

3.1 REQUIRED PROPOSAL DOCUMENTS

Requirements:

- (1) pp. A2• (4, 9, 12); 7c(2)(i), 8c(2)(i), App. 1 1c
pp. A3• (9, 17-18, 22, 24); 8c(2)(i), 9c(2)(iv), App. 1 2c, 3d
pp. A4• (2, 5, 6); 1B, 4H, 5B
- (2) pp. A2• (3, 6-7, 13); 7c(1)(ii), 8c(1)(ii), App. 1 2b
pp. A3• (4-6, 11-14, 23-24); 8c(1)(ii), 9c(1)(ii), App. 1 3b-c
pp. A5•3; 6
- (3) pp. A2• (3-4, 8-9, 10-11); 7c(1)(iv), 8c(1)(iv)F, J, 8c(2)(iv)
pp. A3• (7-8, 14-16, 18-21); 8c(1)(iv), 9c(1)(iv)K, 9c(2)(vii)
pp. A4• (5, 6, 6-7); 4F-G, 5B, 6B
- (4) pp. A5•2; 4A

Guidelines:

- (5) p. A1•(4-6, 10-12); Vol. 1 Ch. 3 33, Vol. 2 Ch. 1 5

3.2 DETERMINE METHOD OF APPROVAL

Purpose:

Determine whether airworthiness approval can be completed through field approval (with or without engineering assistance) or if a TC or STC is required.

Procedure:

- A) Use table 3.2.1 on the following page to determine which of the following methods of approval will be used. A preliminary data analysis may have to be completed before you can answer all of the questions in the table.
1. **TC/STC** - Approvals must be completed via TC or STC, continue with section 3.3.
 2. **ACO** - Approvals require engineering assistance. Contact your ACO, then skip to section 3.4 and continue with the approval. Flight tests may require the ACO or an authorized test pilot designated engineering representative (DER).
 3. **Field Approval** - A field approval can be completed. The installer can conduct the required flight tests. Go to section 3.4.
 4. **None** - Approval can be completed via FAA Form 337 and approved data (airplane flight manual or flight manual supplement) without an ASI's signature in block 3 of FAA Form 337. The approval does not require the field approval process.

3.2 DETERMINE METHOD OF APPROVAL

Table 3.2.1 - Determine Method of Approval

#	Question	If YES	If NO
1	Is the approval a duplicate of an STC for the same equipment on the same model/type aircraft?(1)	None	Continue
2	Is the approval for special use (not for navigation)? (2)	Field Approval	Continue
3	Is this the first approval for this type of GPS equipment? (3)	TC/STC	Continue
4	Is the approval for VFR use?	go to #14	Continue
5	Is this approval for primary means oceanic and remote? (4)	ACO	Continue
6	Is this a multi-sensor approval?	Continue	go to #10
7	Is the approval for TSO-C129 Class C() equipment? (5)	TC/STC	Continue
8	Is the amount, type, or mix of sensors different from previous approvals? (6)	ACO	Continue
9	If an autopilot/flight director will be integrated with the GPS, is the autopilot or aircraft model and series different from previous approvals? (6)	ACO	Continue
10	Does the approval require changes to software affecting navigation, integrity, or the availability of functions? (6)	TC/STC	Continue
11	Is the cross-track deviation display outside of the pilot's primary field of view? (6)	ACO	Continue
12	Are any GPS controls outside of easy reach of the pilot? (6)	ACO	Continue
13	Are any GPS annunciators outside of the pilot's normal field of view? (6)	ACO	Continue
14	Does the installation require a high degree of integration with the aircraft system? (6)	ACO	Continue
15	Are you uncomfortable with any part of the installation? (6)	ACO	Field Approval

3.2 DETERMINE METHOD OF APPROVAL

Requirements:

- (1) p. A4•2-3; 1A, 1C
p. O4•3; 5B
p. O8•7; 6d
- (2) pp. A5•2; 3
- (3) pp. A2• (2, 5-6); 7a, 8a
pp. A3• (8-9, 10); 8c(2), 9a
p. A4• (4, 5, 6); 4A, 5A, 6A
p. O4•3; 5A
p. O8•6; 6b
- (4) p. A4•7-8; 8A
p. O4•3; 5A, B
p. O8•6-7; 6
- (5) p. A3•10-11; 9a(3)
- (6) pp. A2• (2, 6); 7a(2), 8a(2)
pp. A3• (8-9, 10, 17, 23); 8c(2), 9a(2), 9c(2)(i-iii), App. 1 3a(2)

3.3 AIRWORTHINESS APPROVAL VIA TC OR STC PROCESS

Purpose:

If approval can not be completed via field approval, inspectors may assist the applicant with the TC or STC process and should track the results of the process.

Procedure:

A) Assist applicant with TC or STC approval request by helping them contact the appropriate aircraft certification office (ACO).

B) Review TC or STC when complete.

Note: Although no approval by the PAI or PMI is required for a TC or STC, the inspectors should be aware of the GPS installation. The inspectors may want to review the TC or STC for the considerations outlined in sections 3.4.1 and 3.4.2.

C) Coordinate with POI to begin operations approval (see chapter 4).

3.4 AIRWORTHINESS FIELD APPROVAL

3.4.1 Detailed Analysis of Proposal

Purpose:

Analyze proposal package provided by applicant to assess the airworthiness of the proposed installation **(9)**.

Procedure:

- A) Analyze the proposal package in accordance with checklist A2. The depth of the analysis will depend on the particular approval situation and should be determined by the PAI.
- B) Document any deficiencies in the proposal data and feed the information back to the applicant to correct and resubmit.
- C) Provide initial approval for the applicant to install the GPS equipment if the data are complete and indicate that the installation will be airworthy.

3.4.1 CHECKLIST A2 - DETAILED ANALYSIS

- I** Required for IFR installations
- i* Recommended for IFR (especially first follow-on of a type GPS by a particular repair shop)
- V** Required for VFR installations
- v* Recommended for VFR (especially first follow-on)
- s** Recommended for special use (not for navigation) systems

#	Req'd	Proposal Data Analysis	Pass
1	I, V	TC/STC (1)	
		a) Current for antenna, software, autopilot/flight director interface, system integration, etc.	
		b) Indicates that equipment satisfies accuracy and ground test requirements	
2	I	TSO - C129 approval appropriate to desired operations (1)	
3	i, v	Sample approved flight manual supplement includes: (2)	
		a) Equipment operating limits	
		b) Emergency/abnormal operations	
		c) Normal procedures for GPS and interfaced equipment	
		d) General description of GPS or reference to a pilot's guide	
4	i, v	GPS environmental specification appropriate to aircraft environment (1, 3)	
		a) Maximum speed	
		b) Temperature, altitude, pressure	
5	i, v	Antenna installation (3)	
		a) Isolated from other antennas	
		b) Free from shadowing by aircraft structures	
		Continued...	

3.4.1 CHECKLIST A2 - DETAILED ANALYSIS (Continued)

#	Req'd	Proposal Data Analysis	Pass
6	<i>i, v, s</i>	Cockpit layout (3) a) Controls (accessible and visible) b) Displays and annunciators (within normal view - CDI, HSI within primary field of view for IFR) c) Circuit breakers (labeled and accessible) d) Switching arrangement	
7	<i>i, v</i>	Structural analysis (equipment and antenna) (3) a) Mounting b) Dynamics c) Crash load requirements	
8	<i>i</i>	Wiring diagrams and routing (3)	
9	<i>i, v</i>	Data flow diagram (recommended for multi-sensor VFR installations) (3)	
10	<i>i</i>	Electrical load analysis (3)	
11	<i>i</i>	For aircraft approved for flight into icing, the antenna is resistant to ice buildup (4)	
12	<i>v</i>	Cockpit layout will include a placard stating "GPS (or Navigation or Flight Management System) limited to VFR use only" (5)	
13	<i>s</i>	Cockpit layout will include a placard stating "GPS/DGPS not to be used for navigation" (6)	
		Continued...	

3.4.1 CHECKLIST A2 - DETAILED ANALYSIS (Continued)

#	Req'd	Proposal Data Analysis	Pass
14	<i>i, v</i>	Flight test procedures include: (7, 10) a) Overall system function (covering all modes of multi-sensor systems) b) Steering response (if coupled to autopilot) c) Interference (either to or from other equipment) (see ref.) d) Accessibility of controls e) Visibility of displays, controls, annunciators	
15	<i>i</i>	Flight test procedures include: (7, 10) a) Effects of failure b) GPS parameters on cockpit instruments c) Effects of switching and transfer functions d) Continuity of navigation in turns (360° left and right at 30° bank) e) Cross track error, flight technical error f) Instrument approaches (if approval includes approach, at least three)	
16	<i>s</i>	Flight test procedures include evaluation of aircraft performance through speed ranges and maneuvers normally conducted during specific application of GPS (8, 10)	
17	<i>s</i>	Ground test procedures (8)	

3.4.1 Detailed Analysis of Proposal

Requirements:

- (1) pp. A2• (4, 9); 7c(2)(i), 8c(2)(i)
pp. A3• (9, 17-18); 8c(2)(i), 9c(2)(iv)
pp. A4• (2, 4-5); 1B, 4E
- (2) pp. A2• (12, 13, 14-21); App.1 1c, App. 1 2c, App. 2
pp. A3• (9, 17-18, 22, 24, 25-32); 8c(2)(i), 9c(2)(iv), App.1
2c, App.1 3d, App. 2
pp. A4• (2-3, 7); 1A-C, 7A-B
- (3) pp. A2• (3, 6-8, 13); 7c(1)(ii), 8c(1)(ii), App. 1 2b
pp. A3• (4-6, 11-14, 23-24); 8c(1)(ii), 9c(1)(ii), App. 1 3b-c
pp. A5•3; 6
- (4) pp. A3• 11; 9b(7)
- (5) pp. A2•3; 7c(1)(ii)(D)
pp. A3•4; 8c(1)(ii)(E)
pp. A4•4; 4D
- (6) pp. A5•3-4; 7
- (7) pp. A2• (3-4, 9, 10-11); 7c(1)(iv), 8c(1)(iv)F, J, 8c(2)(iv)
pp. A3• (7-8, 14-16, 18-21); 8c(1)(iv), 9c(1)(iv)K, 9c(2)(vii)
pp. A4• (5, 6, 6-7); 4F-G, 5B, 6B
- (8) p. A5• (2, 3); 4A, 5

Guidelines:

- (9) pp. A1•(6-7, 10-13); Vol. 1 Ch. 3 35, Vol. 2 Ch. 1 5
- (10) pp. A6•2-17; Ch. 2

3.4.2 Conformity Inspection

Purpose:

Conduct a conformity inspection of the GPS installation to ensure that the equipment was installed as described in the proposal package and meets the requirements of the flight test **(8)**.

Procedure:

- A) Inspect the GPS installation in accordance with checklist A3. The inspector may choose to inspect data only or may conduct a physical inspection of the aircraft. The depth of the conformity inspection will be dependent on the particular approval situation and should be determined by the PAI.
- B) Document any deficiencies found during the inspection and feed back the information to the applicant to correct and resubmit.
- C) Continue with section 3.4.3 to approve the airworthiness of the installation if the results of the inspection indicate that the installation is airworthy.

3.4.2 CHECKLIST A3 - CONFORMITY INSPECTION

- I** Required for IFR installations
- i* Recommended for IFR (especially first follow-on of a type GPS by a particular repair shop)
- V** Required for VFR installations
- v* Recommended for VFR (especially first follow-on)
- s* Recommended for special use (not for navigation) systems

#	Req'd	Inspection Items	Pass
1	I, V	Form 337 (or other field approval document) indicates that installation was completed in accordance with accepted procedures and a functional flight test was conducted in accordance with AC 20-138 (1)	
2	I, V	Limitations of flight manual supplement not different from limitations from original approved flight manual supplement (required for VFR if system includes multiple navigation sources, composite roll steering, or unusual limitations and operating procedures) (1)	
3	i, v	Flight manual supplement includes (2) a) Equipment operating limits b) Emergency/abnormal operations c) Normal procedure for GPS and interfaced equipment d) General description of GPS or reference to a pilot's guide	
4	i, v	General function (3) a) GPS equipment functioning properly	
5	i, v, s	Interference (3) a) GPS equipment does not interfere with other equipment b) Other equipment does not interfere with GPS equipment (check harmonic interference from VHF transmitters - see (3) for frequencies)	
		Continued...	

3.4.2 CHECKLIST A3 - CONFORMITY INSPECTION

#	Req'd	Inspection Items	Pass
6	<i>i, v</i>	Cockpit layout (4)	
		a) Controls (within reach)	
		b) Displays and annunciators (within normal view - CDI, HSI within primary field of view for IFR)	
		c) Circuit breakers (labeled and accessible)	
		d) Switching arrangement	
		e) Matches description in flight manual supplement	
7	<i>i, v</i>	Antenna installation structurally sound (4)	
8	<i>i, v</i>	Flight test -- review results of (data) or ride along (3, 9)	
		a) Overall system functioning properly (all modes of multi-sensor systems)	
		b) Accurate (over five known locations)	
		c) Steering response good (if coupled to autopilot)	
		d) No interference (either to or from other equipment)	
		e) Accessible controls	
		f) Visible displays, controls, annunciators	
		Continued...	

3.4.2 CHECKLIST A3 - CONFORMITY INSPECTION

	<u>Req'd</u>	Inspection Items	<u>Pass</u>
9	<i>i</i>	Flight test -- review results of (data) or ride along (3, 9) a) Effects of failure are as expected b) GPS parameters displayed correctly on cockpit instruments c) Effects of switching and transfer functions as expected d) Continuous navigation through turns e) Cross track error and flight technical error within limits (flight technical error less than 1.0 NM for en route and approach transition, less than 0.25 NM for approach) f) Instrument approaches performed correctly	
10	<i>s</i>	Results of flight test -- use of GPS does not interfere with aircraft or pilot performance (5, 9)	
11	<i>v</i>	Cockpit layout includes a placard stating "GPS (or Navigation or Flight Management System) limited to VFR use only" for VFR installations (6)	
12	<i>s</i>	Cockpit layout includes a placard stating "GPS/DGPS not for navigation" (7)	
13	<i>i</i>	Wiring within accepted standards (4)	
14	<i>s</i>	Results of ground test (review data or watch testing) (5)	

3.4.2 Conformity Inspection

Requirements:

- (1) pp. A2• (4-5, 9); 7c(2)(i), 8c(2)(i)
pp. A3• (9, 17-18); 8c(2)(i), 9c(2)(iv)
pp. A4• (2, 4-5); 1B, 4E
- (2) pp. A2• (12, 13, 14-21); App.1 1c, App. 1 2c, App. 2
pp. A3• (9, 17-18, 22, 24, 25-32); 8c(2)(i), 9c(2)(iv), App.1
2c, App.1 3d, App. 2
- (3) pp. A2• (3-5, 8-9, 10-11); 7c(1)(iv), 8c(1)(iv)F,J, 8c(2)(iv)
pp. A3• (7-8, 14-16, 18-21); 8c(1)(iv), 9c(1)(iv)K, 9c(2)(vii)
pp. A4• (5, 6, 6-7, 9-10); 4F-G, 5B, 6B, 10
- (4) pp. A2• (3, 6-8, 13); 7c(1)(ii), 8c(1)(ii), App. 1 2b
pp. A3• (4-6, 11-14, 23-24); 8c(1)(ii), 9c(1)(ii), App. 1 3b-c
pp. A5•3; 6
- (5) p. A5• (2, 3); 4A, 5.
- (6) pp. A2•3; 7c(1)(ii)(D)
pp. A3•4; 8c(1)(ii)(E)
pp. A4•4; 4D
- (7) pp. A5•3-4; 7

Guidelines:

- (8) pp. A1•(8-9, 10-13); Vol. 1 Ch. 3 37, Vol. 2 Ch. 1 5
- (9) pp. A6•2-17; Ch. 2

3.4.3 Field Airworthiness Approval

Purpose:

Finalize the airworthiness approval for the GPS equipment **(4)**.

Procedure:

- A) Sign off on the new flight manual supplement (generally IFR only, but may be required for VFR) **(1)**.
- B) Sign off on the FAA form 337 (or other field approval document) **(1)**.
- C) Make entry in the program tracking and reporting subsystem (PTRS). Fill out the "NATIONAL USE" block of FAA Form 8000-36 with the letters "GPS" and a description of the type of GPS activity accomplished in the "Comment Text" Column **(2)**.
- D) If the approval is for a special use, not for navigation system and the inspector determines that the data are capable of being used for other similar make and model operations, the inspector may authorize Block 3 of Form 337 for duplication for similar make and model aircraft **(3)**.

3.4.3 Airworthiness Approval

Requirements:

- (1) pp. A4• (2, 6, 7); 1A-B, 5B, 7A-B
- (2) p. A4•8; 9
- (3) pp. A5•3; 6

Guidelines:

- (4) pp. A1• (9-10, 10-13); Vol.1 Ch.3 39, Vol.2 Ch.1 5

3.5 CONTINUING GPS AIRWORTHINESS

Purpose:

Ensure continued airworthiness of the newly installed GPS system.

Procedure:

- A) For Part 121, 125 and 135 operations, coordinate with the POI to ensure that the operator's maintenance program covers the following **(1)**:
 - 1. Manuals, policies and procedures incorporate the GPS manufacturer's instructions for continued airworthiness of the GPS equipment.
 - 2. As applicable, revisions to the MMEL, MEL, CDL and/or dispatch deviation procedures include the GPS equipment.
 - 3. Service difficulties with the GPS equipment are reported in accordance with FAR 121 and 135.
- B) Periodically, survey operator and/or repair shop activities to ensure continued GPS airworthiness. Review inspection reports, service reports, maintenance records, incident and accident reports, and other relevant information for potential GPS airworthiness problems.

Requirements:

- (1)** p. O2-6; 5F

4. OPERATIONS

4.0 OPERATIONS APPROVAL/VALIDATION

Operations approval is not required for special (not for navigation) use, for VFR use, or for Part 91 or 137 use (except in MNPS airspace or for use as “primary means” Class II navigation) of GPS. Operators requesting approval or information for operations that do not require operations approval may be provided with the General Operations requirements listed in the following section (section 4.1).

Operations approval is required for Part 91 or 137 use if the approval is for operations in special use (MNPS) airspace or for use of GPS as “primary means” for Class II navigation. This approval is usually in the form of a Letter of Authorization (LOA). Guidance on these approvals is not included in the current release of this document, but will be included in the next revision. POIs are referred to FAA Order 8700.1 chapter 222 for more information.

Operations approval (and validation testing) is required for IFR use of GPS by Part 121, 125, and 135 operators. Validation testing may be completed without validation flights unless the approval is for operations in Class II or special use airspace. Validation flights are required for operations in Class II or special use airspace by any FAR Part operators. This chapter steps through the process for POIs to conduct operations approval/validation testing for the use of GPS.

There are four checklists included in this chapter:

- (1) General Operations Requirements
- (2) Required Proposal Documents/Validation Test Plan
- (3) Detailed Analysis of Proposal
- (4) Demonstration/Validation Test

The checklists are coded with letters in the left hand column to indicate requirements for different types of approvals (e.g., approvals for non-precision approach use or long range use). In addition, the checklists are coded with capital letters to indicate **required** items and lower-case italicized letters to indicate **recommended** items. As a conservative approach, inspectors should include each of the items in the approval process. The recommended category is provided because it is recognized that some inspection items may be difficult for inspectors and costly for operators. If necessary, inspectors may use other means (such as observing simulator tests to observe GPS operations) to evaluate recommended items.

There are six main sections in this chapter:

- i) Section 4.1 provides a checklist of general operations requirements for the use of GPS. ASIs should ensure that applicants are aware of, and are operating in compliance with, these requirements.
- ii) Section 4.2 is the first step in the approval process for an ASI. It provides a list of required proposal documents/validation test items. It corresponds to Phase II in the general approval process, training approval process, and validation test process listed in FAA Order 8400.10 Operations Inspector's Handbook (reference O1, pp. O1•2-33).
- iii) Section 4.3 provides a checklist of items that should be evaluated in a detailed analysis of the proposal. This step corresponds to Phase III in the 8400.10 operations approval process.
- iv) Section 4.4 is a list of demonstration (validation test) items (corresponds to Phase IV in the 8400.10 approval process).
- v) Section 4.5 provides details of completing the final operations approval (corresponds to Phase V in the 8400.10 approval process).
- vi) Finally, section 4.6 provides information on ensuring continued safe operations using GPS.

4.1 GENERAL OPERATIONS REQUIREMENTS

Purpose:

Provide a list of general operations requirements to all operators planning to use GPS equipment.

Procedure:

- A) Use this list to familiarize yourself and to provide information to operators on general GPS operations requirements.
- B) For operators that do not require operations approval, no further action is required.
- C) For operators that do require operations approval, continue with section 4.3.

4.1 CHECKLIST O1 - GENERAL OPERATIONS REQUIREMENTS

- V Required for VFR use
- I Required for IFR use
- N Additional requirements for IFR nonprecision approach
- L Additional requirements for IFR Class II (long-range) navigation
- P Additional requirements for GPS as “primary means” of IFR Class II navigation

#	Req'd	General Operations Requirements	Pass
1	V, I	GPS system is FAA approved for airworthiness (see chapter 3) (1)	
2	V, I	GPS equipment and TSO-C129 approval status appropriate for desired operations (see tables 1.3.1 and 1.3.2) (1)	
3	I	Aircraft equipped with approved and operational alternate appropriate to operations (2)	
4	I	Ground-based en route facilities for destination and alternate available and operational (3)	
5	I	Equipment has RAIM or RAIM equivalent capabilities (required by TSO-C129 approval class) (1)	
6	P	Equipment has approved FDE and FDE prediction program (4)	
7	I	Pilots review NOTAMs prior to flight for potential satellite outages (5)	
8	I	If RAIM capabilities lost during flight, pilot actively monitors alternate (6)	
9	I	If RAIM capabilities predicted to be lost, pilots rely on other approved equipment or cancel or delay flight (6)	
10	I	GPS operations conducted in accordance with approved flight manual or flight manual supplement (7)	
11	P	Flight manual supplement includes statement requiring FDE prediction program (7)	
		Continued...	

4.1 CHECKLIST 01 - GENERAL OPERATIONS REQUIREMENTS

#	Req'd	General Operations Requirements	Pass
12	I	Flight plan includes appropriate suffix (usually /G -- RNAV) (8)	
13	I	Air carrier and commercial operators meet provisions of OpSpecs (9)	
14	L	Operations in special use (MNPS) airspace and/or "primary means" operations approved via Letter of Authorization (LOA) or OpSpecs (9)	
15	L	Class II operations not approved for "primary means" may be conducted with a single GPS with RAIM (TSO-C129 Class A1, A2, B1, B2, C1, C2) and a different approved long range system (e.g., INS or Omega) unless approved for "primary means" (10)	
16	P	Class II operations approved for "primary means" may be conducted with dual GPS with RAIM (TSO-C129 Class A1, A2, B1, B2, C1, C2) (10)	
17	P	Class II operations approved for single GPS "primary means" (restricted areas) may be conducted with single GPS with RAIM (TSO-C129 Class A1, A2, B1, B2, C1, C2) (10)	
18	P	Prediction program is used before departure to demonstrate (11) : a) No outages in capability to navigate b) Maximum duration of loss of capability to detect faults (e.g., duration of RAIM not available) less than time to exit protected airspace at 35 NM/h cross track	
19	P	For navigation or integrity failures during flight (11) , a) If GPS displays loss of navigation, pilot begins dead reckoning and reports to ATC and flight following Continued...	

4.1 CHECKLIST O1 - GENERAL OPERATIONS REQUIREMENTS

#	Req'd	General Operations Requirements	Pass
19	P	b) If capability to detect faults lost (RAIM not available), verify navigation integrity with last verified position and report to ATC	
		c) If satellite fails, monitor position uncertainty - over 10 NM, use dead reckoning and report to ATC	
20	N	Equipment must be approved to TSO-C129 Class A1, B1, B3, C1, or C3 (1)	
21	N	Approach to be flown is retrievable from the GPS equipment database (12)	
22	N	Overlay instrument approach procedures to be flown are (12) :	
		a) Nonprecision	
		b) Do not include LOC, LDA, or SDF procedures	
		c) In U.S. NAS (unless otherwise authorized)	
23	N	Air carriers comply with FAR 121.349 and 135.165 -- e.g., two VORs and operational ground NAVAIDs positioned to continue to alternate and land (13)	
24	N	Alternate airport has approved, operational, and available IAP (not GPS or Loran) that can be flown with aircraft-installed equipment (14)	
25	N	For approach procedures without GPS in the title ("overlay" procedures), ground-based alternate equipment is installed and operational at the destination and at alternate airport(s) (14)	
26	N	For approach procedures with GPS in the title, ground-based alternate equipment is installed and operational at alternate airport(s) (14)	

4.1 GENERAL OPERATIONS REQUIREMENTS

Requirements:

- (1) pp. O2•(3-4, 7); 5A(a), 8A-B (11) pp. O4•(4-6); 6D-E
pp. O4•3; 5A-B
p. O7•6-8; Section 1 4 (12) pp. O2•(8, 9); 11A-B, 12A-B
p. O8•6; 6a pp. O5•3-4; 4-5
pp. O7•(4-6, 9-16); Section 1
3e-g, Section 2
- (2) pp. O2•(7, 8); 8E, 10
p. O4•2; 1 (13) p. O2•10; 13
p. O8•2; 1
- (3) p. O2•7-8; 9 (14) p. O2•(9,10); 12, 14
p. O5•4-5; 6B-C
pp. O7•4-6; Section 1 3e-g
- (4) p. O4•4-5; 6D(1)
pp. O8•(2-5, 7-15) ;4-5, App.
1-4
- (5) pp. O5•3; 3F
p. O7•17; Section 3 2c
- (6) pp. O2•(7, 7, 8, 9); 8C, 8E,
10, 11D
p. O5•2; 3C
p. O7•17; Section 3 2d
- (7) p. O4•3; 5C
p. O5•2; 3D
- (8) p. O2•7; 8D
p. O5•2; 3E
p. O7•18; Section 3 2e
- (9) p. O2•6; 7
p. O4•9; 9
pp. O5•(3, 3-4); 3G, 4
- (10) p. O2•8; 10
p. O4•2; 1
pp. O5•3-4; 4
p. O8•2; 1

4.2 REQUIRED PROPOSAL DOCUMENTS/VALIDATION TEST PLAN

Purpose:

Provide applicant with a list of required data for operations approval. Verify receipt of all required data in the proposal package **(9)**.

Procedure:

- A) Review the following checklist and determine what proposal data will be required for the given operations approval scenario.
- B) Inform applicant of required proposal documents or data.
- C) Open a PTRS record **(10)**.
- D) Verify that the received proposal package contains all of the required data using checklist O2.
- E) Inform the applicant of discrepancies and ask them to submit the missing information if the proposal is incomplete.
- F) Write a letter denying the request for approval for GPS operations if the operator refuses to correct the deficiencies.
- G) Continue with section 4.3 when the proposal package is complete.

4.2 CHECKLIST O2 - REQUIRED DOCUMENTS

- I** Required for IFR use
- N** Additional requirements for IFR nonprecision approach use
- L** Additional requirements for long-range (Class II) navigation

#	Req'd	Proposal Documents	Date Rec'd
1	I	Letter of Request (1, 9) a) Make and model GPS b) TSO-C129 classification c) Airworthiness approval status d) Desired type of operations (e.g., IFR, nonprecision approach) e) Desired area of operations f) Verification of alternate navigation equipment and compliance with FAR 121.349 and 135.165	
2	I	Sample (or copy of original approved) flight manual supplement (2)	
3	I	Proposed crew training program (3) a) Facilities b) Schedule c) Syllabus/outline for both classroom and practical training d) Courseware	
4	I	Proposed crew qualification program (3) a) Initial qualification procedures b) Recurrent qualification procedures c) Initial and recurrent schedule	
5	I	Manuals and procedures to be used (4) 1. Pre-flight procedures 2. General operating manual/ procedures 3. Outage/emergency procedures	
6	I	Validation program (5, 10)	
7	L	Validation test flight plans (6, 10)	
8	I	Maintenance program (7)	
9	N	If applicable, special GPS IAPs (coordinate with regional flight procedures branch and AFS-400) (8)	

4.2 REQUIRED PROPOSAL DOCUMENTS

Requirements:

- (1) pp. O2•(3, 3-4); 4A, 5A(a)
p. O4•3; 5A-B
- (2) p. O4•3 5C
- (3) pp. O1•13-19; Vol.3 Ch.2 315-321
pp. O2•4-5; 5Ba-d
p. O4•4; 6B-C
- (4) pp. O2• (4, 5, 7); 5A(b), 5B(e), 8C
pp. O4• (4-6); 6D-E
- (5) pp. O2•(3, 5, 6); 2D, 5E, 7A
- (6) pp. O4•7-9; 8
- (7) p. O2•6; 5F
- (8) p. O5•5; 6C

Guidelines:

- (9) pp. O1•2-6; Vol.1 Ch.4 205-209
- (10) pp. O1•30-36; Vol.3 Ch.9 1565-1573 and 1655-1667

4.3 DETAILED ANALYSIS OF PROPOSAL

Purpose:

Analyze proposal package provided by applicant to determine whether the proposed operations changes will provide for operations using GPS equivalent to the current level of safety **(12)**.

Procedure:

- A) Analyze the proposal package in accordance with checklist O3. The depth of the analysis will depend on the particular approval situation and should be determined by the POI.
- B) Consult the appropriate references for additional approval requirements if the analysis indicates that the operator is requesting approval for operations that are beyond their current approvals using other navigation systems (for example, expanding IFR operations to include nonprecision approach or expanding areas of operation to include Class II, etc.).
- C) Document any deficiencies in the proposal data and provide feedback to the applicant to correct and resubmit.
- D) Write a letter denying the request for approval for GPS operations and for initial approval of the training program if the operator refuses to correct the deficiencies.
- E) Provide initial approval for the applicant to begin implementation of the training program if the data are complete and acceptable **(12)**. This approval requires a letter with an expiration date of no greater than 2 years beyond the date of the initial approval. The letter should include:
 - Identification of the approved curriculum including page numbers and revision control dates
 - A statement indicating that initial approval is granted including the effective and expiration dates
 - Any specific conditions affecting the initial approval
 - A request for advance notice of training schedules

4.3 CHECKLIST O3 - DETAILED ANALYSIS

- I** Required for IFR use
- N** Additional requirements for nonprecision approach use
- L** Additional requirements for long-range (Class II) navigation
- P** Additional requirements for “primary means” Class II navigation

#	Req'd	Proposal Data Analysis	Pass
1	I	Airworthiness approval complete (1)	
2	I	Equipment is TSO-C129 approved, any Class (2)	
3	N	Equipment is TSO-C129 approved to Class A1, B1, B3, C1, or C3 (2)	
4	L	Equipment is TSO-C129 approved to Class A1, A2, B1, B2, C1, or C2 (2)	
5	I	Operator complies with FAR 121.349 and 135.165, aircraft equipped with alternate navigation system approved for IFR en route (3)	
6	N	Aircraft equipped with alternate navigation system approved for non-precision approaches (3)	
7	L	Aircraft equipped with alternate long-range navigation system (e.g., Omega, INS) (not required for “primary means” approvals) (3)	
8	P	For primary means oceanic and remote (4), a) FAA navigation specialist contacted b) Fault detection and exclusion (FDE) program approved c) Pre-departure FDE prediction program approved	
9	I	If area or type of operations is beyond current approvals with other navigation systems, additional requirements reviewed (see B. on previous page)	
		Continued...	

4.3 CHECKLIST O3 - DETAILED ANALYSIS

#	Req'd	Proposal Data Analysis	Pass
10	I	Training program covers (5)	
		a) Principals of GPS navigation	
		b) GPS equipment operations	
		i) Software use	
		ii) Hardware operation and interface with other equipment	
		iii) Database updating procedures	
		iv) Limitations of GPS equipment	
		c) Pre-departure procedures	
		d) Standard en route procedures	
		e) Emergency/contingency procedures	
f) Maintenance and dispatch procedures			
g) Contents of OpSpecs			
11	P	Training program covers use of GPS as primary means of navigation for long range and use of fault detection and evaluation (FDE) prediction program (6):	
		a) Pre-departure procedures	
		b) En route procedures	
12	I	Training program includes practical training (in flight, in a simulator, or with GPS equipment in simulation mode) (5)	
13	I	Training schedule includes adequate hours to cover topics and for crew to pass a written exam and proficiency check (5)	
		Continued...	

4.3 CHECKLIST O3 - DETAILED ANALYSIS

#	Req'd	Proposal Data Analysis	Pass
14	I	Qualification program proficiency check (7) a) In flight or in approved simulator b) Covers all requested operations c) Consistent with qualification required for ILS, VOR/DME, RNAV and multi-sensor RNAV/ FMS d) If approval includes special GPS approach procedures (e.g., steep descent), covers similar approaches	
15	I	Qualification program includes recurrent training/qualification (7) a) In flight or in approved simulator b) Pilot in command performs GPS proficiency check every 6 months	
16	N	Recurrent qualification program (7) a) Pilot in command performs GPS approach proficiency check every 6 months b) GPS may substitute for another non-precision approach but not vice versa c) Unless both pilots are qualified, crew cannot perform a GPS approach in IMC	
17	I	Manuals, policies, procedures (8) a) Updated to be consistent with GPS manufacturer's recommendations b) Include outage procedures c) Include pre-departure procedures d) Include instructions for continued airworthiness	
		Continued...	

4.3 CHECKLIST O3 - DETAILED ANALYSIS

#	Req'd	Proposal Data Analysis	Pass
18	I	Maintenance Program (9)	
		a) Includes GPS manufacturers requirements for maintenance and continued maintenance	
		b) Covers revisions to MMEL, MEL, CDL, and dispatch deviation for GPS as applicable	
		c) Service difficulties reported in accordance with FARs 121 and 135	
19	I	Validation program ensures GPS system is accurate and reliable (10, 12)	
20	L	Validation test flight plans include: (11, 12)	
		a) At least one flight observed by ASI	
		b) Dispatch procedures will demonstrate Class II navigation in area where operations are intended	
		c) Adequate duration to demonstrate	
		i) Knowledge of dispatch requirements	
		ii) Capability to navigate with GPS	
		iii) Normal and non-normal procedures	
		d) For operator without previous Class II experience, at least one non-revenue (except cargo) flight in Class II area where it plans to operate	
		e) For operator with previous Class II experience, at least one flight in either:	
		i) Class I to simulate Class II (may be revenue) or	
		ii) Class II (nonrevenue except cargo)	
f) For NAT/MNPS airspace, pass performance data in AC 120-33			

4.3 DETAILED ANALYSIS OF PROPOSAL

Requirements:

- (1) pp. O2•3-4; 5A(a)
p. O4•3; 5A-B
- (2) p. O2•6-7; 8A-B
p. O5•2; 3A
p. A4•9-10; 10
- (3) pp. O2• (7, 8, 10); 8E, 10, 13
pp. O5• (2, 3-4); 3B, 4
pp. O9• (2-4, 5-6); 121.347-121.349, 135.165
- (4) pp. O4•(3-4, 4-6); 6A, 6D-E
pp. O8• (2-5, 7-15); 4-5, App. 1-4
- (5) pp. O2•4-5; 5B(a)-(c)
p. O4•4; 6B-C
- (6) pp. O4•4-6; 6B-E
- (7) pp. O2•(4, 5); 5B(a), (c)-(d)
p. O4•4; 6C
pp. O9• (4-5, 6-8); 121.441, 135.297
- (8) pp. O2• (4, 7); 5A(b)-(c), 8C
p. O4•4; 6B
- (9) pp. O2• (4, 6); 5A(b)-(d), 5F
- (10) p. O2•5; 5E
pp. O4•7-9; 7, 8
- (11) pp. O4•7-9; 7, 8

Guidelines:

- (12) pp. O1• (6-7, 19-24, 32-33, 33-36); Vol.1 Ch.4 211, Vol.3 Ch.2 327-333, Vol.3 Ch.9 1569, 1655-1667

4.4 DEMONSTRATION/VALIDATION TESTING

Purpose:

Evaluate operator's demonstration of the capability to conduct safe operations using GPS navigation (7).

Procedure:

- A) Ensure that the operator has adequately demonstrated its capability to conduct safe GPS operations using checklist O4 on the following pages. In general, these items are verifications that the operator is conducting training, qualification, and operations in the manner described in the proposal package.
- B) Document any deficiencies in the operator's performance.
- C) Provide feedback to the applicant to correct any deficiencies in the operator's performance if identified. Reevaluate new data in accordance with section 4.3 and reevaluate the demonstration in accordance with this section if necessary.
- D) Write a letter denying the request for approval for GPS operations if the operator refuses to correct the deficiencies. If applicable, write a letter withdrawing the initial approval of the GPS training program.
- E) Indicate that the operator has adequately demonstrated its capability to operate using GPS navigation and continue with section 4.5 to approve the operator's use of GPS if the data are complete.

4.4 CHECKLIST O4 - DEMONSTRATION/VALIDATION TEST

- I** Required for IFR use
- i** Recommended for IFR use
- N** Additional requirements for nonprecision approach use
- n** Additional recommendations for nonprecision approach use
- L** Additional requirements for long-range (Class II) navigation
- P** Additional requirements for “primary means” Class II navigation

#	Req'd	Proposal Documents	Pass
1	I	Observe initial training sessions and evaluate (7)	
		a) Curriculum outline	
		b) Courseware	
		c) Instructional delivery methods	
		d) Training environment	
		e) Training hours	
		f) Practical (hands on) training	
		g) Testing and checking (including results)	
2	I	Observe training program and verify coverage of topics in proposal: (1)	
		a) Principals of GPS navigation	
		b) GPS equipment operations	
		i) Software use	
		ii) Hardware operation and interface with other equipment	
		iii) Database updating procedures	
		iv) Limitations of GPS equipment	
		c) Pre-departure procedures	
d) Standard en route procedures			
e) Emergency/contingency procedures			
f) Maintenance and dispatch procedures			
g) Contents of OpSpecs			
		Continued...	

4.4 CHECKLIST O4 - DEMONSTRATION/VALIDATION TEST

#	Req'd	Proposal Documents	Pass
3	P	Observe training program and verify coverage of use of GPS as primary means of navigation for long-range navigation (2)	
4	I	Observe initial qualification proficiency checks and verify the following: (3) a) In flight or in approved simulator b) Covers all requested operations c) Consistent with qualification required for ILS, VOR/DME, RNAV and multi-sensor RNAV/ FMS d) If applicable, includes any special GPS approach procedures	
5	i	Observe recurrent qualification program and verify pilot in command performs GPS proficiency check every 6 months (3)	
6	n	Observe recurrent qualification program and verify both pilots perform GPS proficiency check every 6 months (3)	
7	i	Survey operator activities to ensure that they are performing GPS operations in accordance with approved manuals policies and procedures (4)	
8	i	Verify that operator is conducting a validation program to ensure that the GPS is accurate and reliable (5)	
		Continued...	

4.4 CHECKLIST O4 - DEMONSTRATION/VALIDATION TEST

#	Req'd	Proposal Documents	Pass
9	L	Ride on at least one validation test flight and verify: (6) a) Dispatch procedures demonstrate Class II navigation area where operations are intended b) Demonstrates knowledge of dispatch requirements c) Demonstrates capability to navigate with GPS d) Demonstrates normal and non-normal procedures e) For operator without previous Class II experience, flight must be non-revenue (except cargo) in Class II area of planned operation f) For operator with previous Class II experience, flight must be either: i) Class I to simulate Class II (may be revenue) or ii) Class II (nonrevenue except cargo)	
10	P	Validation flight includes both pre-departure and en route procedures for FDE prediction program (6)	
11	<i>i</i>	Ride on a flight in which the operator is conducting GPS operations and evaluate operator's capability to navigate using GPS.	
12	<i>n</i>	Ride on a flight in which the operator is conducting GPS operations and evaluate operator's capability to conduct non-precision approaches using GPS.	

4.4 DEMONSTRATION/VALIDATION TESTING

Requirements:

- (1) pp. O2•4-5; 5B(a)-(c)
p. O4•4; 6B-C
- (2) pp. O4•4-6; 6C-E
- (3) pp. O2•(4, 5); 5B(a), (c)-(d)
p. O4•4; 6C
pp. O9• (4-5, 6-8); 121.441, 135.297
- (4) pp. O2• (4, 7); 5A(b)-(c), 8C
p. O4•4; 6B
- (5) p. O2•5; 5E
pp. O4•7-9; 7, 8
- (6) pp. O4•7-9; 7, 8

Guidelines:

- (7) pp. O1• (7-9, 24-27, 33, 34-36); Vol.1 Ch.4 213, Vol.3 Ch.2 335-337, Vol.3 Ch.9 1571, 1665-1667

4.5 ISSUING THE OPERATIONS APPROVAL

4.5.1 Updating Operations Specifications

Purpose:

Update the operator's Operations Specifications (OpSpecs) to allow them to begin operations using GPS for navigation **(1)**.

Procedure:

- A) Verify that the operator has passed the items in checklists O3 and O4 and has demonstrated their capability to conduct safe operations using GPS.

Note: The POI may choose to update the OpSpecs to allow the operator to begin GPS operations before final training approval has been given. However, if the operator does not receive final training approval before the expiration of the initial training approval, the POI will have to remove GPS operations from the operator's OpSpecs.

- B) Follow the steps in the following tables to update the operator's OpSpecs for the following operations:
- Class I en route authorization - Table 4.5.1 (page 4-23) **(2)**
 - Class II en route authorization - Table 4.5.2 (page 4-25) **(3)**
 - Class II en route authorization for GPS as primary means - Table 4.5.3 (page 4-32) **(4)**
 - Nonprecision approach authorization - Table 4.5.4 (page 4-35) **(5)**

4.5.1 Updating Operations Specifications

Table 4.5.1 Operations Specification Issuance Instructions for En Route Authorization for Use of GPS for Class I Navigation

CE Class I en route authorization
RNAV Additional requirement if existing avionics installation does not include RNAV capability
PCA Additional requirement if Class I navigation is authorized In Class A airspace (PCA)

#	Req'd	Class I En Route (2)
1	CE	Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
2	RNAV	Mark the Operations Specification checklist to check the appropriate block (paragraph B34 requires 6b or 12c and 5q to be checked; paragraph B35 requires 4a and [4c or 6b] and 5p to be checked)
3	CE	Using the "Additional Text" feature for paragraph B31, insert the following new subparagraph at the beginning of the "Additional Text" section: <i>"The operator may use approved GPS navigation equipment as a supplement to ICAO standard navigation equipment while conducting Class I navigation."</i>
4	CE	Change the signature block of paragraph B31 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
5	CE	Using the "Additional Text" feature for paragraph B34a, insert the aircraft model, and the make and model of the GPS receiver.
		Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Class I En Route (2)
6	CE	Change the signature block of paragraph B34 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
7	PCA	In paragraph B35a, insert the aircraft make and GPS receiver make and model in the existing table.
8	CE	In paragraph B50, access the Limitations, Provisions, and Reference Paragraphs section for the specific areas authorized, and insert paragraph B35 adjacent to the existing referenced paragraphs. Class I navigation using GPS shall be authorized only for the U.S. NAS unless authorized by the appropriate sovereign state. If RNAV equipment (other than GPS) is authorized in a foreign state(s), paragraph B50 shall contain a limitation to prohibit the use of GPS for Class I navigation in a foreign state(s).
9	CE	Change the signature block of paragraph B50 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
10	CE	Print paragraph B31, B34, B35 and B50, as appropriate, in final form.
11	CE	Present the documents to the operator for acceptance, and recover the existing documents

4.5.1 Updating Operations Specifications

Table 4.5.2 Operations Specification Issuance Instructions for En Route Authorization for Use of GPS for Class II Navigation

CIIE Class II en route authorization
CEPAC Additional steps to include CEPAC airspace
NOPAC Additional steps to include NOPAC airspace
MNPS Additional steps to include MNPS airspace
MU Additional steps to include Areas of Magnetic Unreliability

#	Req'd	Class II En Route (3)
1	CIIE	Log on to the operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
2	CIIE	Mark the Operations Specification checklist to check the appropriate block. Paragraph B36 requires question 4c and (5n or 5o) to be checked, as appropriate.
3	CIIE	In paragraph B36, subparagraph a(1), insert the aircraft make and GPS receiver make and model
4	CIIE	Change the signature block of paragraph B36 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number
5	CIIE	Print paragraph B36.
6	CEPAC	Mark the Operations Specification checklist to check the appropriate block. Paragraph B37 requires question 4a and 4c; and, 5n or 5o; and, 5l to be checked, as appropriate.
7	CEPAC	Change the signature block of paragraph B37 to reflect the Effective Date anticipated for paragraph approval. Change the amendment Number to reflect the next sequential number.
		Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Class II En Route (3)
8	CEPAC	Print paragraph B37 in final form. The purpose for issuance of paragraph B37 using the OPSS software is to make a permanent record of the issuance in the national data base. The computer generated page will be discarded and be replaced as described below.
9	CEPAC	Manually update the table of contents Revision Page to include, <i>“*37.Operations In Central East Pacific (CEPAC) Airspace -- Authorization And Limitations * = Authorized in A4”</i>
10	CEPAC	Fill in Paragraph B37 (Revision) page: <i>“B37.Operations in Central East Pacific (CEPAC) Composite Airspace (05/11/95). The certificate holder is authorized to conduct operations in Central East Pacific (CEPAC) airspace (between the State of Hawaii and the 48 contiguous states) where composite separation is applied by ATC, provided the provisions of this paragraph are met. The certificate holder shall not conduct any other operations in this airspace under these operations specifications. a. <u>Required Navigation Capabilities.</u> The certificate holder shall not takeoff an airplane for flight within CEPAC airspace, where composite separation is applied by ATC, unless at least one of the following navigation capabilities is available and operational: (1) Two independent approved Inertial navigation systems. (2) Two independent approved Omega navigation systems.</i>

Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Class II En Route (3)
10	CEPAC	<p>...continued</p> <p>(3) <i>An approved redundant navigation capability consisting of an independent Inertial navigation system and an independent Omega navigation system.</i></p> <p>(4) <i>An approved Doppler radar navigation system and either an approved Inertial navigation system or an approved Omega navigation system</i></p> <p>(5) <i>An approved redundant navigation capacity consisting of an independent Global Positioning System (GPS) and either an independent Inertial Navigation System/Inertial Reference System or an Independent Omega navigation system.</i>"</p>
11	NOPAC	Mark the Operations Specification checklist to check the appropriate block. Paragraph B38 requires question 4c and 5n, or 5o and 5m to be checked, as appropriate.
12	NOPAC	Change the signature block of paragraph B38 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
13	NOPAC	Print paragraph B38 in final form. The purpose for issuance of paragraph B38 using the OPSS software is to make a permanent record of the issuance in the national data base. The computer generated page will be discarded and be replaced as described below.
14	NOPAC	Manually update the table of contents Revision Page to include <i>"*38.Operations In North Pacific (NOPAC) Airspace * = Authorized in A4"</i>
		Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Class II En Route (3)
15	NOPAC	<p>Fill in Paragraph B38 (Revision) page to include: <i>"B38. <u>Operations in North Pacific (NOPAC) Airspace (05/11/95)</u>. The certificate holder is authorized to conduct North Pacific (NOPAC) operations within the area of operation authorized in subparagraph a., provided any operation within this area meets the provisions of this paragraph. The certificate holder shall not conduct any other operation within this area of operation under these operations specifications.</i></p> <p><i>a. <u>Authorized Area of Operation</u>. The area of operation authorized by this paragraph lies within the Anchorage and Tokyo FIR's. The southern lateral boundary of this area is 100 NM south of the southernmost route where composite separation is applied, and the northern lateral boundary is the northern boundaries of the Anchorage and Tokyo FIR's. The vertical boundaries include the airspace between the MEA and the MAA.</i></p> <p><i>b. <u>Airborne Weather Radar Limitations/Procedures</u>. The certificate holder shall not takeoff for flight within this area of operation unless airborne weather radar approved for ground mapping, is installed and operational. The certificate holder shall use the radar on a full-time basis for monitoring navigational system accuracy and weather avoidance while operating within this area.</i></p> <p>Continued...</p>

4.5.1 Updating Operations Specifications

#	Req'd	Class II En Route (3)
15	NOPAC	<p><i>c. Required Navigation and Capabilities.</i> <i>The certificate holder shall not takeoff for flight within the authorized area of operation unless at least the following navigation capabilities are available and operational.</i></p> <p><i>(1) For all flights at FL 280 or above, at least one of the following:</i></p> <ul style="list-style-type: none"> <i>(a) Two independent approved Inertial navigation systems.</i> <i>(b) Two independent approved Omega navigation systems.</i> <i>(c) An approved redundant navigation capability consisting of an independent Inertial navigation system and an independent Omega navigation system.</i> <i>(d) An approved Doppler radar navigation system and either an approved Inertial navigation system or an approved Omega navigation system.</i> <i>(e) An approved redundant navigation capacity consisting of an independent Global Positioning System (GPS) and either an independent Inertial Navigation System/Inertial Reference System or an independent Omega Navigation System.</i> <p><i>(2) For all flights at FL 270 and below, either of the following conditions must be met:</i></p> <ul style="list-style-type: none"> <i>(a) The equipment specified in subparagraph c.(1) above is installed and operational.</i> <p>Continued...</p>

4.5.1 Updating Operations Specifications

#	Req'd	Class II En Route (3)
15	NOPAC	<p>...continued</p> <p>(b) <i>A flight navigator is used with the required navigation equipment specified in paragraph B36b.(1)(a) or B36b.(1)(b).</i></p> <p>d. <i>Special Routing Limitations. For West bound flights transitioning to North Pacific routes designated R-220 and R-580, the certificate holder shall accomplish all transitions to these routes via the published oceanic transition routes or published airways.</i>”</p>
16	MNPS	Mark the Operations Specification checklist to check the appropriate block. Paragraph B39 requires question 4a and 4c checked; 5k checked and 5n or 5o checked, as appropriate.
17	MNPS	Change the signature block of paragraph B39 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
18	MNPS	If unrestricted routing is to be authorized, in paragraph B39, subparagraph c, insert the aircraft make, GPS receiver make and model and the make and model of the second long-range navigation system.
19	MNPS	If restricted routing over special contingency routings (Blue Spruce Routes) with a single GPS is to be authorized, in paragraph B39, subparagraph d, insert the aircraft make, and GPS receiver make and model.
20	MNPS	Print paragraph B39 in final form
21	MU	Using the “Additional Text” feature for paragraph B40, insert aircraft makes, make and model of the GPS receiver, and the make and model of the second long-range navigation system, in the navigation equipment table.
		Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Class II En Route (3)
22	MU	Change the signature block of paragraph B40 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
23	MU	Print paragraph B40 in final form.
24	CIIE	Present the documents to the operator for acceptance and recover the existing documents.

4.5.1 Updating Operations Specifications

Table 4.5.3 Operations Specification Issuance Instructions for En Route Authorization for Use of GPS as Primary Means for Class II Navigation

- PRIM** Authorization for dual GPS as primary means of Class II en route navigation
- SING** Additional steps to include use of single GPS as primary means of Class II navigation (may only be issued for operations in the Caribbean Sea, Gulf of Mexico, and the Atlantic Ocean west of MNPS airspace)
- MNPS** Additional steps to include MNPS airspace
- MU** Additional steps to include Areas of Magnetic Unreliability

#	Req'd	Primary Means Class II En Route (4)
1	PRIM	Log on to the operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
2	PRIM	Mark the Operations Specification checklist to check the appropriate block. Paragraph B36 requires question 4c and (5n or 5o) to be checked, as appropriate.
3	PRIM	In paragraph B36, subparagraph a(1), insert the aircraft make and the makes and models of the GPS receivers.
4	PRIM	Change the signature block of paragraph B36 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
5	PRIM	Print paragraph B36.
		Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Primary Means Class II En Route (4)
6	SING	In paragraph B50, access the Limitations, Provisions, and Reference Paragraphs section for the Caribbean Sea, Gulf of Mexico, Atlantic Ocean West of MNPS airspace, and/or special contingency routes in MNPS airspace, as applicable, and enter the following statement adjacent to the existing referenced paragraphs: <i>“Class II navigation with the approved single GPS listed in paragraph B36(1) is limited to this specific geographic area.”</i>
7	SING	Change the signature block of paragraph B50 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
8	SING	Print paragraph B50 in final form.
9	MNPS	If unrestricted routing is to be authorized, mark the Operation Specification checklist to check the appropriate block. Paragraph B39 requires question 4a and 4c, checked, 5k checked and 5n or 5o checked as appropriate.
10	MNPS	Change the signature block of paragraph B39 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
11	MNPS	If unrestricted routing is to be authorized, in paragraph B39, subparagraph c, insert the aircraft make and the makes and models of the GPS receivers. NOTE: Normally operators receiving authorization under paragraph B39c should also receive authorization in paragraph B39d for ferry and contingency purposes.
12	MNPS	If restricted routing over special contingency routing is to be authorized, in paragraph B39, subparagraph d, insert the aircraft make and the makes and models of the GPS receivers.
13	MNPS	Print paragraph B39 in final form.
		Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Primary Means Class II En Route (4)
14	MU	Using the "Additional Text" feature for paragraph B40, insert the aircraft makes and models of GPS receivers in the navigation equipment table.
15	MU	Change the signature block of paragraph B40 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
16	MU	Print paragraph B40 in final form.
17	PRIM	Present the documents to the operator for acceptance, and recover the existing documents.

4.5.1 Updating Operations Specifications

Table 4.5.4 Operations Specifications Issuance Instructions for Use of GPS to Conduct Nonprecision Instrument Approach Procedures

NP Nonprecision Approach authorization
RNAV Additional requirement if RNAV approaches using GPS are authorized
SIAP Additional requirement if special instrument approach procedures are authorized

#	Req'd	Nonprecision Approach (5)
1	NP	Verify Class I en route authorization has been issued in accordance with table 4.5.1
2	NP	Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
3	NP	Using the "Additional Text" feature for paragraph C52 (paragraph H102 for rotorcraft), insert the following new subparagraph "c" at the beginning of the "Additional Text" section: <i>"C. <u>GPS nonprecision approach procedure authorization</u>. The certificate holder is authorized to conduct VOR, VOR/DME, NDB, and NDB/DME instrument approach operations using the approved GPS equipment listed in paragraph B34 or B35. The certificate holder shall not conduct GPS instrument approach operations unless authorized by these operations specifications. Approaches using GPS are subject to the following limitations:</i> <i>(1) The airborne GPS navigation equipment used must be approved and current for IFR operations, including nonprecision approaches, and the GPS constellation and the required airborne equipment must be providing the levels of accuracy, continuity of function and integrity required for that operation.</i> Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Nonprecision Approach (5)
3		<p>...continued</p> <p><i>(2) The flight crew must have successfully completed the certificate holders approved training program curriculum segments for GPS operations; and the pilot in command must be checked for competency by a authorized check airman or FAA inspector for instrument approach operations using GPS in each aircraft type and GPS combination.</i></p> <p><i>(3) During the initial 6 months of operation with a particular aircraft type and GPS combination, the certificate holder shall not use IFR approach and landing minimums, for that particular aircraft and GPS combination, lower than 200 feet and 1/2 statute mile above the lowest MDA and visibility/RVR minimums authorized for instrument approaches and landings at that airport using GPS."</i></p>
4	CE	Change the signature block of paragraph C52 (H102 for rotorcraft) to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
5	CE	Print paragraph C52 (H102 for rotorcraft) in final form.
6	RNAV	Change the signature block of paragraph C63 (H112 for rotorcraft) to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
7	RNAV	In paragraph C63 (H112 for rotorcraft), insert the aircraft make, and the make and model of GPS receiver.
		Continued...

4.5.1 Updating Operations Specifications

#	Req'd	Nonprecision Approach (5)
8	RNAV	Print paragraph C63 (H112 for rotorcraft) in final form.
9	SIAP	Change the signature block of paragraph C64 (H113 for rotorcraft) to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
10	SIAP	In paragraph C64e (H113e for rotorcraft), insert the specific Special Terminal Instrument Approach Procedure authorized.
11	SIAP	Print paragraph C64 (H113 for rotorcraft) in final form.
12	NP	Present the documents to the operator for acceptance, and recover the existing documents.

4.5.1 Updating Operations Specifications

Requirements:

- (1)** pp. O1• (9-10, 11-12); Vol.1 Ch.4 215, Vol.3 Ch.1 261-265
- (2)** pp. O3•2-4; 1
- (3)** pp. O3• (4-11, 16-19); 2-8, Samples
- (4)** pp. O4•9-12; App. 1
- (5)** pp. O3•11-15; 9

4.5.2 Operations Manuals, Approach Procedures And MEL Approval

Purpose:

Coordinate with the appropriate FAA branches to approve manuals, approach procedures, and MEL changes as needed.

Procedure:

- A) Verify that the operator's manuals have been revised in accordance with checklist O3 (consistent with GPS manufacturer's recommendations, include outage, pre-departure, and continued airworthiness instructions).
- B) For those manuals that require FAA approval, enter the effective date and sign under the words "FAA-approved" on the page control sheets (or on every page if there are no page control sheets) **(1)**.
- C) If the GPS operations approval included special instrument approach procedures, coordinate with your regional Flight Standards Division and AFS-400 to approve the special instrument approach procedures.
- D) Coordinate with the flight operations evaluation board to approve any changes to the MEL for the operator.

Guidelines:

- (1)** pp. O1-27-29; 339

4.5.3 Training Program Approval

Purpose:

Approve operator's training program **(1)**.

Procedure:

- A) Verify that the operator has passed the items in checklists O3 and O4 dealing with the crew training and qualification program for the use of GPS.

Note: The evaluation of the training program may continue as long as the POI determines necessary up to the expiration date given on the initial approval letter. If the POI chooses to validate recurrent qualification before giving final approval, he will have to observe the program for at least 6 months.

- B) Stamp, date and sign either a list of effective pages for the training curriculum or each page in the curriculum.
- C) Transmit the approved training curriculum to the operator with a signed final letter of approval.

Guidelines:

(1) pp. O1•27-29; 339

4.6 CONTINUING GPS OPERATIONS EVALUATION

Purpose:

Ensure that the operator maintains continued safe operations using GPS navigation.

Procedure:

- A) Periodically, survey operator activities to ensure continued safe GPS operations. Review inspection reports, incident and accident reports, exam results, proficiency check results and other relevant information for potential GPS operations problems.
- B) Coordinate with the PAI to ensure that the operator's maintenance program covers the following **(2)**:
 - 1. Manuals, policies and procedures incorporate the GPS manufacturer's instructions for continued airworthiness of the GPS equipment.
 - 2. As applicable, revisions to the MMEL, MEL, CDL and/or dispatch deviation procedures include the GPS equipment.
 - 3. Service difficulties with the GPS equipment are reported in accordance with FAR 121 and 135.

Guidelines:

(1) pp. O1•25-27; 337

(2) p. O2•6; 5F

REFERENCE A1

FAA ORDER 8300.10

Airworthiness Inspector's Handbook

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

VOLUME 1. CHAPTER 3. THE GENERAL PROCESS FOR APPROVAL OR ACCEPTANCE

29. GENERAL

- A. *Generic Process.* The general process for approval or acceptance of certain operations, programs, documents, procedures, methods, or systems is an orderly method used by flight standard inspectors to ensure such items meet regulatory standards and provide for safe operating practices. It is a generic process that can be applied to many types of approval or acceptance tasks. The process generally consists of five related “phases”. The process can result in approving or not approving, accepting or not accepting an applicant’s proposal. It is important for an inspector to understand that the process described in this section is not all-inclusive, but rather a tool to be used with good judgment in conducting day-to-day duties and responsibilities.
- B. *Understanding the Process.* It is essential for the inspector to understand that any process described in this handbook may result in a decision to approve or accept a proposal. This process, combined with job task procedures, is used to assist in making both positive or negative determinations.
- C. *Process Supplementing Task Procedures.* This general process applies to many tasks described throughout this handbook. The general process supplements the procedures outlined in each task.

31. PHASE ONE. The first phase is initiated when an applicant for a certificate, an operator, a person, an aviation interest, or the FAA inquires about or states a need for a change in some aspect of an aviation activity.

- A. *Applicant Initiation.* The person or operator conveys to the FAA a need which is related to the operation. This “need” may be a requirement for FAA approval or acceptance. For example, an

operator may need, want, or be required to have a Minimum Equipment List (MEL) change. The operator initiates the process by inquiring about the correct procedures to receive approval from the FAA for the change. During initial inquiries it is important for the FAA and the operator to become familiar with the subject matter. If, for example, an operator requests an operational approval, the inspector must:

- Become thoroughly familiar with existing FAA policy and approval requirements
- Become familiar with the appropriate technical material
- Accurately assess the character and scope of the proposal
- Determine if a demonstration is required
- Determine the need for any coordination requirements
- Ensure the operator has a clear understanding of the minimum requirements which constitute an acceptable submission
- Determine the date the operator intends to implement the proposal

B. *FAA Initiation.* Phase one may also be initiated when the FAA conveys to the operator or person a requirement related to the operation that must be approved or accepted. The principal inspector should act in an advisory capacity to the operator during the preparation of the submission. Such advice may include the following:

- The need for a deviation, authorization, waiver, or exemption
- The need for required demonstrations
- Clarification of Federal Aviation Regulations or handbook information
- Sources of specific technical information
- Acceptable standards for submission

C. *Responsibility for Development of Submission.* An element common to either an operator or an FAA-initiated action is the effort expended by the operator in preparing or developing a submission to be evaluated by the FAA. However, it is essential (particularly in phase one) for the operator to have a clear understanding that although the inspector may provide advice and guidance, the development of the final product submitted to the FAA is solely the responsibility of the operator.

D. *Applicant-FAA Communication.* In phase one, the inspector must ensure the operator clearly understands the form, content, and documents required for the submission to be acceptable to the FAA. The operator must be informed of the benefits of submitting required documents as early as possible. The operator also must be made aware of its responsibility to advise the FAA, in a timely manner, of any significant changes in the proposal.

E. *Phase One Illustration*

(1) Phase one of the process is illustrated as follows:

- Operator makes inquiry or request to FAA

-OR-

- FAA requires operator to take an action

(2) During phase one the following actions should occur:

- FAA and operator develop an understanding of subject area
- Operator understands form, content, and documents required for acceptable submission

33. PHASE TWO. Phase two begins when the operator formally submits a proposal for FAA evaluation. The request may be submitted in a variety of ways, e.g., registered mail, hand-carried, etc.

A. *Initial Action.* The inspector's initial action, in phase two, is to review the operator's submission to ensure that the proposal is clearly defined and that the documentation specified in phase one has been provided. Furthermore, the required information must

be complete and detailed enough to permit a thorough evaluation of the operator's capability and competence to fully satisfy the applicable regulations, national policy, and safe operating practices. Phase two does not include a detailed operational and technical evaluation or analysis of the submitted information (see phase three). However, in phase two the submission must be examined to assess the completeness of the required information.

B. *Submission Unsatisfactory*. If the operator's submission is not complete or the quality is obviously unacceptable, it must be immediately returned, with an explanation of the deficiencies, before any further review and evaluation is conducted.

(1) Normally, an unacceptable submission should be returned with a written explanation of the reasons for its return.

(2) In many complex cases, a meeting with the operator's key personnel may be necessary to resolve issues and agree on a mutually acceptable solution. If mutual agreements cannot be reached, the inspector must terminate the meeting, inform the operator that the submission is unacceptable, and return the submission.

(3) If all parties are able to reach agreement on measures to correct omissions or deficiencies, and the principal inspectors (operations, maintenance, and avionics, if applicable) determine that the submission is acceptable, the operator is informed, and phase three begins.

C. *Status Reports*. It is important for the inspector involved to keep the operator advised of the status of the proposal. If the inspector takes no other action, or if the submission is deficient and not returned in a timely manner, the applicant may assume the FAA has tacitly accepted the submission and is continuing with the process. Timeliness of action depends on the situation as well as inspector judgment and is discussed in sections of this handbook pertaining to the subject matter.

D. *Phase Two Illustration*

(1) Phase two of the process is illustrated as follows:

- Operator submits proposal
- FAA makes initial examination of the documents for completeness with respect to requirements established in phase one

(2) As a result of phase two:

- FAA accepts submitted proposal

-OR-

- FAA returns submitted proposal

35. PHASE THREE

A. *Detailed Analysis.* Phase three is the FAA's detailed analysis, review, and evaluation of the operator's proposal. These actions may take place entirely within a field office, at the site of operations, or at both facilities. In phase three the FAA evaluation is focused on the form, content, and technical quality of the submitted proposal to determine that the information:

- Is not contrary to any applicable Federal Aviation Regulations
- Is not contrary to the direction provided in this handbook or other safety related documents
- Provides for safe operation practices

B. *Evaluation Criteria.* Criteria for evaluation of the formal submission is found in the applicable chapters of this handbook. The inspector must ensure that the documents adequately establish the operator's capability and competence to conduct operations safely in accordance with the submitted proposal.

C. *Addressing Deficiencies.* During phase three the FAA inspector must address any deficiencies in the submitted material in a timely manner before proceeding to subsequent phases. Discussion with the operator may be sufficient to resolve certain discrepancies or questions or to obtain additional information. It may be necessary to return certain portions of the submission to

the operator for specific changes. However, when an inspector determines that, for specific reasons, the material is unacceptable, the inspector must return the submission to the operator with an explanation and immediately terminate the process. If the results of the evaluation are acceptable and a demonstration is necessary, the inspector may need to grant some form of conditional, initial, or provisional approval to the proposal before continuing with the process.

D. *Phase Four Planning.* An important aspect of phase three is for FAA inspectors to begin planning the conduct of phase four. While evaluating the operator's formal submission, inspectors should begin to formulate plans to observe and evaluate the operator's ability to perform. These plans must be finalized before the actual demonstrations.

E. *Phase Three Illustration*

(1) Phase three is illustrated as follows:

- FAA evaluates the formal submission for compliance with the Federal Aviation Regulations, compliance with the direction provided in this handbook, and compliance with other safety-related documents and safe operating practices
- When results of FAA evaluation are unsatisfactory, return submission to the operator for correction and/or terminate the phase
- Begin planning of phase four (if required)

(2) As a result of phase three, the following actions should be taken:

- When results of FAA evaluation are satisfactory, proceed with phase four (if a demonstration is required) and if appropriate, grant conditional approval or acceptance

-OR-

- Proceed to phase five if demonstration is not required

37. PHASE FOUR

- A. *Observation and Evaluation of Demonstration.* Phase four is an operational evaluation of the operator's ability to function in accordance with the proposal evaluated in phase three. Usually these demonstrations are required by regulation. Some examples include training programs, emergency evacuation demonstration, external load class operational tests, and non-destructive inspection tests.
- B. *Evaluation Criteria.* Criteria and procedures for evaluating an operator's demonstrated ability are described in applicable chapters of this handbook.
- C. *Handling Discrepancies.* The inspector must plan for the conduct and observation of the demonstration to include such things as participants, evaluation criteria, and sequence of events. During these demonstrations it is normal for minor discrepancies to occur. Discrepancies can often be resolved during the demonstration by obtaining commitments from responsible company officials.
- (1) The inspector responsible for overseeing a demonstration must evaluate each discrepancy in terms of its overall impact on the operator's ability and competence to conduct the proposed operation.
 - (2) The inspector must stop the demonstration in phase four when deficiencies or unacceptable levels of competency are observed. The inspector must identify the phase of the general process to which the applicant must return or decide to terminate the process entirely. For example, if an emergency evacuation demonstration is unsatisfactory because of equipment failure (a slide fails to inflate), it may be appropriate to require the operator to reenter the process at phase four and conduct another demonstration. However, if the demonstration is unacceptable because crew members were unable to perform their assigned duties, it may be appropriate to advise the operator that the process is terminated and a new proposal should be submitted.
- C. *Acceptable Demonstration.* If the FAA evaluation of the operator's demonstrated ability is acceptable, the process

continues. An operator will not, under any circumstances, be authorized or otherwise approved to conduct any particular operation until all airworthiness and operations requirements are met and the operator is clearly capable of conducting a safe operation in compliance with FAA regulations and safe operating practices.

D. *Phase Four Illustration*

(1) Phase four of the process is illustrated as follows:

- FAA observes the demonstration
- Operator demonstrates ability

(2) As a result of phase four:

- Demonstration is satisfactory

-OR-

- Demonstration is unsatisfactory

39. PHASE FIVE

A. *Approval or Acceptance.* In phase five, the FAA approves or accepts the operator's proposal. If the proposal is not approved or accepted, the operator is notified in phase three or four.

B. *Indicating Approval.* Approval is granted by letter, a stamp of approval, the issuance of operations specifications, or some other official means of conveying approval. Each chapter of Volume II which discusses a requirement for approval provides specific guidance concerning approval procedures and documentation.

C. *Acceptances.* Other proposals, submissions, or requests not requiring specific FAA approval but required to be submitted to the FAA are items that are presented for acceptance. Acceptance of an operator's proposal may be accomplished by various means including a letter, verbal acceptance, or by taking no action, which indicates there is no FAA objection to the proposal. Methods and procedures used to accept operator

proposals or submissions, when appropriate, are discussed in the applicable chapters of this handbook.

D. *Conditional Approval or Acceptance.* Sometimes FAA approval or acceptance of an operator's proposal may be conditional in nature. For example, a training program may be initially approved, provided the simulator to be used in that program receive approval from the National Simulator Evaluation Team.

E. *Phase Five Illustration*

(1) Phase five is illustrated as follows

- FAA approves submission

-OR-

- FAA accepts submission

VOLUME 2. CHAPTER 1. PERFORM FIELD APPROVAL OF MAJOR REPAIRS AND MAJOR ALTERATIONS

3. OBJECTIVE. This chapter provides guidance in determining the category of a repair or alteration and ensuring that the aircraft can be returned to service in accordance with approved technical data.

5. GENERAL

A. Definitions

(1) *Major alteration:* An alteration not listed in the aircraft, aircraft engine, or propeller specifications that:

- Might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness
- Is not done according to accepted practices or cannot be done by elementary operations

- (2) *Major repair*: A repair that:
- If improperly done, might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness
 - Is not done according to accepted practices or cannot be done by elementary operations
- (3) *Minor alteration*: Any alteration that is not classified as a major alteration.
- (4) *Minor repair*: Any repair that is not classified as a major repair.
- (5) *Field approval*: An approval by an authorized inspector of a major repair or major alteration that is accomplished by:
- Examination of data only - one aircraft
 - Physical inspection, demonstration, testing, etc. - one aircraft
 - Examination of data only - duplication of identical aircraft
- (6) *Data*: Information that supports and/or describes the alteration or repair, including the following:
- Drawings, sketches, and/or photographs
 - Stress analysis
 - Engineering Orders
 - Operating limitations
- (7) *Approved data*: Data used to approve major repairs and major alterations, including the following:
- Type Certificate Data Sheets

- Supplemental Type Certificates (STCs)
- Airworthiness Directives
- Manufacturer's FAA approved data
- Designated Engineering Representative (DER) approved data
- Designated Alteration Station (DAS) approved data developed for alterations performed by that station only

B. *Inspector Qualifications.* The inspector must be authorized, experienced, and/or trained with the methods, techniques, and materials involved in the major repair/major alteration.

C. *Inspector Responsibilities.* The inspector must be able to determine that, by granting a field approval, the affected product can reasonably be expected to result in safe operation and conform to regulatory requirements. If the inspector is not thoroughly familiar with all aspects of the alteration or repair or has any doubt about the expected airworthiness, approval or denial will not be given until the necessary assistance has been acquired.

D. *Data Requirements and Coordination*

- (1) The source of data presented by an operator is strictly the operator's responsibility. Inspectors should not obtain nor provide data for the operator's use. Source, cost and other matters concerning an operator's acquisition of data, presented as part of an alteration approval action, should not be questioned.
- (2) Acceptable data that may be used on an individual basis to obtain approval are:
 - FAA Advisory Circulars (e.g., Advisory Circulars 43.13-1A and 43.13-2A)
 - Manufacturer's technical information (e.g., manuals, bulletins, kits, etc.)

- Mil Specs
 - FAA Field Approvals
- E. Designated Engineering Representatives (DER). If an appropriately rated Designated Engineering Representative is employed by the operator, the inspector should coordinate with the operator.
- (1) The Designated Engineering Representative may be limited to technical areas that do not fully cover the entire project. Any area not covered by this approval must be reevaluated by the FAA.
 - (2) The Designated Engineering Representative should not be permitted to make any determination as to which inspections are necessary for the pertinent alteration or repair, since this activity is outside the scope of the DER's authorization.
 - (3) Designated Engineering Representatives do not have authority, by virtue of their delegation, to:
 - Grant field approvals or otherwise "sign off" an FAA Form 337 in any way
 - Issue Supplemental Type Certificates
 - Grant data approvals by signing log books or other similar documents

7. REQUIRED ENGINEERING APPROVAL

- A. Many alterations that are commonly called major alterations are actually major design changes and will require a Supplemental Type Certificate. Previously unapproved major changes to structural strength, reliability, and operational characteristics affect the airworthiness of the product and therefore require engineering approval. Typical major alterations in this category include the following:

(13) Changes that do not conform to the minimum standards established in a Technical Standard Order under which a particular aircraft component or appliance is manufactured

(14) Modifications to approved type (TSO or CAATC) radio communications and navigational equipment that may adversely affect reliability or airworthiness, such as:

- Changes that deviate from the vacuum tube or semiconductor manufacturer's operation limitations
- Any changes to IF frequency
- Extension of receiver frequency range above or below the manufacturer's extreme design limits
- Major changes to the basic design of low approach aids
- Changes that deviate from the design environmental performance

(16) Changes in aircraft flight manuals and/or manual information in the form of placards or markings

B. Engineering assistance and advice should be requested when working in areas that include:

- Application of Technical Standard Orders to specific installations
- Alternative means for complying with Airworthiness Directives
- Any change to a required aircraft instrument system
- Any other complex special process that if not properly performed could have an adverse effect on the integrity of the product

C. Requests for engineering evaluation/assistance and/or approval of non-Designated Engineering Representative approved data for field approvals should be made by the inspector, not the operator.

- D. When the alteration or repair data file is forwarded to engineering for review, a memorandum of transmittal must accompany the file. When necessary, the transmittal will provide pertinent and detailed information not contained in the submitted data, such as the airworthiness inspector's recommendations, viewpoints, and specific requests for advice.
- E. When engineering assistance is requested for field approval purposes, the inspector who will complete the field approval will normally be expected to coordinate and implement the assistance requested by engineering.
- F. The inspector should be aware that the data approved by FAA engineering may not cover all the steps and procedures needed to accomplish the alteration or repair. A Field Approval by the inspector may be required for the completion of the task.

9. FLIGHT TEST AND OPERATION CHECK REQUIREMENTS

- A. An alteration or repair requiring a change to a flight manual or operation limitation must be coordinated with the appropriate engineering office.
- B. Avionics alterations requiring flight manual supplement or operations limitations changes must be coordinated with the Aircraft Certification Office.
- C. Any alteration or repair that may have appreciably changed the aircraft flight characteristics or substantially affected its operation in flight will be operationally checked in accordance with FAR § 91.167 and the results recorded on the aircraft records.
- D. If an operational check is unsatisfactory as a result of using approved data, additional data must be developed by the operator.

11. FAA FORM 337, MAJOR REPAIR AND ALTERATION

A. Data Approval

- (1) Data approval issued for one aircraft is applicable to only the aircraft described in Block 1 of FAA Form 337. This data cannot automatically be used as approved data for other aircraft. The data may be used only with the approval of the local office as the basis for obtaining approval on other aircraft.
- (2) Data approval issued for duplication of identical aircraft may be used as approved data only when the identical alteration is performed on an aircraft of identical make, model, and series by the original modifier.
- (3) When the alteration has been performed by persons other than the original modifier, this data may be used as the basis for obtaining approval on other aircraft.

B. Approval for return to service (Block 7 of FAA Form 337) by a Flight Standards airworthiness inspector will be performed only when the operator's designated person(s) is not available.

Section 2 Procedures

5. PROCEDURES

A. *Review Operator Submitted Data.* Inspectors must determine that the data supplied is complete enough to proceed with evaluation of proposed alteration or repair.

- (1) The inspector must review and evaluate the following:
 - (a) A formal application submitted on one of the following:
 - FAA Form 337 complete in duplicate
 - Other administrative forms used by a manufacturer or operator that are acceptable to the Administrator

- (b) Data that may include, but is not limited to, the following:
- Detailed description of the proposed alteration or repair
 - Detailed design standards such as methods, sketches, drawings, stress analyses, photographs, electrical load analyses, etc.
 - Testing procedures or methods to meet certification and/or operating rules, such as flammability, carbon monoxide, and noise requirements
- (c) The description of proposed alteration or repair to ensure that it correctly and accurately describes the alteration or repair.
- (d) Detailed design standards, to ensure that the operator has considered all applicable design standards and has analyses to substantiate the findings in this regard. The standards must consider at least the following:
- The structural requirements that may be affected by the alteration or repair
 - Any hazards that may affect the aircraft or its occupants
 - Weight and balance computations
 - Operating limitations
 - Any other factors affecting safety or airworthiness
- (e) Test procedures, to ensure that they include all tests necessary to substantiate that the alteration or repair meets applicable certification requirements and are appropriate to the alteration or repair.
- (2) If data is not complete, the operator must supply any additional information needed.

B. *Evaluate Proposal.* To determine compatibility with the current aircraft configuration, make a preliminary evaluation of the proposed alteration or repair and an inspection of the aircraft, as required. Accomplish at least the following, as applicable:

- (1) Review aircraft records for previous alterations and repairs that may have an affect on the proposed alteration or repair
- (2) Review maintenance and inspection procedures to determine that the alteration or repair is referenced
- (3) Inspect aircraft for the following:
 - Previous alterations or repairs that may not have been recorded
 - Compatibility of previous alterations or repairs with intended alterations or repairs
- (4) If a determination is made that the proposed alteration is beyond the scope of a field approval, advise the operator that FAA engineering evaluation is necessary. Assistance to the operator will include:
 - Furnishing an application for Type Certificate, Production Certificate, or Supplemental Type Certificate, as applicable
 - Furnishing FAA Form 8110-12 (OMB 2120-0031)
 - Advising that supporting data must be attached
- (5) If the inspector determines that assistance from engineering is needed for approving a major repair, the inspector will contact FAA engineering. Coordination with the operator will include:
 - Requesting that the operator provide all supporting data
 - Cautioning against proceeding with the repairs prior to receiving engineering approval

C. *Evaluate Alteration or Repair After Data Approval or Acceptance.* The inspector will schedule a conformity inspection with the operator to verify workmanship and compliance to accepted or approved data.

(1) The inspection must account for activities during and after the alteration or repair process. This includes but is not limited to the following:

- Witnessing that loading requirements are properly accomplished
- Operational tests and checks
- Any other techniques or methods as deemed necessary

(2) If, during the conformity inspection, it is determined that the operator cannot comply with the data submitted, the operator must revise the data accordingly.

(3) When an operator's data is "data approved only," check the operator's workmanship, conformity, and compliance with the alteration or repair as part of normal surveillance.

D. *Review the Approval for Return to Service.* The aircraft must be approved for return to service by a person authorized by FAR § 43.7 by completing block 7 of FAA Form 337 and making a maintenance record entry.

7. TASK OUTCOMES

A. File PTRS Transmittal Form

B. Completion of this task can result in the approval of data, alteration, or repair by an FAA inspector. This approval will be recorded by entering the appropriate statement in Block 3 of FAA Form 337 and identify the district office, the approval date, and the signature of the inspector. When recording approvals, the inspector will use one of the following statements:

(1) Approval by Examination of Data Only - One Aircraft:

- “The data identified herein complies with the applicable airworthiness requirements and is approved for the above described aircraft, subject to conformity inspection by a person authorized in FAR 43.7.”

(2) Approval by Physical Inspection, Demonstration, Testing, etc. - One Aircraft:

- “The alteration or repair identified herein complies with the applicable airworthiness requirements and is approved for the above described aircraft, subject to conformity inspection by a person authorized in FAR Part 43, Section 43.7.”

(3) Approval by Examination of Data Only - Duplication of Identical Aircraft:

- “The alteration identified herein complies with the applicable airworthiness requirement and is approved for duplication on identical aircraft make, model, and altered configuration when accomplished by the original modifier.”

REFERENCE A2

ADVISORY CIRCULAR 20-138

**Airworthiness Approval of Global Positioning System
(GPS) Navigation Equipment for Use as a VFR and IFR
Supplemental Navigation System**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

7. AIRWORTHINESS CRITERIA FOR GPS INSTALLATIONS
USED AS A SUPPLEMENTAL NAVIGATION SYSTEM
LIMITED TO VISUAL FLIGHT RULES (VFR) ONLY

- a. Application Process. Operators wishing to obtain approval of Class A() GPS equipment limited to VFR use only may do so via the type certificate (TC), supplemental type certificate (STC), or, for equipment previously approved via the TC or STC process, data approved by the FAA (responsible Flight Standards District Office) on FAA Form 337, Major Repair and Alteration. The approval for return to service must be signed by one of the entities noted in 14 CFR part 43; i.e., repair station, manufacturer, holder of an inspection authorization, etc.
 - (1) The initial (first-time airworthiness approval) certification of a GPS navigation system should be accomplished via the TC or STC approval process.
 - (2) Subsequent (follow-on) installations of the same GPS navigation system (hardware and software) in other aircraft are approved using a less extensive evaluation process since the basic engineering design of the GPS equipment has already been evaluated. Approval of follow-on installations may be accomplished via the TC, STC, or FAA Form 337 process. The extent of required evaluations depends upon the degree of integration of the GPS system with other aircraft systems, the similarity between the initial and follow-on aircraft models, and other changes that may have been incorporated in the GPS navigation system. The decision to allow an applicant to use FAA approved engineering data in support of an FAA Form 337 approval is left to the field inspector's judgment. The FAA Airworthiness Inspector's Handbook (FAA Order 8300.10) provides guidance applicable to GPS equipment installations.

c. VFR Airworthiness Approval

(1) First-Time VFR Airworthiness Approval Criteria (for a Particular type of GPS Equipment)

(ii) Aircraft Installation Data Evaluation. Normally the manufacturer of the GPS equipment will provide an aircraft as a test bed for the first-time installation approval. This approval will serve as a basis for subsequent installation approvals regardless of aircraft type or model. The following assessments are made:

(A) Review of the equipment installation in the aircraft.

(B) Verification that the GPS equipment is appropriate to the aircraft environment in which it is installed.

(C) Verification that the installation of the GPS equipment, including antenna, is sufficient to meet all structural mounting, dynamic, and emergency landing loads appropriate to the aircraft.

(D) Verification that a placard stating “GPS limited to VFR use only” is installed in clear view of and readable by the pilot.

(E) Verification that the GPS equipment installation does not interfere with the normal operation of other equipment installed in the aircraft.

(iv) Flight Test Evaluations. Flight tests are conducted to verify proper operation and accuracy of the GPS equipment as installed in the aircraft. Flight tests should include at least the following:

NOTE: Required flight evaluations for the first-time airworthiness approval of a particular GPS system are accomplished by the cognizant Aircraft Certification Office (ACO) unless specific tests are delegated by the ACO to a flight test pilot designated engineering representative (DER).

- (A) Evaluation of installed GPS navigation system to verify that it is functioning properly, safely, and operates in accordance with the manufacturer's specifications.
- (B) Evaluation of steering response while the autopilot and/or flight director is coupled to the GPS equipment during a variety of different track and mode changes. All available display sensitivities should be evaluated.
- (C) Evaluation to verify the GPS installation does not adversely affect other onboard equipment (this test may be partially accomplished as a ground test).
- (D) [Requirement cancelled in guidance memorandum dated 5/24/96.]
- (E) Evaluation of the accessibility of all controls pertaining to the GPS installation.
- (F) Evaluation of the visibility of the controls, displays, and annunciators relating to the GPS installation during day and night lighting conditions. No distracting cockpit glare or reflections may be introduced and all controls must be illuminated for identification and ease of use. Night lighting shall be consistent with other cockpit lighting.

(2) Follow-On VFR Airworthiness Installation Approvals. This type of approval refers to installation approvals in any model or type of aircraft after a first-time airworthiness approval of the particular GPS equipment has been issued via the TC or STC process. Follow-on approvals may use the first time airworthiness approval as a basis for installation approval. The applicant or installing agency requesting a follow-on GPS equipment installation limited to VFR use should:

- (i) Unless otherwise provided, contact either the manufacturer or organization responsible for obtaining the first time airworthiness approval of the GPS equipment in order to:

- (A) Obtain a sample airplane or rotorcraft flight manual supplement (or supplemental flight manual), if required for the aircraft.
 - (B) Obtain verification of the equipment approval status, including antenna, software, autopilot/flight director interface, system integration requirements, etc.
 - (C) Verify that the maximum operating speed for which the GPS equipment is qualified is compatible with the maximum expected ground speed of the aircraft.
- (ii) Conduct a similar data evaluation as outlined in paragraph 7c(1)(ii) of this AC.
 - (iii) Conduct a functional flight evaluation covering the items specified in paragraph 7c(1)(iv) of this AC.

NOTE: Required flight evaluations for follow-on equipment installations approved via the FAA Form 337 process may be conducted by the installer.

8. AIRWORTHINESS CRITERIA FOR GPS INSTALLATIONS USED AS A SUPPLEMENTAL NAVIGATION SYSTEM UNDER INSTRUMENT FLIGHT RULES (IFR).

- a. Application Process. Operators wishing to obtain approval of Class A () GPS equipment for IFR operations may do so via the type certificate (TC) or supplemental type certificate (STC) process. For equipment produced under TSO-C129 authorization that has previously obtained initial installation approval via the TC or STC process, approval may also be obtained via data approved by the FAA (responsible Flight Standards District Office) on FAA Form 337. The approval for return to service must be signed by one of the entities noted in 14 CFR part 43; i.e., repair station, manufacturer, holder of an inspection authorization, etc.
- (1) The initial (first-time airworthiness approval) certification of a GPS navigation or sensor system requires extensive engineering and flight test evaluations and must be accomplished via the TC or STC approval process.

- (2) Subsequent (follow-on) installations of the same GPS navigation system (hardware and software) in other aircraft are approved using a less extensive evaluation process since the basic engineering design of the GPS equipment has already been evaluated. Approval of follow-on installations may be accomplished via the TC, STC, or FAA Form 337 process. The extent of required evaluations depends upon the degree of integration of the GPS system with other aircraft systems, the similarity between the initial and follow-on aircraft models, and other changes that may have been incorporated in the GPS navigation system. The decision to allow an applicant to use FAA approved engineering data in support of an FAA Form 337 approval is left to the field inspector's judgment. The FAA Airworthiness Inspector's Handbook (FAA Order 8300.10) provides guidance applicable to GPS equipment installations. Changes to software accomplishing navigation, integrity, or availability functions or significant changes to operating limitations cannot be accomplished using the FAA form 337 process.

c. IFR Airworthiness Approval.

(1) First-Time IFR Airworthiness Approval (for a Particular Type of GPS Equipment)

- (ii) Aircraft Installation Data Evaluation. Normally the manufacturer of the GPS equipment will provide an aircraft as a test bed for the first time installation approval. This approval will serve as a basis for subsequent installation approvals regardless of aircraft type or model. The following assessments are to be made:
 - (A) Review of installation drawings, wiring diagrams, and descriptive wiring routing.
 - (B) Evaluation of the cockpit layout of the installed equipment with emphasis on equipment controls, applicable circuit breakers (labels and accessibility), switching arrangement, and related indicators, displays, annunciators, etc.

- (C) Analysis of a data flow diagram in order to review which equipment provides what data to which other equipment.
- (D) Review of a structural analysis of the equipment installation, including antenna, in order to ascertain whether structural mounting, dynamic, and crash load requirements are satisfied.
- (E) Review of an electrical load analysis in order to verify that the total electrical load requirements are within the capabilities of the aircraft's electrical generating system. Determine that the supplied electrical power is consistent with applicable equipment reliability requirements.
- (F) Verification that the aircraft environment in which the GPS equipment is installed is appropriate to the environmental categories (or criteria) in RTCA/DO-160C to which the equipment has been tested.
- (G) Evaluation of the antenna installation. It is important that the antenna be one that is approved for the particular type of GPS equipment installed. A critical aspect of any GPS installation is the installation of the antenna. Adequate isolation must be provided between the GPS antenna and any other transmitting antenna(s) installed on the aircraft. Shadowing by aircraft structure can adversely affect the operation of the GPS equipment. Typically, a GPS antenna is located forward of the wings on the top of the fuselage to minimize effects of the wings, tail, etc. during aircraft maneuvering. For installations on helicopters, the effects of the rotor blades on antenna performance must be considered.

NOTE: The GPS signal is typically below the value of the background noise. Electrical noise in the vicinity of the antenna can adversely affect the performance of the system. Antenna installation in close proximity to traffic alert and collision avoidance system (TCAS), satellite communication

(SATCOM), and other transmitting antennas (particularly “L” band) should be carefully evaluated for potential mutual interference.

(iv) Flight Test Evaluations.

- (F) Evaluation to determine satisfactory electromagnetic compatibility (EMC) between the GPS installation and other onboard equipment (this test may be partially accomplished as a ground test)

NOTE 1: Particular attention should be given to other “L” band equipment, such as TCAS or SATCOM equipment, VHF transmissions on the frequencies stated in paragraph 8b6(iii) of this AC, high frequency (HF) communications systems, and other transmitting equipment (ACARS, AFIS, Flightfone, etc.).

NOTE 2: Installation instructions for each GPS receiver installation shall include the requirement for verification of adequate isolation from the interference of VHF communication transceivers. These tests shall be conducted on the completed GPS installation by tuning each VHF transmitter to the frequencies listed below and transmitting for a period of 20 seconds while observing the signal status of each satellite being received. Degradation of individually received satellite signals below a point where navigation is no longer possible is not accepted and will require that additional isolation measures (low pass or notch filters installed at the output of the VHF transmitter, additional spacing between the VHF transmitter and the GPS antenna, replacement of the VHF transmitter with a unit having no excessive harmonic emissions, etc.) be included in the aircraft installation. Reevaluation of installed VHF transceiver performance is not necessary if the filter insertion loss is 2 dB or less. The following VHF frequencies shall be evaluated:

121.150 MHz	131.250 MHz
121.175 MHz	131.275 MHz
121.200 MHz	131.300 MHz

Please use proper radio regulations when conducting this test.

- (J) [Requirements deleted in guidance memorandum dated 5/24/96.]

(2) Follow-On IFR Airworthiness Installation Approvals. This type of approval refers to installation approvals after a first time airworthiness approval of the particular GPS equipment has been issued. Follow-on approvals may use the first time airworthiness approval, which was either a TC or an STC, as a basis for installation approval.

- (i) Unless otherwise provided, contact either the manufacturer or organization responsible for obtaining the first time airworthiness approval of the GPS equipment in order to:
- (A) Obtain a sample airplane or rotorcraft flight manual supplement (or supplemental flight manual, if appropriate).
 - (B) Obtain verification of the equipment approval status, including antenna, software, autopilot/flight director interface, system integration requirements, etc.
 - (C) Discuss any problem areas and seek assistance in their solution.
 - (D) Verify that the design maximum operating speed for the GPS equipment is compatible with the maximum expected ground speed of the aircraft.
- (ii) If the aircraft is approved for flight in known icing conditions, verify the suitability of the antenna installation in accordance with the guidance specified in paragraph 8b(7) of this AC.

(iii) Conduct a data evaluation similar to that outlined in paragraph 8c(1)(ii) of this AC.

(iv) Conduct a functional flight evaluation covering the following items:

- (A) Overall operation of the installed GPS equipment, including interface with other equipment in the aircraft.
- (B) The effect(s) of GPS equipment failure (open circuit breaker), including autopilot/flight director response, if applicable.
- (C) If interfaced with an autopilot and/or flight director, steering response while the autopilot and/or flight director is coupled to the GPS equipment.
- (D) Displayed GPS navigation parameters on all interfaced cockpit instruments.
- (E) The effect(s), if any, of switching and transfer functions, including electrical bus switching, pertaining to the GPS installation.
- (F) Evaluation to determine satisfactory EMC between the GPS installation and other equipment as specified in paragraph 8c(1)(iv)(F) of this AC.

NOTE: Verification of adequate isolation from harmonic interference of VHF communication transceivers is required for installation of GPS navigation equipment in each individual aircraft. This test should be repeated if a VHF transceiver is replaced or added, or if a new or replacement VHF communications antenna is installed.

- (G) Accessibility and visibility (day and night conditions) of all controls pertaining to the GPS installation.
- (H) Validate GPS accuracy in each operating mode as specified in paragraph 8c(1)(iv)(J) of this AC.

- (I) Verify continuity of navigation data during 360 degree left and right turns at 30 degrees of bank.
- (J) Monitor displayed cross-track error during en route, and, if applicable, approach transition and approach operations to verify FTE is less than 1.0 nmi (en route and approach transition) and 0.25 nmi (approach), both with and without use of the autopilot and flight director (if installed).
- (K) For equipment approved for approach, conduct at least three published instrument approaches (retrieved from the data base) to verify proper operation of the equipment in the approach environment.

NOTE: Required flight evaluations will be conducted by the cognizant Aircraft Certification Office (ACO) or, when authorized, by a flight test pilot designated engineering representative (DER) in accordance with the procedures used by the cognizant ACO. Depending upon the level of similarity between the initial and follow-on installations, including aircraft type, the ACO may accept flight evaluations conducted by the installer.

APPENDIX 1. PROCEDURES FOR OBTAINING FAA APPROVAL FOR IFR/VFR OPERATIONS BY FAA FORM 337 FOR FOLLOW-ON GPS EQUIPMENT INSTALLATIONS

1. FOLLOW-ON GPS EQUIPMENT INSTALLATIONS LIMITED TO VFR USE ONLY. Approval of follow-on GPS equipment installations limited to VFR use only (where the initial approval was accomplished using the TC or STC process) are normally obtained using FAA Form 337 approved by the responsible Flight Standards District Office (FSDO). Such installations can usually be approved for return to service by one of the entities noted in 14 CFR part 43; i.e., repair station, manufacturer, holder of an inspection authorization, etc., provided the installation:
 - a. General Installation Methods. Conforms to the acceptable methods, techniques, and practices contained in AC 43.13-1A, Acceptable Methods, Techniques and Practices - Aircraft

Inspection and Repair, and AC 43.13-2A, Acceptable Methods, Techniques, and Practices - Aircraft Alterations.

- b. Installation Criteria. The installation criteria should be in accordance with the criteria specified in paragraph 7c(1)(ii) of this AC. A certification from the manufacturer to confirm that the en route/terminal accuracy requirements of paragraph 6 and ground accuracy test requirements of paragraph 7c(1)(iii) have been met should be provided. This certification can be accomplished by reference to the first time TC/STC approval.

NOTE: Limited test data may be required to verify/demonstrate that the applicable requirements have been satisfied.

- c. Aircraft Flight Manual Supplement/Placard(s). Except for those installations where placards adequately address required limitations, an airplane or rotorcraft flight manual supplement (or supplemental flight manual) prepared by the applicant and containing at least the following information must be presented for FAA approval. The proposed flight manual supplement (or supplemental flight manual) is submitted for approval along with the other data associated with the installation.

(1) Equipment operating limitations.

(2) Emergency/abnormal operating procedures (if applicable).

(3) Normal procedures for operating the GPS system and any interfaced equipment. (May be provided in a pilot's guide that is referenced in the flight manual supplement.)

(4) General description of system (or reference to a pilot's guide that provides an equipment description).

- d. Functional Flight Evaluation. A functional flight evaluation covering the items listed in paragraph 7c(1)(iv) of this AC is accomplished by the installer. The results of this evaluation are included with the data provided to the FSDO.

- 2. FOLLOW-ON GPS EQUIPMENT INSTALLATIONS FOR IFR USE. Approval of follow-on GPS installations for IFR use (where the initial approval was accomplished using the TC or STC process) may be obtained using an FAA Form 337 approved by the responsible FSDO.

- a. Data Submitted by the Applicant. Alteration data for the equipment installation is submitted with a properly executed FAA Form 337 and a certification from the manufacturer to confirm that the accuracy requirements of paragraph 6a and ground accuracy test requirements or paragraph 8c(1)(iii) of this AC and system performance specifications of TSO-C129 have been met. (This certification can be accomplished by reference to TSO-C120 approval and the original TC/STC approval.) The FAA Form 337, along with all required data pertaining to the installations, should be submitted to the responsible FSDO.
- b. Additional Data That May be Required. If required by the FSDO (or an ACO consulting with the FSDO when reviewing the data/conducting necessary tests requested by the FSDO) approving the technical data/installation, the applicant may also be required to furnish a copy of the equipment data (for equipment not produced under TSO-C129 authorization), manufacturer's operating and installation instructions, fault analysis for installation, installation details and/or photographs, structural substantiation, system wiring diagrams, and ground test evaluation results.
- c. Aircraft Flight Manual Supplement. An airplane or rotorcraft flight manual supplement (or supplemental flight manual) prepared by the applicant and containing at least the following information must be presented for FAA approval. The proposed flight manual supplement (or supplemental flight manual) is prepared using the guidance contained in appendix 2 and submitted to the FSDO.
 - (1) Equipment operating limitations.
 - (2) Emergency/abnormal operating procedures.
 - (3) Normal procedures for operating the GPS system and any interfaced equipment. (May be provided in a pilot's guide that is referenced in the flight manual supplement.)
 - (4) General description of system (or reference to a pilot's guide that provides an equipment description).
- d. Functional Flight Evaluation. A functional flight evaluation covering the items listed in paragraph 8c(2)(iv) is accomplished.

If the criteria specified in appendix 1, paragraph 2a(2) above is satisfied, the installer conducts the flight evaluation. In situations where additional FAA evaluation is necessary, required flight evaluations will be conducted by the cognizant ACO or, when authorized, by a flight test pilot designated engineering representative (DER) in accordance with the procedures used by the ACO.

APPENDIX 2. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (FAA Form 337 Approval Process).

1. The following sample Airplane Flight Manual Supplement (AFMS) is provided as an example of the format to be used and information to be included when preparing required supplements. An AFMS must follow the organization of the flight manual being supplemented.

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT

Installation Center/Repair Station
123 Fourth Street
System
Anytown, USA

Model XXX GPS
Navigation

FAA APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT
ABC MODEL XXX GPS NAVIGATION SYSTEM

AIRPLANE MAKE: _____
AIRPLANE MODEL: _____
AIRPLANE SERIAL NO.: _____
REGISTRATION NO.: _____

This document must be carried in the airplane at all times. It describes the operating procedures for the ABC Model XXX GPS navigation system when it has been installed in accordance with *<manufacturer's installation manual number and date>* and FAA Form 337 dated *<insert date>*.

For airplanes with and FAA Approved Airplane Flight Manual, this document serves as the FAA Approved ABC Model XXX GPS Flight Manual Supplement. For airplanes that do not have an approved flight manual, this document serves as the FAA Approved ABC Model XXX GPS Supplemental Flight Manual.

The information contained herein supplements or supersedes the basic Airplane Flight Manual dated *<insert date>* only in those areas listed herein. For limitations, procedures, and performance information not contained in this document, consult the basic Airplane Flight Manual.

FAA APPROVED

Title
Office
Federal Aviation Administration
City, State

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
System
Anytown, USA

Model XXX GPS
Navigation

Table of Contents

<u>Section</u>	<u>Page</u>
1 General.....	<>
2 Limitations.....	<>
3 Emergency/Abnormal Procedures.....	<>
4 Normal Procedures.....	<>
5 Performance.....	<>
6 Weight and Balance.....	<>
7 System Description.....	<>

FAA Approved
Date: _____

Page <> of <>

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
System
Anytown, USA

Model XXX GPS
Navigation

SECTION 1 - GENERAL

1. *<Provide a very brief (i.e., one paragraph) general description of the GPS navigation system installed in the aircraft.>*
2. Provided the ABC Model XXX GPS navigation system is receiving adequate usable signals, it has been demonstrated capable of and has been shown to meet the accuracy specifications of:

VFR/IFR en route oceanic and remote, en route domestic, terminal, and instrument approach (GPS, Loran-C, VOR, VOR-DME, TACAN, NDB, NDB-DME, RNAV) operation (*specify operations, i.e., en route oceanic and remote, en route domestic, terminal, instrument approach, etc., as applicable to the particular approval.*) within the U.S. National Airspace System, North Atlantic Minimum Navigation Performance Specification (MNPS) Airspace and latitudes bounded by \diamond North and \diamond South using the WGS-84 (or NAD 83) coordinate reference datum in accordance with the criteria of AC 20-XXX, AC 91-49, AC 120-33, and *<list additional applicable ACs>*. Satellite navigation data is based upon use of only the global positioning system (GPS) operated by the United States.

SECTION 2 - LIMITATIONS

1. The ABC Model XXX GPS Pilot's Guide, P/N *<insert part number>*, dated *<insert date>* (or later appropriate revision) must be immediately available to the flight crew whenever navigation is predicated on the use of the system. The software status stated in the Pilot's Guide must match that displayed on the equipment.

FAA Approved
Date: _____.

Page \diamond of \diamond

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
System
Anytown, USA

Model XXX GPS
Navigation

2. The system must utilize software version *<insert version identification>*.
3. IFR en route and terminal navigation is prohibited unless the pilot verifies the currency of the data base or verifies each selected waypoint for accuracy by reference to current approved data.
4. Instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the GPS equipment data base. The GPS equipment data base must incorporate the current update cycle.
 - (a) Instrument approaches must be conducted in the approach mode and RAIM must be available at the Final Approach Fix.
 - (b) Accomplishment of ILS, LOC, LOC-BC, LDA, SDF, and MLS approaches are not authorized.
 - (c) When an alternate airport is required by the applicable operating rules, it must be served by an approach based on other than GPS or Loran-C navigation, the aircraft must have operational equipment capable of using that navigation aid, and the required navigation aid must be operational.
5. The aircraft must have other approved navigation equipment installed and operating appropriate to the route of flight.
6. *<Specify any airspace limitations that may be applicable to systems that do not provide for coordinate reference system conversions of the displayed navigation information for airspace that is not referenced to the WGS-84 or NAD-83 geodetic datums.>*

FAA Approved
Date: _____

Page <> of <>

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
Anytown, USA

Model XXX GPS
Navigation System

7. *<Specify any additional limitations applicable to the particular installation.>*

SECTION 3 - EMERGENCY/ABNORMAL PROCEDURES

EMERGENCY PROCEDURES

No Change

ABNORMAL PROCEDURES

1. If ABC Model XXX GPS navigation information is not available or invalid, utilize remaining operational navigation equipment as required.
2. If "RAIM NOT AVAILABLE" message is displayed, continue to navigation using the GPS equipment or revert to an alternate means of navigation appropriate to the route and phase of flight. When continuing to use GPS navigation, position must be verified every 15 minutes using another IFR-approved navigation system.

SECTION 4 - NORMAL PROCEDURES

NOTE: Transmission on VHF communication frequencies 121.150, 121.175, 121.200, 131.250, 131.275, and 31.300 MHz may adversely affect reception of the GPS signal. Transmissions in excess of approximately 15 seconds may result in loss of GPS signal reception. Navigation will be restored within 5 seconds after the completion of the transmission.

1. Normal operating procedures are outlined in the ABC Model XXX GPS Pilot's Guide, P/N *<insert part number>*, dated *<insert date>* (or later appropriate revision).

FAA Approved
Date: _____

Page <> of <>

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
Anytown, USA

Model XXX GPS
Navigation System

2. *<Describe approach mode sequencing and signal RAIM prediction capability.>*
3. System Annunciators
 - a. Waypoint - *<describe each annunciator>*
 - b. Message - *<describe each annunciator>*
 - c. Approach - *<describe each annunciator>*
 - d. *<describe any other annunciators>*
4. System Switches
 - a. Nav/GPS - *<describe switch use and function>*
 - b. RMI Switch - *<describe switch use and function>*
 - c. *<describe any other switches>*
5. Pilot's display *<describe the pilot's GPS display(s)>*
6. Flight Director/Autopilot Coupled Operation *<describe the procedures for coupling GPS to the flight director and/or autopilot system(s)>*
7. *<include any other normal operating procedures necessary>*

SECTION 5 - PERFORMANCE

No Change

FAA Approved
Date: _____

Page <> of <>

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
System

Model XXX GPS
Navigation

SECTION 6 - WEIGHT AND BALANCE

<Refer to revised weight and balance date, if applicable>

SECTION 7 - SYSTEM DESCRIPTION

*<Provide a brief description of the system, its operation, installation,
etc.>*

FAA Approved
Date: _____

Page ◊ of ◊

REFERENCE A3

**ADVISORY CIRCULAR 20-130A
(Draft)**

**Airworthiness Approval of Navigation or Flight
Management Systems Integrating Multiple Navigation
Sensors**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

7. SYSTEM ACCURACY.

a. 2D Accuracy Requirements (95 percent probability).

- (1) For equipment incorporating a Class B() of C() GPS sensor, the total position fixing error of the airborne multi-sensor equipment shall be equal to or less than that shown in Table 2 when GPS data is used in the position/navigation computation:

Table 2. 2D Accuracy Requirements, Equipment Incorporating Class B() or C() GPS Sensor

Error Type	Oceanic and remote (nmi)	En Route Domestic (nmi)	Terminal (nmi)	Non-Precision Approach* (nmi)
Position Fixing Error**	0.124	0.124	0.124	0.0560
CDI Centering ***	0.2	0.2	0.2	0.01

* Non-precision approach criteria only applies to equipment incorporating a Class B1, B3, C1, or C3 GPS sensor.

** Equipment error assumes an average GPS HDOP of 1.5, GPS equipment waypoint input resolution of 0.01 minute, and output resolution of 0.01 minute for approach and 0.1 minute otherwise.

*** The maximum difference between the displayed cross track deviation and the computed cross track deviation.

- (2) For equipment not incorporating a GPS sensor (or when GPS data is not used in a system including a GPS sensor), the total

position fixing error of the airborne multi-sensor equipment shall be equal to or less than that shown in Table 3:

Table 3. 2D Accuracy Requirements, Equipment Not Incorporating a GPS Sensor

Error Type	Oceanic and remote (nmi)	En Route (Domestic) (nmi)	Terminal (nmi)	Non-Precision Approach (nmi)
Position Fixing Error*	12.0	2.8	1.7	0.3 (0.5 if navigation data derived from a single collocated VOR/DME station)
CDI Centering **	0.2	0.2	0.2	0.1

* Equipment error assumes a multi-sensor equipment waypoint input resolution of 0.01 minute, and output resolution of 0.01 minute for approach and 0.1 minute otherwise.

** The maximum difference between the displayed cross track deviation and the computed cross track deviation.

8. AIRWORTHINESS CRITERIA FOR NAVIGATION AND FLIGHT MANAGEMENT SYSTEMS INTEGRATING MULTIPLE NAVIGATION SENSORS LIMITED TO VISUAL FLIGHT RULES (VFR) ONLY

a. Application Process. Persons wishing to use a navigation or flight management system integrating multiple navigation sensors for operations limited to VFR only may obtain approval of the installation by Type Certificate (TC), Supplemental Type Certificate (STC) or data approved by the FAA (responsible Flight Standards District Office) on FAA Form 337 (Major Repair and Alteration). The approval for return to service must be signed by one of the entities noted in 14 CFR part 43; i.e., repair station, manufacturer, holder of an inspection authorization, etc.

c. VFR Airworthiness Approval

(1) First-Time VFR Airworthiness Approval (for a Particular Type of Multi-Sensor Navigation of Flight Management System)

(ii) Aircraft Installation Data Evaluation. Normally the manufacturer of the multi-sensor equipment will provide an aircraft as a test bed for the first time installation approval. This approval will serve as a basis for subsequent approvals, regardless of aircraft type or model. The following assessments are made:

- (A) Review of the equipment installation in the aircraft.
- (B) Verification that the multi-sensor equipment is appropriate to the environment in which it was installed.
- (C) Analysis of a data flow diagram in order to review which equipment provides what data to which other equipment.
- (D) Verification that the installation of the GPS equipment, including antenna, is sufficient to meet all structural mounting, dynamic, and emergency landing loads appropriate to the aircraft category.
- (E) Verification that a placard stating “XXX Navigation (or Flight Management) System limited to VFR use only” is installed in clear view of and readily readable by the pilot.
- (F) Verification that the multi-sensor equipment does not interfere with the normal operation of other equipment installed in the aircraft.
- (G) Evaluation of the antenna installation. A critical aspect of many multi-sensor equipment installations is the installation of the antenna(e). It is important that the antenna for each sensor be one that is approved for the particular type (make and model) sensor installed.

- (1) Adequate isolation must be provided between the GPS antenna and any other transmitting antenna(s) installed on the aircraft. Shadowing by aircraft structure can adversely affect the operation of GPS equipment. Typically, a GPS antenna is located forward of the wings on the top of the fuselage to minimize effects of the wings, tail, etc. during aircraft maneuvering. Installations on helicopters must consider the effects of the rotor blades on antenna performance.

NOTE: The GPS signal is typically below the value of the background noise. Electrical noise in the vicinity of the antenna can adversely affect the performance of the system. Antenna installation in close proximity to Traffic Alert and Collision Avoidance System (TCAS), satellite communication (SATCOM), and other transmitting antennae (particularly "L" band) should be carefully evaluated for potential mutual interference. Inter modulation effects are possible between multiple channel SATCOM installations and GPS. Harmonic interference from VHF transmissions on 121.150, 121.175, 121.200, 131.250, 131.275, and 131.300 MHz may adversely affect reception of the GPS signal if less than 100 dB isolation is provided.

- (2) "E" field antennas (whip, plate, or blade type) are typically used with Loran-C sensors and many Omega/VLF sensors. Precipitation static has an adverse effect upon the signal receiving capability of this type of antenna. The adverse effects of P-static can be minimized by use of the proper antenna type and location, by proper installation of high-quality static dischargers, and by proper bonding of airframe surfaces. The manufacturer's installation or maintenance manual usually describes acceptable "E" field antenna installation practices. Each aircraft should be subjected to a careful ohmic survey of electrical airframe bonding (an electrical bonding limit of 10 milliohms is considered acceptable). P-static

protection is a required part of the system installation and must be maintained for proper system operation.

- (3) “H” field antennas (loop type) are typically used with Omega/VLF sensors. The signal receiving quality of this type of antenna is adversely affected by aircraft electrical skin currents, particularly by 400 Hz ac. P-static has no appreciable effect on an “H” field antenna, and its effects are usually not observed. A procedure called skin mapping is normally employed to determine a good mounting location for “H” field antennas. It should be noted that shifting major aircraft electrical components to different locations within the aircraft or installing new equipment subsequent to antenna installation may render a previously determined skin map location unsuitable. A simple test to verify the effectiveness of an “H” field antenna installation located by skin mapping is to park the aircraft away from any external electrical noise source. Then, using only the aircraft’s battery, and with all other electrical equipment off, activate the multi-sensor equipment and record signal-to-noise values (or quality factors) for all receivable stations of the appropriate sensor. Repeat this process of recording signal-to-noise values (or quality factors) with engine(s) running and all electrical/electronic equipment operating on aircraft power. If the antenna installation is satisfactory, there should not be any significant degradation in signal reception.

- (iii) Ground Test Evaluations. For multi-sensor equipment incorporating a Class B() of C() GPS sensor, static ground tests are conducted to verify the installed GPS equipment configuration (including antenna) provides position data meeting the accuracy criteria specified in paragraph 8a(1) of this AC. These tests shall cover a continuous period of 24 hours with a maximum sample interval of five minutes.

NOTE: The 24-hour ground accuracy test may be performed on the aircraft or by use of a representative mock-up configuration. If a mock-up test fixture is used, the entire installed GPS equipment configuration, including antenna, must consist of the hardware to be used in the installation and be representative of the installed system configuration.

- (iv) Flight Test Evaluations. Flight tests are conducted to verify proper operation and accuracy of the multi-sensor equipment as installed in the aircraft. Flight tests should include at least the following:

NOTE: Required flight evaluations for the first-time airworthiness approval of particular multi-sensor equipment are accomplished by the cognizant Aircraft Certification Office unless specific tests are delegated by the ACO to a flight test pilot designated engineering representative (DER).

- (A) Evaluation of installed multi-sensor equipment to verify that it is functioning properly, safely, and operates in accordance with the manufacturer's specifications.
- (B) Evaluation of steering response while autopilot and/or flight director is coupled to the multi-sensor equipment during a variety of different track and mode changes. Additionally, all available display sensitivities shall be evaluated.
- (C) Evaluation to verify the multi-sensor equipment installation does not adversely affect other onboard equipment (this test may be partially accomplished as a ground test).
- (D) Evaluation of the accessibility of all controls pertaining to the multi-sensor equipment installation.
- (E) Evaluation of the visibility of the controls, displays, and annunciators relating to the multi-sensor equipment installation during day and night lighting conditions. No distracting cockpit glare or reflections may be introduced, and all controls must be illuminated for identification and ease of use. Night lighting shall be consistent with other cockpit lighting.

- (F) Demonstrate multi-sensor equipment navigational performance (including, as applicable to the sensors integrated in the system, Loran-C chain selection/switching, adequate P-static protection, etc.) has not been adversely affected by the installation in the aircraft.
- (G) Validate multi-sensor equipment navigational accuracy in each operating mode. In addition to overall system navigation performance, particular test requirements for navigational accuracy will vary depending upon the particular sensors integrated in the multi-sensor equipment and whether sensor accuracy performance data has previously been obtained.
 - (1) GPS sensor accuracy should be verified in each operating mode by at least 5 low altitude over flights of one or more surveyed locations (ensure survey point coordinates are relative to WGS-84 or NAD-83). An acceptable method of conducting this accuracy demonstration is to accomplish low altitude (less than 100 feet AGL) overflight of a runway threshold and record the GPS position as the aircraft crosses the threshold. The system accuracy is the distance between the coordinate position determined by the GPS and the coordinate position of the surveyed location (runway threshold). Runway threshold coordinates may be obtained from the airport operator. If coordinate data conversion to WGS-84/NAD-83 is necessary, contact the National Flight Data Center at (202)267-9277.
 - (2) Follow-On VFR Airworthiness Installation Approvals. This type of approval refers to installation approvals in any model or type of aircraft after a first time airworthiness approval of the particular multi-sensor equipment has been issued. Follow-on approvals may use the first time airworthiness approval, which was either a TC or an STC, as a basis for installation approval. Follow-on installation approvals may be accomplished by TC, STC, or data approved on FAA Form 337. Flight Standards District Offices (FSDOs) receiving an application for field approval of a multi-sensor equipment on FAA Form 337 must

coordinate with the cognizant Aircraft Certification Office (ACO) for review of installation data, accomplishment of any necessary flight tests and evaluations, and approval of the required flight manual supplement. The applicant or installing agency requesting a follow-on multi-sensor equipment installation utilizing this method of data approval should:

- (i) Unless otherwise provided, contact either the manufacturer or organization responsible for obtaining the first time airworthiness approval of the multi-sensor equipment in order to:
 - (A) Obtain a sample airplane or rotorcraft flight manual supplement (or supplemental flight manual, if appropriate), if required by the installation.
 - (B) Obtain verification of the equipment approval status, including antenna, software, autopilot/flight director interface, and system integration requirements, etc.
 - (C) Discuss any problem areas and seek assistance in their solution.
 - (D) Verify that the maximum operating speed for which the multi-sensor equipment is qualified is compatible with the maximum expected ground speed of the aircraft.
- (ii) Conduct a similar data evaluation as outlined in paragraph 8c(1)(ii) of this AC.
- (iii) Conduct a functional flight evaluation covering the items listed in paragraph 8c(1)(iv) of this AC.

NOTE: Required flight evaluations for follow-on equipment installations approved via the Form 337 process may be conducted by the installer.

9. AIRWORTHINESS CRITERIA FOR NAVIGATION AND FLIGHT MANAGEMENT SYSTEMS INTEGRATING MULTIPLE NAVIGATION SENSORS USED UNDER INSTRUMENT FLIGHT RULES (IFR)
- a. Application Process. Persons wishing to obtain approval of multi-sensor equipment integrating any combination of GPS, Omega/VLF, Loran-C, VOR/DME, Multiple DME, or INS/IRS sensors for IFR operations may do so via the Type Certificate (TC) or Supplemental Type Certificate (STC) process. For equipment produced under TSO-C115b authorization that has previously obtained initial installation approval via the TC or STC process, approval may also be obtained via data approved by the FAA (responsible Flight Standards District Office) on FAA Form 337 (Major Repair and Alteration). The approval for return to service must be signed by one of the entities noted in 14 CFR part 43; i.e., repair stations, manufacturer, holder of an inspection authorization, etc. Procedures for VFR only airworthiness approval are detailed in paragraph 8 of this AC.
- (1) The initial (first-time airworthiness approval) certification of multi-sensor equipment requires extensive engineering and flight test evaluations and must be accomplished via the TC or STC approval process.
- (2) Subsequent (follow-on) installations of the same navigation or flight management system (hardware and software) in other aircraft are approved using a less extensive engineering and flight test evaluation. Approval of follow-on installations may be accomplished via the TC, STC, or FAA Form 337 process. The extent of required evaluations depends upon the degree of integration of the navigation system with other aircraft systems and/or other changes that may have been incorporated in the multi-sensor equipment. Changes to software accomplishing navigation, integrity or availability functions; changes in the number, type, or mix of sensors integrated in the system; changes to/addition of approved operating areas; or significant changes to operating limitations cannot be accomplished using the FAA Form 337 process and must use TC or STC procedures.
- (3) Approval of multi-sensor equipment integrating a Class C() GPS sensor with any other combination of sensors for IFR

operations must use the TC or STC process. Because of the unique enhanced display and system integration requirements applicable to this integration of sensors and displays, appropriate test requirements and procedures must be determined based upon the particular application.

b. Airworthiness Considerations

- (7) Anti-Ice Protection. If the aircraft in which the multi-sensor equipment is installed is approved for flight into known icing conditions, any antennae must have anti-ice protection or be found not to be susceptible to ice buildup. Alternatively, if the equipment can be shown to operate satisfactorily when the antenna is subject to icing, then anti-ice protection is not required. (The effect of ice accumulation on the antenna, if any, can be found in the manufacturer's installation instructions.)

c. IFR Airworthiness Approval

(1) First-Time IFR Airworthiness Approval (for a Particular Type of Multi-sensor Navigation or Flight Management System)

(ii) Aircraft Installation Data Evaluation. Normally the manufacturer of the multi-sensor equipment will provide an aircraft as a test bed for the first time installation approval. This approval will serve as a basis for subsequent installation approvals, regardless of aircraft type or model. The following assessments are to be made:

- (A) Review of installation drawings, wiring diagrams, and descriptive wiring routing.
- (B) Evaluation of the cockpit layout of the installed equipment with emphasis on equipment controls, applicable circuit breakers (labels and accessibility), switching arrangement, and related indicators, displays, annunciators, etc.
- (C) Analysis of a data flow diagram in order to review which equipment provides what data to which other equipment.

- (D) Review of a structural analysis of the equipment installation, including antenna(e), in order to ascertain whether structural mounting, dynamic, and crash load requirements are satisfied.
 - (E) Review of an electrical load analysis in order to verify that the total electrical load requirements are within the capabilities of the aircraft's electrical generating system. Determine that the supplied electrical power is consistent with applicable equipment reliability requirements.
 - (F) Verification that the aircraft environment in which the multi-sensor equipment is installed is appropriate to the environmental categories (or criteria) to which the equipment has been tested.
 - (G) Evaluation of the antenna installation. A critical aspect of many multi-sensor equipment installations is the installation of the antenna(e). It is important that the antenna for each sensor is approved for the particular type (make and model) sensor installed.
- (L) Adequate isolation must be provided between a GPS antenna and any other transmitting antenna(s) installed on the aircraft. Shadowing by aircraft structure can adversely affect the operation of GPS equipment. Typically, a GPS antenna is located forward of the wings on the top of the fuselage to minimize effects of the wings, tail, etc. during aircraft maneuvering. Installations on helicopters must consider the effects of the rotor blades on antenna performance.

NOTE: The GPS signal is typically below the value of the background noise. Electrical noise in the vicinity of the antenna can adversely affect the performance of the system. Antenna installation in close proximity to traffic alert and collision avoidance system (TCAS), satellite communication (SATCOM), and other transmitting antennas (particularly "L" band)

should be carefully evaluated for potential mutual interference.

- (2) “E” field antennas (whip, plate, or blade type) are typically used with Loran-C sensors and many Omega/VLF sensors. Precipitation static has an adverse effect upon the signal receiving capability of this type of antenna. The adverse effects of P-static can be minimized by use of the proper antenna type and location, by proper installation of high-quality static dischargers, and by proper bonding of airframe surfaces. The manufacturer’s installation or maintenance manual usually describes acceptable “E” field antenna installation practices. Each aircraft should be subjected to a careful ohmic survey or electrical airframe bonding (an electrical bonding limit of 10 milliohms is considered acceptable). P-static protection is a required part of the system installation and must be maintained for proper system operation.
- (3) “H” field antennas (loop type) are typically used with Omega/VLF sensors. The signal receiving quality of this type of antenna is adversely affected by aircraft electrical skin currents, particularly by 400 Hz ac. P-static has no appreciable effect on an “H” field antenna, and its effects are usually not observed. A procedure called skin mapping is normally employed to determine a good mounting location for “H” field antennas. It should be noted that shifting major aircraft electrical components to different locations within the aircraft or installing new equipment subsequent to antenna installation may render a previously determined skin map location unsuitable. A simple test to verify the effectiveness of an “H” field antenna installation located by skin mapping is to park the aircraft away from any external electrical noise source. Then, using only the aircraft’s battery, and with all other electrical equipment off, activate the multi-sensor equipment and record signal-to-noise values (or quality factors) for all receivable

stations of the appropriate sensor. Repeat this process of recording signal-to-noise values (or quality factors) with engine(s) running and all electrical/electronic equipment operating on aircraft power. If the antenna installation is satisfactory, there should not be any significant degradation in signal reception.

(iv) Flight Test Evaluations.

(K) Validate multi-sensor equipment navigational accuracy in each operating mode. In addition to overall system navigation performance, particular test requirements for navigational accuracy will vary depending upon the particular sensors integrated in the multi-sensor equipment and whether sensor accuracy performance data has previously been obtained. The performance of each navigation sensor should be evaluated separately and in combination with other sensors as applicable.

(1) GPS sensor accuracy should be verified in each operating mode by at least 5 low altitude over flights of one or more surveyed locations (ensure survey point coordinates are relative to WGS-84). An acceptable method of conducting this accuracy demonstration is to accomplish low altitude (less than 100 feet AGL) overflight of a runway threshold and record the GPS position as the aircraft crosses the threshold. The system accuracy is the distance between the coordinate position determined by the GPS and the coordinate position from the surveyed location (runway threshold). Runway threshold coordinates may be obtained from the airport operator. If coordinate data conversion to WGS-84/NAD-83 is necessary, contact the National Flight Data Center at (202) 267-9277.

(2) Initial certification for systems including an Omega/VLF sensor that has not previously been certified shall be based upon a demonstration of system accuracy by recording (at not less than 15-

minute intervals) the Omega/VLF sensor position and comparing it to the actual position during evaluation flights representative of the area in which approval is desired. Suitable accuracy and navigation capability must be demonstrated using Omega only. Recorded data should include sufficient signal parameters and sensor performance data to provide a clear indication of satisfactory sensor performance. The particular flight paths should be selected based upon an analysis of critical signal characteristics, station geometry, aircraft movement, time of day, etc. The system should demonstrate its ability to re-acquire Omega/VLF signals after power interruptions of less than seven minutes and more than seven minutes, as well as areas of marginal performance. It should demonstrate its ability to detect inadequate navigation capability, poor signal quality, etc.

- (3) Initial certification for systems including a Loran-C sensor that has not previously been certified shall be based upon a demonstration of system accuracy by recording (at not less than 15 minute intervals) the Loran-C sensor position and comparing it to the actual position during evaluation flights representative of the area in which approval is desired. Recorded data should include sufficient signal parameters and sensor performance data to provide a clear indication of satisfactory sensor performance. The particular flight paths should be selected based upon an analysis of critical signal characteristics, station geometry, chain/station selection criteria, known poor signal areas, aircraft movement, seasonal effects (i.e., snow pack vs. trees, water vs. ice, etc.), time of day, etc. The system should demonstrate its ability to re-acquire the Loran-C signal following momentary signal interruptions and prolonged (more than 5 minutes) inflight power failure, etc.

- (4) Initial certification for systems including a VOR/DME or multiple (scanning) DME sensor that has not been previously certified shall be based upon a demonstration of system accuracy by recording (at not greater than 15 minute intervals) the VOR/DME and/or DME/DME sensor position and comparing it to the actual position during evaluation flights representative of the area in which approval is desired. Recorded data should include sufficient signal parameters and sensor performance data to provide a clear indication of satisfactory sensor performance. The particular flight paths should be selected based upon an analysis of critical signal characteristics, station geometry, signal coverage (including limited station availability with acceptable range), aircraft movements, etc. The system should demonstrate its ability to detect poor signal conditions, inadequate navigation capability, operations outside approved operating areas, recovery from inflight power failure, etc.
- (5) Initial certification for systems including an inertial navigation system (INS) or inertial reference unit (IRU) that has not been previously certified shall be based upon a demonstration of system accuracy by recording (at not greater than 15 minutes intervals) the INS/IRU sensor position and comparing it to the actual position during evaluation flights representative of the area in which approval is desired. Recorded data should include sufficient sensor performance parameters to provide a clear indication of satisfactory sensor performance and drift rates. The system should demonstrate its ability to detect inadequate navigation capability, operations outside approved operating areas, recovery from power failure, reinitialization in flight, alignment in limiting areas, etc.

- (2) Follow-On IFR Airworthiness Installation Approvals. This type of approval refers to installation approvals in any model or type of aircraft after a first time airworthiness approval of the particular multi-sensor equipment has been issued. Follow-on approvals may use the first time airworthiness approval, which was either a TC or an STC, as a basis for installation approval. Follow-on installation approvals may be accomplished by TC, STC, or data approved on FAA Form 337.
- (i) For multi-sensor equipment limited to en route and terminal operations only, the Flight Standards District Office (FSDO) may approve the installation without consulting the Aircraft Certification Office (ACO) unless the responsible inspector is not familiar with the installation approval criteria established in this AC or has other questions related to the installation.
 - (ii) For multi-sensor equipment approved for instrument approaches, the FSDO may approve the installation without consulting the ACO provided:
 - (A) There is not autopilot/flight director interface or the autopilot/flight director and aircraft model and series are identical to a previously approved installation.
 - (B) An external cross-track deviation display (CDI, HSI, etc.) is located in the pilot's primary field of view.
 - (C) All GPS equipment controls are located within easy reach of the pilot with the least practicable deviation from the pilot's normal position.
 - (D) Required GPS annunciators are located within the pilot's normal field of view when looking forward along the flight path, including the center radio stack.
 - (iii) For GPS equipment installations where the criteria of 9c(2)(i) or (ii) of this AC are not satisfied, the FSDO should contact the ACO for assistance in completing any necessary evaluation(s) prior to approval.
 - (iv) Unless otherwise provided, contact either the manufacturer or organization responsible for obtaining the first time

airworthiness approval of the multi-sensor equipment in order to:

- (A) Obtain a sample airplane or rotorcraft flight manual supplement (or supplemental flight manual, if appropriate).
 - (B) Obtain verification of the equipment approval status, including antenna, software, autopilot/flight director interface, and system integration requirements, etc.
 - (C) Discuss any problem areas and seek assistance in their solution.
 - (D) Verify that the maximum operating speed for which the multi-sensor equipment is qualified is compatible with the maximum expected ground speed of the aircraft.
- (v) If the aircraft is approved for flight in known icing conditions, verify the suitability of the antenna installation in accordance with the guidance specified in paragraph 8b(7) of this AC.
- (vi) Conduct a similar data evaluation as outlined in paragraph 9c(1)(ii) of this AC.
- (vii) Conduct a functional flight evaluation covering at least the following items:

NOTE: Required flight evaluations for follow-on equipment installations may be conducted by the installer if the criteria specified in paragraph 8c(2)(i) or (ii) of this AC are met. In other circumstances, required flight evaluations will be conducted by the cognizant Aircraft Certification Office (ACO) or, when authorized, by a flight test pilot designated engineering representative (DER) in accordance with the procedures used by the cognizant ACO.

- (A) Evaluation of all operating modes of the multi-sensor equipment. Particular attention should be given to mode switching and transition requirements

associated with the approach mode for equipment incorporating Class B1, B3, C1, and C3 GPS sensors.

- (B) Evaluation of the interface (function) of other equipment connected to the multi-sensor equipment.
- (C) Review of various failure modes and associated annunciations, such as loss of electrical power, loss of signal reception, equipment failure, individual sensor failure, autopilot/flight director response to system flags, etc.
- (D) Evaluation of steering response while autopilot and/or flight director is coupled to the multi-sensor equipment during a variety of different track and mode changes. This evaluation shall include, as applicable, transition from en route to approach transition to approach modes and vice-versa. Additionally, all available display sensitivities shall be evaluated.
- (E) Evaluation if displayed multi-sensor equipment parameters on interfaced cockpit instruments such as HSI, CDI, distance display, electronic flight instruments system (EFIS), moving maps, fuel management systems, etc.
- (F) Assessment of all switching and transfer functions, including electrical bus switching, pertaining to the multi-sensor equipment installation.
- (G) Evaluation to determine satisfactory electromagnetic compatibility (EMC) between the multi-sensor equipment installation and other onboard equipment (this test may be partially accomplished as a ground test).

NOTE 1: For systems incorporating a GPS sensor, particular attention should be given to other “L” band equipment, such as TCAS or SATCOM equipment, VHF transmissions on the frequencies stated in paragraph 9a(2) of this AC, high frequency (HF)

communications systems, and other transmitting equipment (ACARS, AFIS, Flightfone, etc.).

NOTE 2: Installation instructions for each GPS receiver installation shall include the requirement for verification of adequate isolation from the harmonic interference of VHF communication transceivers. These tests shall be conducted on the completed GPS installation by tuning each VHF transmitter to the frequencies listed below for a period of 20 seconds while observing the signal status of each satellite being received. Degradation of individually received satellite signals below a point where navigation is no longer possible is not acceptable and will require that additional isolation measures (low pass or notch filters installed at the output of the VHF transmitter, additional spacing between the VHF transmitter and the GPS antenna, replacement of the VHF transmitter with a unit having no excessive harmonic emissions, etc.) be included in the aircraft installation. Reevaluation of installed VHF transceiver performance is not necessary if the filter insertion loss is 2 dB or less. The following VHF frequencies shall be evaluated:

121.150 MHz	131.250 MHz
121.175 MHz	131.275 MHz
121.200 MHz	131.300 MHz

- (H) Evaluation of the accessibility and visibility of all controls pertaining to the multi-sensor equipment installation.
- (I) Validate multi-sensor equipment navigational accuracy in each operating mode, as described in paragraph 9c(1)(iv)(K) of this AC.
- (J) Verify continuity of navigation data during normal aircraft maneuvering, including holding patterns and turns at up to at least 30 degrees of bank for one minute.

- (K) Monitor displayed cross-track error to verify that flight technical error (FTE) is less than 2.0 nmi for en route, 1.0 nmi for terminal (approach transition), and 0.25 nmi (for equipment using GPS data) or 0.5 nmi (for equipment not using GPS data) for approach operating modes, both with and without autopilot and/or flight director, as applicable.
- (L) For equipment including an approach mode, conduct at least three published instrument approaches (retrieved from the database) to verify the proper operation of the equipment in the approach environment.

APPENDIX 1. PROCEDURES FOR OBTAINING FAA APPROVAL OF FOLLOW-ON MULTI-SENSOR EQUIPMENT INSTALLATIONS FOR IFR/VFR OPERATIONS BY FAA FORM 337

- 2. FOLLOW-ON MULTI-SENSOR EQUIPMENT INSTALLATIONS LIMITED TO VFR USE ONLY. Approval of follow-on multi-sensor equipment installations limited to VFR use only (where the initial approval was accomplished using the TC or STC process) are normally obtained using FAA Form 337 approved by the responsible Flight Standards District Office (FSDO). Such installations can usually be approved for return to service by one of the entities noted in 14 CFR part 43; i.e., repair station, manufacturer, holder of an inspection authorization, etc., provided the installation:
 - a. General Installation Methods. Conforms to the acceptable methods, techniques, and practices contained in AC 43.13-1A, Acceptable Methods, Techniques and Practices - Aircraft Inspection and Repair, and AC 43.13-2A, Acceptable Methods, Techniques, and Practices - Aircraft Alterations.
 - b. Installation Criteria. Is in accordance with the criteria specified in paragraph 7c(2) of this AC. A certification from the manufacturer to confirm that the en route/terminal accuracy requirements or paragraph 6 and ground accuracy test requirements of paragraph 7c(1)(ii) have been met should be provided. This certification can be accomplished by reference to the first time TC/STC approval.

NOTE: Limited test data may be required to verify/demonstrate that the applicable requirements have been satisfied.

- c. Aircraft Flight Manual Supplement/Placard(s). Except for those installations where placards adequately address required limitations, an airplane or rotorcraft flight manual supplement (or supplemental flight manual) prepared by the applicant and containing at least the following information must be presented for FAA approval. The proposed flight manual supplement (or supplemental flight manual) is submitted to the FSDO for approval along with the other data associated with the installation.
- (1) Equipment operating limitations.
 - (2) Emergency/abnormal operating procedures (if applicable).
 - (3) Normal procedures for operating the multi-sensor equipment and any interfaced equipment. (May be provided in a pilot's guide that is referenced in the flight manual supplement.)
 - (4) General description of system (or reference to a pilot's guide that provides an equipment description).

NOTE: The FAA inspector will evaluate and sign the flight manual supplement (or supplemental flight manual) presented by the applicant as part of a field approval. Generally, FAA inspectors should have sufficient understanding of the AFM or RFM to approve a supplement for the multi-sensor equipment installation without need for assistance from the ACO. However, if assistance is needed the inspector should request it early in the program.

- d. Functional Flight Evaluation. A functional flight evaluation covering the items listed in paragraph 7c(2)(iii) is accomplished by the installer. The results of this evaluation are included in the data provided to the FSDO.
3. FOLLOW-ON MULTI-SENSOR EQUIPMENT INSTALLATIONS FOR IFR USE. Approval of follow-on multi-sensor equipment installations for IFR use (where the initial approval was accomplished using the TC or STC process) may be obtained using an FAA Form 337 approved by the responsible Flight Standards District Office.

a. Approval Process.

- (1) Multi-sensor equipment installations limited to en route and terminal operations only are normally approved by the FSDO without consulting the Aircraft Certification Office (ACO). In cases where the responsible inspector is not familiar with the installation approval criteria established in this AC or has other questions related to the installation, consultation with the ACO may be necessary.
- (2) Multi-sensor equipment installations approved for non-precision instrument approaches may be approved by the FSDO without consulting the ACO provided:
 - (i) There is no autopilot/flight director interface or the autopilot/flight director and aircraft model and series are identical to a previously approved installation;
 - (ii) An external CDI or HSI that displays multi-sensor equipment cross-track deviation information is located in the pilot's primary field of view;
 - (iii) All multi-sensor equipment controls are located within easy reach of the pilot with the least practicable deviation from the pilot's normal position; and
 - (iv) All required multi-sensor equipment annunciators are located within the pilot's normal field of view when looking forward along the flight path, including the center panel radio stack.
- (3) If the above criteria is not satisfied, the FSDO inspector should contact the ACO for assistance in completing any necessary evaluation(s) prior to approval.

- b. Data Submitted by the Applicant. Alteration data specified in paragraph 8c(2)(v) for the equipment installation is submitted with a properly executed FAA Form 337, and a certification from the manufacturer to confirm that the accuracy requirements of paragraph 7a and ground accuracy test requirements of paragraph 8c(1) (iii) of this AC and system performance specifications of TSO-C115a have been met. (This certification can be

accomplished by reference to TSO-C115a or b approval and the original TC/STC approval.) The FAA Form 337, along with all required data pertaining to the installation, should be submitted to the responsible FSDO.

- c. Additional Data Which May be Required. If required by the FSDO (or an ACO when consulting with the FSDO when reviewing the data/conducting necessary tests requested by the FSDO) approving the technical data/installation, the applicant may also be required to furnish a copy of the equipment data (for equipment not produced under TSO-C115a or b authorization), manufacturer's operating and installation instructions, fault analysis for installation, installation details and/or photographs, structural substantiation, system wiring diagrams and ground test evaluation results.
- d. Aircraft Flight Manual Supplement. An airplane or rotorcraft flight manual supplement (or supplemental flight manual) prepared by the applicant and containing at least the following information must be presented for FAA approval. The proposed flight manual supplement (or supplemental flight manual) is prepared using the guidance contained in Appendix 2 and submitted to the FSDO.
- (1) Equipment operating limitations.
 - (2) Emergency/abnormal operating procedures (if applicable).
 - (3) Normal procedures for operating the multi-sensor equipment and any interfaced equipment. (May be provided in a pilot's guide that is referenced in the flight manual supplement.)
 - (4) General description of system (or reference to a pilot's guide that provides an equipment description).

NOTE: The FAA inspector will evaluate and sign the flight manual supplement (or supplemental flight manual) presented by the applicant as part of a field approval. Generally, FAA inspectors should have sufficient understanding of the AFM or RFM to approve a supplement for the multi-sensor equipment installation without need for assistance from the ACO. However, if assistance is needed the inspector should request it early in the program.

- e. Functional Flight Evaluation. A functional flight evaluation covering the items listed in paragraph 8c(2)(vi) is accomplished. If the criteria specified in paragraph 3a(2) above is satisfied, the

installer conducts the flight evaluation. In situations where additional FAA evaluation is necessary, required flight evaluations will be conducted by the cognizant ACO or, when authorized, by a Flight Test Pilot Designated Engineering Representative (DER) in accordance with the procedures used by the ACO.

APPENDIX 2. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT(FAA Form 337 Approval Process).

1. The following sample Airplane Flight Manual Supplement (AFMS) is provided as an example of the format to be used and information to be included when preparing required supplements. An AFMS must follow the organization of the flight manual being supplemented.

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT

Installation Center/Repair Station
123 Fourth Street
Anytown, USA

Model XXX Multi-Sensor
Navigation System

FAA APPROVED AIRPLANE FLIGHT MANUAL SUPPLEMENT
ABC MODEL XXX MULTI-SENSOR NAVIGATION SYSTEM

AIRPLANE MAKE:
AIRPLANE MODEL:
AIRPLANE SERIAL NO.:
REGISTRATION NO.:

This document must be carried in the airplane at all times. It describes the operating procedures for the ABC Model XXX Multi-Sensor navigation system when it has been installed in accordance with *<manufacturer's installation manual number and date>* and FAA Form 337 dated *<insert date>*.

For airplanes with and FAA Approved Airplane Flight Manual, this document serves as the FAA Approved ABC Model XXX Multi-Sensor navigation system Flight Manual Supplement. For airplanes that do not have an approved flight manual, this document serves as the FAA Approved ABC Model XXX Multi-Sensor navigation system Supplemental Flight Manual.

The information contained herein supplements or supersedes the basic Airplane Flight Manual dated *<insert date>* only in those areas listed herein. For limitations, procedures, and performance information not contained in this document, consult the basic Airplane Flight Manual.

FAA APPROVED

Manager, Flight Test Branch
XXX Aircraft Certification Office
Federal Aviation Administration
City, State

FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
Anytown, USA

Model XXX Multi-Sensor
Navigation System

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2 Limitations.....	<>
3 Emergency/Abnormal Procedures.....	<>
4 Normal Procedures.....	<>
5 Performance.....	<>
6 Weight and Balance.....	<>
7 System Description.....	<>

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FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
Anytown, USA

Model XXX Multi-Sensor
Navigation System

SECTION 1 - GENERAL

1. *<Provide a very brief (i.e., one paragraph) general description of the multi-sensor navigation system installed in the aircraft.>*
2. Provided the ABC Model XXX multi-sensor navigation system is receiving adequate usable signals, it has been demonstrated capable of and has been shown to meet the accuracy specifications of:

VFR/IFR en route oceanic and remote, en route domestic, terminal, and instrument approach (GPS, Loran-C, VOR, VOR-DME, TACAN, NDB, NDB-DME, RNAV) operation (*specify operations, i.e., en route oceanic and remote, en route domestic, terminal, instrument approach, etc., as applicable to the particular approval.*) within the U.S. National Airspace System, North Atlantic Minimum Navigation Performance Specification (MNPS) Airspace and latitudes bounded by \diamond North and \diamond South using the WGS-84 (or NAD 83) coordinate reference datum in accordance with the criteria of AC 20-130A, AC 91-49, AC 120-33, and *<list additional applicable ACs>*. Satellite navigation data is based upon use of only the Global Positioning System (GPS) operated by the United States.

SECTION 2 - LIMITATIONS

1. The ABC Model XXX Multi-Sensor Navigation System Pilot's Guide, P/N *<insert part number>*, dated *<insert date>* (or later appropriate revision) must be immediately available to the flight crew whenever navigation is predicated on the use of the

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FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station
123 Fourth Street
Anytown, USA

Model XXX Multi-Sensor
Navigation System

system. The software status stated in the Pilot's Guide must match that displayed on the equipment.

2. The system must utilize software version *<insert version identification>*.
3. IFR en route and terminal navigation is prohibited unless the pilot verifies the currency of the database or verifies each selected waypoint for accuracy by reference to current approved data.
4. Instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrieved from the multi-sensor equipment database. The multi-sensor equipment data base must incorporate the current update cycle.
 - (a) Instrument approaches must be conducted in the approach mode and GPS integrity monitoring (for systems incorporating a GPS sensor) must be available at the Final Approach Fix.
 - (b) Accomplishment of ILS, LOC, LOC-BC, LDA, SDF, and MLS approaches are not authorized.

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FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station Model XXX Multi-Sensor
123 Fourth Street Navigation System
Anytown, USA

- (c) When an alternate airport is required by the applicable operating rules, it must be served by an approach based on other than GPS or Loran-C navigation, the aircraft must have operational equipment capable of using that navigation aid, and the required navigation aid must be operational.
5. The aircraft must have other approved navigation equipment installed and operating appropriate to the route of flight.
6. *<Specify any airspace limitations that may be applicable to systems that do not provide for coordinate reference system conversions of the displayed navigation information for airspace that is not referenced to the WGS-84 or NAD-83 geodetic datums.>*
7. *<Specify any additional limitations applicable to the particular installation.>*

SECTION 3 - EMERGENCY/ABNORMAL PROCEDURES

EMERGENCY PROCEDURES

No Change

ABNORMAL PROCEDURES

1. If ABC Model XXX multi-sensor equipment navigation information is not available or invalid, utilize remaining operational navigation equipment as required.
2. If “GPS INTEGRITY NOT AVAILABLE” message is displayed, continued navigation using the GPS equipment or reversion to an alternate means of navigation appropriate to the

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FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station Model XXX Multi-Sensor
123 Fourth Street Navigation System
Anytown, USA

route and phase of flight is necessary. When continuing to use GPS navigation, position must be verified every 15 minutes using another IFR-approved navigation system.

SECTION 4 - NORMAL PROCEDURES

NOTE: Transmission on VHF communication frequencies 121.150, 121.175, 121.200, 131.250, 131.275, and 131.300 MHz may adversely affect reception of the GPS signal. Transmissions in excess of approximately 15 seconds may result in loss of GPS signal reception. Navigation will be restored within 5 seconds after the completion of the transmission.

1. Normal operating procedures are outlined in the ABC Model XXX Multi-Sensor Equipment Pilot's Guide, P/N *<insert part number>*, dated *<insert date>* (or later appropriate revision).
2. *<Describe approach mode sequencing and signal integrity capability.>*
3. System Annunciators
 - a. Waypoint - *<describe each annunciator>*
 - b. Message - *<describe each annunciator>*
 - c. Approach - *<describe each annunciator>*
 - d. *<describe any other annunciators>*

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FIGURE 1. SAMPLE AIRPLANE FLIGHT MANUAL
SUPPLEMENT (continued)

Installation Center/Repair Station Model XXX Multi-Sensor
123 Fourth Street Navigation System
Anytown, USA

4. System Switches
 - a. Nav/FMS - *<describe switch use and function>*
 - b. RMI Switch - *<describe switch use and function>*
 - c. *<describe any other switches>*
5. Pilot's display *<describe the pilot's multi-sensor navigation data display(s)>*
6. Flight Director/Autopilot Coupled Operation *<describe the procedures for coupling multi-sensor equipment navigation information to the flight director and/or autopilot system(s)>*
7. *<include any other normal operating procedures necessary>*

SECTION 5 - PERFORMANCE

No Change

SECTION 6 - WEIGHT AND BALANCE

<Refer to revised weight and balance data, if applicable>

SECTION 7 - SYSTEM DESCRIPTION

<Provide a brief description of the system, its operation, installation etc.>

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REFERENCE A4

**FAA ORDER 8300.10
APPENDIX 4, FSAW 94-32A**

**Installation and Approval Procedures of Global
Positioning System (GPS) Equipment Used for
Supplemental Navigation for En Route, Terminal, and
Nonprecision Approaches**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

1. PURPOSE. This document was amended/updated to provide handbook guidance on the installation and approval of GPS navigation equipment used for “supplemental” navigation and “primary means” for Oceanic/Remote Operations. Please note that GPS equipment may be field approved, via the field approval process, for use as a supplemental means of navigation in the following manner, unless subsequent, superseding policy dictates otherwise:

- A. When the installation duplicates a previously Supplemental Type Certificate (STC) approved installation of the SAME EQUIPMENT on SAME MODEL and TYPE aircraft then Block 3 need not be signed. Installation requires an FAA Form 337 (with approved data) for proper documentation. (Original Aircraft Flight Manual/Aircraft Flight Manual Supplement (AFM/AFMS) is considered part of the installation approval and reflects current configuration.)
- B. When it consists of the SAME EQUIPMENT that was approved by a Type Certificate (TC) or STC installed in a DIFFERENT MODEL and TYPE aircraft, and the installation is similar to the initial TC or STC. Block 3 of FAA Form 337 must be signed by an FAA Airworthiness Safety Inspector(ASI). An Airplane or Rotorcraft Flight Manual Supplement (AFMS/RFMS) or Supplemental AFM will be considered part of the installation approval. An operational check in accordance with FAR Section 91.407 (para (a) or (b) as it applies to the alteration) may be performed and documented on an FAA Form 337. Minor deviations to the original TC or STC will be documented on the FAA Form 337.
- C. For installations for primary means of navigation for Oceanic/Remote Operations only, no field approval process is required if the installation duplicates a previously STC approved installation of the SAME EQUIPMENT on SAME MAKE/MODEL aircraft. The AFMS/RFMS for the original STC must include specific mention of satisfying GPS primary means

requirements. An AFMS/RFMS or Supplemental AFM will be considered part of the installation. Paragraph 8 contains additional information regarding the approval process of GPS as a primary means of navigation.

- D. Present guidance does not identify the requirement for equipment to be qualified and approved under Parts Manufacturer Approval (PMA), Replacement and Modification Parts. Recent experience has indicated a need to emphasize that GPS navigation equipment must meet the requirements of FAR section 21.303.
- E. If such equipment has been issued a "multiple" STC so that a PMA could be awarded, the PMA is usually aircraft eligibility restricted to a specific type certification basis or type approval to one make or model of aircraft. This restriction should not prevent the installation of GPS or Multi-Sensor navigation equipment into aircraft for which such equipment can be shown to meet applicable environmental qualifications and aircraft compatibility and, therefore, can be field approved.

2. BACKGROUND. GPS navigation equipment can be approved to provide supplemental navigation under Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) within oceanic en route, domestic en route, terminal area, and nonprecision instrument approach (except localized, localizer directional aid and simplified directional facility operations). GPS navigation equipment can also be approved to provide primary means of navigation for oceanic/remote operations, provided additional criteria are met. Paragraph 8 contains additional information regarding the approval of GPS as a primary means of navigation.

3. DEFINITIONS:

- A. GPS Navigation Equipment. GPS navigation equipment not combined with other navigation sensors or navigation systems. GPS navigation equipment may use altimeter aiding and/or augmented GPS signals, and provide navigation information to various compatible displays.
- B. Multi-Sensor Navigation System. A Multi-Sensor Navigation System that computes and/or displays a blended or independent position derived from two or more sensors (for example, GPS, Loran-C, VOR/DME, DME/DME, INS/IRS/IRU Omega, etc.) which provide independent positions. Such systems, based upon

Loran-C, VOR/DME, DME/DME, Omega, INS/IRS/IRU, etc., which compute and display position, may be approved for IFR to monitor or "cross-check" GPS position. If GPS meets the requirements of and is certified to TSO-C129, Class B1/C1 or B2/C2, GPS may be used as the only sensor within a Multi-Sensor Navigation System.

4. GPS INSTALLATIONS LIMITED TO VFR USE ONLY.
 - A. Persons wishing to obtain original airworthiness certification of a GPS installation limited to VFR use only shall obtain approval of the installation by TC or STC. "Follow-on" field approvals can be obtained after an original TC or STC has been awarded.
 - B. The Aircraft Engineering Division, AIR-100, has stipulated that "follow-on" VFR GPS installations for supplemental navigation are major. If the installer has determined and can show that the installation of the GPS navigation equipment, including the antenna installation, does not impact the certificated properties of the aircraft type design, this would permit the installation of the equipment to be declared as a minor alteration.
 - C. It is the responsibility of the person(s) performing the alterations to ensure that the equipment and its installation satisfies all interference immunity requirements and that mutual compatibility with other equipment and systems is maintained. The person(s) must show evidence that such tests and/or analysis were satisfactorily conducted to ensure interference immunity and mutual compatibility.
 - D. A placard stating "GPS not approved for IFR" must be installed in clear view of and readable by the pilot-in-command. Such placard must be identified on the FAA Form 337 for purposes of reviewing and field approving the installation of the placard.
 - E. The above installations intended for "VFR use only" do not require that the GPS equipment comply with TSO-C129, but accuracy should be demonstrated as described in AC 20-138, "Airworthiness Approval of Global Positioning System Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System." The GPS equipment should be installed according to the instructions and limitations provided by the manufacturer of the equipment. Another acceptable method, technique and practice such as AC 43.13-2A, Acceptable Methods, Techniques, and Practices -

Aircraft Alterations, as amended, may be used, if relevant and not contrary to the approved data or the original STC, as a basis for consideration by the FAA for approval.

- F. Functional ground and flight check to ensure correct operation and accuracy will be conducted and recorded, in VFR conditions, by an appropriate FAA certificated person, repair station, or an appropriately rated pilot. A flight check is not required if a GPS VFR installation is made in a manner similar to one which has been previously demonstrated in another approved alterations within a similar aircraft. The approval for return to service must be signed by one of the entities noted in FAR Part 43; i.e., repair station, holder of an inspections authorization, etc.
- G. The GPS navigation equipment may be coupled to an autopilot and/or flight director system if a deviation or steering input that is compatible with the autopilot/flight director system is provided. Approvals of this type of interface will require a flight functional check to verify proper functioning of the equipment installed to demonstrate performance using en route, terminal area, and non-precision approach cross-track deviation sensitivity selections available to the pilot.
- H. For installations which are complex in nature as prescribed in paragraph 4.C. and that incorporate multiple navigation sources, and/or which employ composite roll steering; and/or need to identify necessary limitations and operating procedures, and FAA approved AFMS/RFMS or Supplemental AFM will be required and made readily available to the flight crew.

5. INSTALLATIONS OF GPS NAVIGATION EQUIPMENT FOR USE USER IFR.

- A. The airworthiness certification of a GPS Navigation Equipment shall be according to requirements specified in Aircraft Certification Order 8110.4, Type Certifications, or other acceptable means to show compliance for those approved units not meeting the requirements of TSO-C129, Airborne Supplemental Navigation Equipment Using the Global Positioning System. Person(s) wishing to obtain original approval of a GPS Navigation System for IFR shall do so through the TC or STC process for en route, terminal and for nonprecision approach operations, as described in AC 20-138.

- B. An ASI can field approve installation data when the alteration is based on the original TC or STC approval and the installation data (e.g., installation drawings, parts list, installation wiring diagrams, etc.), and a copy of original FAA approved AFMS/RFMS is available for review. An AFMS/RFMS or Supplemental AFM will be required and must contain all pertinent details of the originally approved AFMS/RFMS or Supplemental AFM. A functional ground and operational flight test must be conducted, in VFR conditions, to verify proper functioning of all equipment installed by the alteration and will need to be recorded on the FAA Form 337. The approval for return to service must be signed by one of the entities noted in FAR Part 43; i.e. repair station, holder of an inspection authorization, etc.
- C. Installations of GPS navigation equipment, approved for en route, terminal area and nonprecision approach use, may be approved by an avionics ASI without consulting the Aircraft Certification Office (ACO) provided the following conditions have been met: review of the steering response while autopilot and /or flight director is coupled to the GPS equipment during a variety of different track and mode changes; the external cross-track deviation display (CDI, ESI, EHSI, etc.) is located within the pilot's primary field-of-view; all GPS controls are located within easy reach of the pilot and required GPS equipment annunciators must be located within the primary field-of-view.

6. INSTALLATION OF MULTI-SENSOR NAVIGATION EQUIPMENT FOR USE UNDER IFR.

- A. A person(s) wishing to obtain original airworthiness certification of a Multi-Sensor Navigation (or Flight Management) Equipment for use under IFR, that integrates any combination of GPS, Omega/VLF, Loran-C, VOR/DME, DME/DME, or INS/IRU sensors must do so under the TC or STC process with appropriate multi-sensors TSO requirements. Nonprecision approach approval may be granted if sensors used for approach operations were evaluated and approved under the TC or STC process as described in AC 20-130A, "Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors."
- B. Field approvals can reference the first-time airworthiness approval, which was obtained by a TC or an STC, as a basis for installation approval if the previously approved data (e.g., installation drawings, parts list, installation wiring diagrams, etc.)

are available for review. Several makes and models of GPS sensors that do not meet the requirements of TSO-C129, but may have been awarded PMA, have been approved for use under IFR conditions by the STC process. Therefore, these sensor may be candidates for field approval. An AFMS/RFMS or Supplemental AFM will be required and must contain all pertinent details of the originally approved AFMS/RFMS or Supplemental AFM. A functional ground and operational flight check will be conducted, in VFR conditions, to verify GPS sensor and other sensor accuracy and proper functioning of all equipment installed. Results of these tests will need to be recorded on FAA Form 337.

7. AIRCRAFT FLIGHT MANUALS.

- A. An approved AFMS/RFMS or Supplemental AFM for aircraft without an FAA-approved flight manual, should be prepared on the basis of compatibility, format specific to the aircraft, and applicability with previously approved AFMS/RFMS or Supplemental AFM's. Each approved AFMS/RFMS must include all provisions pertaining to the system's normal operations, either directly or by reference, and all appropriate operating limitations, emergency/abnormal procedures, and performance details. See Appendix II of AC 20-130A or AC 20-130A or AC 20-138 for examples.
- B. Approval of AFMS involving GPS and Multi-Sensor Navigation Systems may be performed by the avionics ASI's for VFR and IFR. The AFMS/RFMS or Supplemental AFM must contain the same pertinent details as the AFMS approved under the original TC or STC. ASI's are to ensure when reviewing and AFMS/RFMS or Supplemental AFM that all limitations covered are the same as in the original FAA-approved AFM or RFM by reference and by format. Also ensure that the system switches, annunciators, displays and flight director/autopilot and instruments are compatible with the aircraft being modified in this configuration.

8. GPS INSTALLATIONS FOR PRIMARY MEANS FOR OCEANIC AND REMOTE OPERATIONS.

- A. Person(s) wishing to obtain original installation approval shall do so through the TC or STC process as required for GPS systems for use under IFR. If the GPS equipment for primary use for oceanic

and remote operations has not received its approval by the TC or STC process, then the GPS equipment or aircraft manufacturer must obtain a TSO-C129A authorization (Class A1, A2, B1, B2, C1, C2) from the cognizant ACO. The FAA Form 337 or other form acceptable to the Administrator will be used for installations that duplicate the original installation under an existing TC or STC of the SAME EQUIPMENT on the SAME MODEL and TYPE. The desired performance requirements would be satisfied during the original TC or STC process. Follow-on field approvals as described for supplemental GPS installations are not permitted for GPS installations for primary means for oceanic and remote operations.

- B. The person(s) seeking operational approval would apply to the appropriate Flight Standards District Office(FSDO) for authorization to use the GPS system(s) or GPS-based multi-sensor navigation system for the intended operation (e.g., use of GPS in place of Omega or Inertial Navigation System for Class II navigation, or use of GPS/FMS for a particular oceanic/remote route). Intentional operational procedures must be identified in the AFMS or Supplemental AFM.
- C. The principal avionics inspector will review the applicant's airworthiness approval and maintenance procedures to ensure that the installed equipment has been incorporated into the applicant's airworthiness program depending on the owner/operator's type of operation. Following an acceptable review, the principal operations inspector will issue the appropriate operations specifications or letter of authorization.

9. FAA FORM 8000-36, PROGRAM TRACKING AND REPORTING SUBSYSTEM DATA SHEET. Avionics ASI's responsible for reviewing data for all future GPS installations are requested to fill out the "National Use" block by inserting the letters "GPS" and a brief description of the type of GPS activity accomplished in the "Comment Text" column.

10. TSO-C129 GPS CLASS DESIGNATORS.

Class	Stand Alone Approach	Multi-Sensor	RAIMRAIM Equiv.	En Route	Terminal	Nonprec.
A1	X		X	X	X	X
A2	X		X	X	X	
B1		X	X	X	X	
X						
B2		X	X	X	X	
B3		X		X	X	X
B4		X		X	X	
C1		X	X	X	X	X
C2		X	X	X	X	
C3		X		X	X	X
X						
C4		X		X	X	X

Class A - GPS sensor and navigation capability

Class B - GPS sensor data to an integrated navigation system (e.g., FMS, multi-sensor navigation system, etc.)

Class C - GPS sensor data to an integrated navigation management system (as in Class B) which provides enhanced guidance to an autopilot or flight director to reduce flight technical errors. This does not necessarily apply only to Part 121 air carriers.

Note 1: Any changes not approved by TC or STC to software (other than navigation databases) which affect navigation, integrity, or availability functions; changes in the quantity, type, or mix of sensors integrated within the system; changes to or in addition of operating areas; or significant changes to operating limitations cannot be field approved until consultation with the ACO has been done to determine if an other STC is required. Discussions, recommendations, or decision by the ACO will be made part of the inspector's approval process records.

Note 2: Installation instructions for each GPS navigation equipment and Multi-Sensor Navigation System shall include the requirement for verification of adequate isolation from harmonic interference possibly caused by VHF transmitters. Tests shall be conducted by tuning each VHF transmitter to the frequencies listed below and transmitting for 20 seconds while observing the signal status of each or all satellites actively being received. Degradation of individually received or all

satellite signals below a point where navigation using GPS is no longer possible will not be acceptable for use under IFR and will require that additional isolation or filter techniques be included in the aircraft installation. Proper radio procedures must be observed when performing harmonic interference tests.

121.125 MHz	131.200 MHz
121.150 MHz	131.225 MHz
121.175 MHz	131.250 MHz
121.200 MHz	131.275 MHz
121.225 MHz	131.300 MHz
121.250 MHz	131.325 MHz
-----	131.350 MHz

11. INQUIRIES. This FSIB was developed by AFS-350, Avionics Branch.

For questions or comments regarding this FSIB, contact AFS-350 at (202)267-3812.

12. EXPIRATION. This FSIB will expire on 10-30-96.

REFERENCE A5

**FAA ORDER 8300.10
APPENDIX 4, FSAW 94-41**

**Global Positioning System/Differential Global
Positioning System Special Use Applications**

1. PURPOSE. This FSIB provides guidance to Federal Aviation Administration (FAA) inspectors concerning Global Positioning System (GPS)/Differential Global Positioning System (DGPS) to be installed in aircraft used in special applications.
2. BACKGROUND.
 - A. GPS/DGPS technology has been made available for aircraft used in specialized applications, such as agricultural, aerial photography, mapping, fire fighting, search and rescue, etc. The only purpose of these installations is for the accurate sighting of the aircraft. These types of installations are considered non-essential and for special purpose use, therefore, the criteria for equipment performance is to be determined by the GPS/DGPS equipment manufacturers. The flight crews are not to predicate navigation on the GPS/DGPS equipment.
 - B. FAA inspectors presented with a request for approval of installation data should consider the following during the data approval process:
3. INSTALLATION. GPS/DGPS and optional features, such as data logging, must be installed in accordance with approved data. Approved data may be obtained by Type Certification (TC), Supplemental Type Certification (STC), or through the field approval process by the FAA Form 337.
4. FIELD APPROVALS.
 - A. Installers requesting field approvals and inspectors evaluating the data package must ensure that all information and/or referenced documents fully describe how the AIRCRAFT has been modified. The data package will include the installation, post-installation, and ground and flight tests. For example, references to Advisory Circular AC 43.13-1A and/or 43.13-2A and/or equivalent manufacturer's manuals must be specific and directly relevant.
 - B. Should the data not support any part of the installation, post-installation, and ground and flight tests, the installer could use the services of a Designated Engineering Representative or an

FAA Aircraft Certification Office to obtain approval for the data in question.

5. THE FLIGHT TEST. The aerodynamic flight test for externally mounted equipment may be conducted by the installer or operator in accordance with data provided by the GPS/DGPS manufacturer. The flight test shall evaluate the aircraft performance throughout the speed ranges and maneuvers normally conducted during the specific application. The signature of the person performing the flight test, the date of the flight test, and the certificate number of the person who performed the flight test shall be documented on the FAA Form 337.
6. EVALUATION OF DATA. Inspectors are encouraged to examine data packages and to perform a conformity inspection in sufficient detail to establish confidence in the installing agency's ability to accurately duplicate the initial installation. If the inspector determines that the data is capable of being used for other similar make and model installations, then the inspector should authorize Block 3 of the FAA Form 337 for duplication for similar make and model aircraft. For those GPS systems that have been a part of a TC or STC, follow-on approvals may be implemented on similar aircraft. Care should be taken to ensure that any limitations included in the TC or STC are implemented into the follow-on approval.
7. BLOCK 8. Block 8 of the FAA Form 337 shall include a record entry outlining the post-installation ground test and flight test results. Duplication of previous approved data for an identical installation in a similar make and model aircraft is authorized, provided the submitted FAA Form 337 contains a reference in Block 8 identifying the FAA Form 337 it is basing its approval on. A copy also must accompany the FAA Form 337. These similar installations are limited to the same installer. Block 8 of FAA Form 337 must also contain the statement that the aircraft has been placarded "GPS/DGPS not to be used for navigation." This required placard must be placed in plain view of the pilot in the cockpit.

NOTE: In the event the data package is insufficient to determine compliance with the Federal Aviation Regulations (FAR), the inspector will return FAA Form 337 with a statement describing the reason for the rejection to the installer. The inspector will also

send a copy of the rejected FAA Form 337 with a statement describing the reason for rejection to the owner/operator of the aircraft.

8. ACTION. None.

9. INQUIRIES. This FSIB was developed by AFS-300. Direct any questions or comments to AFS-350 at (202)267-8203.

10. EXPIRATION DATA. This FSIB will expire on August 30, 1995.

/S/ Frederick J. Leonelli

REFERENCE A6

**FAA HUMAN FACTORS AND OPERATIONS
CHECKLIST FOR STANDALONE GPS RECEIVERS
(TSO C129 A1)**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

2.1 DEPARTURE

2.1.1 Flight Plan Entry & RAIM Check

Purpose:

To evaluate procedures required for flight plan entry & RAIM check.

Test Procedure:

While on ground:

1. Enter a 9 waypoint flight plan **(4, 6, 8)**
2. Conduct RAIM check for ETA **(5)**

Evaluation Considerations:

- A) Control easy to access and identify **(7)**
 - Reach distance
 - Identification of controls and control operation
 - Visibility of displays when using controls
- B) Control use sequence requires minimal reliance on memory & promotes error free operation **(1, 2, 3, 6, 7)**
 - Number and combination of controls used
 - Number of control actions required
 - Probability of data entry errors
 - Ease of error detection
 - Ease of error recovery
 - Pilot knowledge of what to do next
- C) Display output **(6, 7)**
 - Readability with acceptable change in body position **(3)**
 - Messages understandable

2.2 EN ROUTE

2.2.1 Flight Plan Review & Modification

Purpose:

Evaluate ease of reviewing and modifying a flight plan while in flight.

Test Procedure:

Fly several consecutive legs in the flight plan. While flying to a waypoint in the flight plan:

1. Review legs or segments of the flight plan **(8)**
2. Obtain distance, bearing & name of the active waypoint **(8)**
3. Change two consecutive intermediate waypoints **(8)**

Evaluation Considerations:

- A) Operation of waypoint sequencing **(6)**
- B) Accessibility of flight critical information
- C) Display readability **(4, 5, 7)**
- D) Ease of locating waypoints in database **(1, 2, 4, 7)**
- E) Clarity of waypoint categories
- W) Workload: **(7)**
 - Adequate situational awareness
 - Minimal mental effort
 - Minimal number of control actions

2.2 EN ROUTE

2.2.2 Tracking Accuracy

Purpose:

To evaluate ease of course intercept and tracking accuracy (with and without autopilot).

Test Procedure:

Perform the following both with and without the autopilot:

1. Intercept a segment & fly to a waypoint in flight plan **(4)**

Evaluation Considerations:

- A) Utility of track angle error information and CDI for course intercept **(2)**
- B) Effort required to maintain FTE at less than 1.0 nm **(5)**
- C) Ability to intercept route segment **(6)**
- D) Ability to adjust CDI sensitivity in flight **(3)**

2.2 EN ROUTE

2.2.3 Waypoint Sequencing & Turn Anticipation

Purpose:

To evaluate waypoint sequencing procedure, associated display indications, and turn anticipation.

Test Procedure:

While in flight plan mode, fly to a waypoint and:

- Fly to the left and right of a 'fly by' waypoint at the intersection of two flight plan segments defining a 90° turn. **(7)**
This will require the following passes by the "corner" waypoint:
 - Fly a course parallel with the approaching en route segment with the CDI nearly pegged to the outside (left of course) and follow turn anticipation advisory
 - Repeat with CDI nearly pegged to the inside (right of course)
 - Repeat with CDI on center line
 - Repeat with CDI on center line using autopilot

Evaluation Considerations

- A) Waypoint alert visibility **(7)**
- B) Turn anticipation facilitates smooth transition to next segment using not more than a standard rate turn **(1, 6)**
- C) Information provided to pilot by CDI and message display not misleading **(4)**
- D) Waypoint sequencing consistent and facilitates accurate tracking of airway **(2, 3, 6, 7)**
- E) Verify full scale deflection of CDI ± 5.0 nm **(3)**
- F) Verify resolution of crosstrack error at least 0.10 nm **(3)**

2.2 EN ROUTE

2.2.4 Electromagnetic Compatibility

Purpose:

Determine use of selective radio frequencies on GPS operations.

Note: Reevaluation of installed VHF transceiver performance is not necessary if the filter insertion loss is 2 dB or less.

Test Procedure:

Fly direct to a waypoint:

1. While en route, tune each of the following frequencies for at least 20 seconds & activate mike repeatedly **(1)**

121.150 MHz..... 131.250 MHz

121.175 MHz..... 131.275 MHz

121.200 MHz..... 131.300 MHz

Evaluation Considerations:

- A) Influence on: **(2, 3)**

CDI indication

Display quality

Digital cross track error

Distance to waypoint

Alerts and warnings

- B) Influence on satellite HDOP value Sat: **(2, 3)**

1

2

3

4

5

6

2.2 EN ROUTE

2.2.5 Display Quality Evaluation

Purpose:

Evaluate influences of sunlight on display readability.

Test Procedures:

Exit flight plan & fly direct to waypoints which will position the aircraft in each of the following orientations: **(3, 6)**

- Directly into the sun
- With the sunlight shining across the display from a side window

Evaluation Considerations:

- A) Readability of symbols, letters, numbers, and graphics **(7)**
- B) Visibility of CDI display **(6, 7)**
- C) Range of brightness adjustment **(2, 7)**
 - Manual adjustment
 - Automatic adjustment
- D) Display location **(1)**
- E) Visibility of alerts & warnings **(4, 5)**
- F) Color discriminability

2.3 TRANSITION

2.3.1 Approach Transition

Purpose:

To evaluate receiver functions involved in transition from en route to approach mode.

Test Procedure:

1. Approach terminal area while in flight plan mode, from beyond 30 miles from the airport
2. Select an IAF for an appropriate procedure which includes a course reversal & fly to the IAF

During this procedure: (2)

- Observe terminal area alert
- Enable approach mode
- Request RAIM check (6)

Evaluation Considerations:

- A) Clarity of IAF options (1)
- B) Ability to select one IAF option (1)
- C) Action required to select approach mode (2, 4)
- D) Smoothness of changes in CDI sensitivity (3)
- E) Ease of understanding status of receiver mode (5)
- F) Understandability of displayed messages
- G) Approach enable alert
 - At a radial distance of 30 nm from the destination airport (not distance along the flight plan route) (2, 5)
- H) Barometric pressure alert (5, 7)
 - Informs the pilot of the need to manually insert the barometric pressure setting (unless the automatic altitude input utilizes barometric corrected altitude data). (2)

2.4 APPROACH

2.4.1 Nonprecision Approach With A Procedure Turn

Purpose:

To check receiver operations involved in transitioning from initial approach fix to final approach fix when a procedure turn is required.

Test Procedure:

Fly from IAF, where IAF is on the airport or coincident with the FAF, fly the procedure turn, and fly inbound to the missed approach point.

Evaluation Considerations:

- A) Course guidance outbound & inbound **(5)**
- B) Message displays readable & understandable
- C) Receiver mode status indicator **(7)**
- D) Transitions between terminal & approach mode **(8)**
- E) Waypoint sequencing & timing of waypoint alerts **(4)**
- F) Procedures required to enable a course reversal procedure **(5)**
- G) Access to ground speed, distance, XTE, bearing & track angle error information **(1, 2, 3)**
- H) CDI sensitivity changes smooth, and at appropriate locations **(6)**
- I) Information on active waypoint **(2)**
- J) Operation consistent with pilot expectations
- K) Sensitivity change alert **(7)**
 - At a distance of 3 nm inbound to the final approach fix an annunciation shall indicate that a change will occur in the sensitivity of the analog CDI.
- L) Approach enable alert shall be repeated **(7)**
 - At 3nm from the FAF if the approach mode was not previously activated.
- W) Workload: **(9, 10)**
 - Pilot situational awareness
 - Mental effort
 - Number of control actions required

2.5 MISSED APPROACH

2.5.1 Missed Approach With Course Reversal Back To The FAF

Purpose:

Evaluate receiver function when missed approach requires a course reversal back to FAF using “DIRECT TO” function to enable course guidance to the hold point.

Test Procedure: (8)

1. Activate the “DIRECT TO” button while flying the runway heading, reverse course and follow CDI guidance to the FAF
2. Fly the published hold at the FAF using the OBS function to select inbound leg to the hold waypoint.

Evaluation Considerations:

- A) Receiver shift out of automatic waypoint sequencing at the MAP **(5)**
- B) Positive course guidance provided as an extension of the inbound track and distance from the MAP until manual selection of the next waypoint **(5)**
- C) Actions required to return to the FAF **(5)**
- D) OBS function use for the holding pattern **(4)**
- E) Missed approach holding waypoint as “fly over” waypoint **(1, 2)**
- F) Course guidance to the FAF **(2)**
- G) Sensitivity change for the missed approach **(6)**
- W) Workload **(7, 9)**
 - Pilot situational awareness
 - Mental effort
 - Number of control actions required
 - Frequency of reference to receiver display required

2.5 MISSED APPROACH

2.5.2 Missed Approach With A Heading To Intercept A Bearing To A Waypoint

Purpose:

Evaluate receiver operations when intercepting a bearing to a holding point using the OBS function.

Test Procedure:

1. Fly the center line extension & select the bearing to the waypoint using the OBS function.
2. Intercept the course and fly to the hold point.

Evaluation Considerations:

- A) Use of OBS function for course to hold waypoint **(2)**
- B) The readability of the OBS setting **(2)**
- C) Turn anticipation at point of intercept for course change to hold point **(1)**
- W) Workload: **(3)**
 - Pilot situational awareness & mental effort
 - Number of control actions required
 - Required reference to receiver display

2.6 AUTOPILOT

2.6.1 Autopilot Integration With GPS Receiver

Purpose:

To evaluate the function of the GPS receiver when used with an autopilot during en route, terminal, and approach operations.

Test Procedure:

1. Couple the GPS receiver to the autopilot **(4)**
2. Fly the following: **(1, 5)**
 - Transition from en route to fly an approach
 - Fly a missed approach & hold

Evaluation Considerations:

- A) Course tracking smoothness & precision **(2)**
- B) Performance: **(1)**
 - Direct to operations
 - Turn anticipation
 - Course reversals
 - Waypoint sequencing
- C) Adequacy of information necessary for pilot situations awareness regarding system status & operation.
- D) Operation consistent with pilot expectations
- W) Workload **(3)**
 - Mental effort required
 - Number of control actions required
 - Required reference to receiver display

2.7 GPS ACCURACY

2.7.1 Verification Of GPS Accuracy

Purpose:

Verify the GPS accuracy over a surveyed position on the ground.

Test Procedure:

1. In the en route, terminal, and approach modes: (1)

- Conduct at least 5 low altitude (<100 ft AGL) passes of one or more surveyed locations (survey location data must be in either the WGS-84 or NAD-83 coordinate datum; e.g., waypoint at the runway threshold). (3)
- Push the “save position” button that will record Lat/Lon when the aircraft crosses the designated location and compare with known survey coordinates.

Evaluation Considerations:

A) Recorded Lat/Lon measurements (1)

Box Mode:	En Route	Terminal	Approach
Accuracy Required	0.124 nm	0.124 nm	0.056 nm
Known Lat/Lon			
Recorded Lat/Lon			
1			
2			
3			
4			
5			

2.8 MOVING MAPS

2.8.1 Moving Map Appearance

Purpose:

To evaluate the appearance of the moving map display in flight.
Observe the appearance of the map in en route and approach modes during straight flight and during changes in heading and course.

Test Procedure:

Examine the appearance of the moving map display during straight flight and heading changes.

Evaluation Considerations:

- A) Apparent readability of display **(1)**
- B) Appearance of small symbols and fine lines during map movement **(1, 2, 3, 4, 5, 6)**
- C) Clarity of location and heading of aircraft symbol on plan & profile views **(1, 2, 4, 5)**
- D) Map scale appropriate and clear **(1)**
- E) Map update rate appropriate for en route and terminal operations **(1, 7)**

2.9 ALARMS & ALERTS

2.9.1 Types Of Alarms & Alerts

Purpose:

To ensure that alarms & alerts activate appropriately. **(1)**

Evaluation Considerations:

Each of the following alarms & alerts shall be “timely” (shall take place within the specified time to alarm for the phase of flight in progress) and shall be as follows:

- A) A navigation warning flag shall be displayed on the navigation display in the following cases: **(2, 3)**
- The absence of power required for the navigation function.
 - Loss of navigation function
 - Inadequate or invalid navigation data in the approach mode detected in accordance with RTCA-DO-208
 - The loss of the RAIM detection function in the approach mode at the final approach fix.
 - Loss of the RAIM detection function in the approach mode, after passing the final approach fix. (Only if the RAIM detection function is lost for more than 5 minutes.)
- B) RAIM alerts **(1, 2, 3)**
- When RAIM is not available, inadequate navigation data due to poor space vehicle geometry such that the probability that navigation error exceeds the position integrity performance requirements in RTCA/DO-208 is greater than or equal to 0.5
 - The RAIM function detects a position error that exceeds the GPS position integrity performance requirements in RTCA/DO-208
 - Loss of the RAIM function
 - Predicted unavailability of the RAIM detection function
 - When operating in the approach mode without RAIM and navigation performance is degraded because HDOP exceeds 4.0

2.9 ALARMS & ALERTS

2.9.2 Discriminating Alerts

Purpose:

To ensure that each alert can be discriminated from each other and from background noise. (1)

Test Procedure:

For each alert evaluate the following:

Evaluation Considerations:

- A) Ability of alert to get pilot's attention
- B) Ease of discriminating alert from background
- C) Ease of discriminating critical alerts from other alerts
- D) Clarity of alert messages
- E) Alert contribution to "noisy" cockpit
 - Distraction
- F) Effort to deactivate alert
- G) Alert reminders if alert turned off and situation not reconciled

2.9 ALARMS & ALERTS

2.9.3 Auditory Quality Of Alerts

Purpose:

To ensure that auditory alarms are appropriate. **(1)**

Test Procedures:

For each alarm & alert evaluate the following:

Evaluation Considerations:

- A) Clarity of alarms
 - Loudness
 - Pitch
 - Duration

- B) Synthetic or natural speech quality & intelligibility in terms of:
 - Speech rate
 - Accent/dialect
 - Gender
 - Distinguishable from controllers

- C) Length of auditory alarm
 - Minimal distraction
 - Minimal amount of attention to extract message

REFERENCE A7

FAA ORDER 8400.11

**IFR Approval for Differential Global Positioning
System (DGPS) Special Category I Instrument
Approaches Using Private Ground Facilities**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

CHAPTER 4. RESPONSIBILITIES AND PROCEDURES

4-1. ACTIONS, RESPONSIBILITIES, AND PROCEDURES

All special privately owned ground installations and all airborne installations used to conduct DGPS instrument approach operations shall be evaluated and approved in accordance with the interim national criteria contained in this order. Special private use DGPS ground installations shall be approved, if the requirements of this order are met, for use by U.S. and qualified foreign flag operators to fly DGPS instrument approaches. The responsibilities of AVR, the Associate Administrator for Airway Facilities (AAF), and Associate Administrator for Aviation Standards (AVS) organizations and the actions necessary to initially implement special private use DGPS instrument approach operations are as specified herein.

- a.** Until national criteria for routine approval of DGPS Category I instrument approach operations is established, all requests to establish a DGPS Category I instrument approach operation, or approve an operator to conduct these instrument approaches, shall be forwarded to the Flight Standards' Technical Programs Division, AFS-400 through the regional Flight Standards Division.

- e. DGPS Ground Facility Evaluations.** The regional Airway Facilities Divisions are responsible for evaluating DGPS ground facilities in the United States. The evaluation criteria for facilities in the United States is specified in this order. The evaluation process for these facilities are specified in FAA Order 6700.20A and the RTCA DGNSS MASPS. AFS is responsible for evaluating DGPS ground facilities outside the United States. The FSDO/CHDO/CMO office shall designate an avionics specialist to evaluate and recommend approval or disapproval (if justified) of the special private use DGPS ground facilities outside the United States and operated by the owner/operator (air carrier/Part 91). Results of the evaluation shall be forwarded to AFS-400 for their

final concurrence through the regional Flight Standards Division. Avionics inspectors may consult Aircraft Certification or Airways Facilities personnel at their option for their assistance in addressing any concerns or problems resulting from the evaluation. Any deviations requested for the DGPS ground station will be forwarded to AFS-400 for their review and final concurrence.

- h. Evaluation and Approval.** Upon receiving an initial request from an operator to conduct DGPS Category I operations, the Certificate Holding District Office (CHDO) or FSDO shall assure that the operator is provided sufficient information to comply with the requirements of this order. The following evaluation and approval procedures should be followed:
- (1) Coordination.** Coordination with AFS-400 and the regional Flight Procedures Branch should begin concurrently with the beginning of approval activity. After receiving an operator's request, the CHDO or FSDO shall, as soon as possible, initiate coordination with the regional Flight Procedures Branch in order that they may determine the procedural requirements and coordinate flight inspection schedules. AFS-400 shall also be notified through the regional Flight Standards Division. The CHDO or FSDO is responsible for the coordination process specified for Special Instrument Approach Procedures in FAA Orders 8260.19 and 8400.10.
 - (2) Type Acceptance.** The Associate Administrator for Airway Facilities, AAF-1, is the type acceptance approval authority for LDGPS ground facilities in the United States.
 - (3) Airborne System Evaluation.** The responsible Aircraft Certification Office (ACO), in coordination with the appropriate Aircraft Evaluation Group (AEG), shall assure that the airborne equipment performs its intended function and meets the requirements of the RTCA DGNSS MASPS and this order for DGPS Category I instrument approach operations. This airworthiness certification does not constitute authority for an operator to conduct DGPS operations.
 - (4) Ground System Evaluation.** For DGPS ground facilities in the United States, the responsible regional Airway Facilities Division shall assure that the ground station equipment is properly installed, performs its intended function, and meets all applicable provisions of this order and the RTCA DGNSS

MASPS. Successful completion of the ground system evaluation is required prior to commissioning flight inspection. For DGPS ground facilities outside the United States, AFS-400 is responsible for final concurrence.

- (5) **Evaluation.** The CHDO or FSDO shall assure that the airborne system to be used has been properly approved as specified in IAW Chapter 7, Section 1 (h) and Chapter 8, Paragraph 1(a) of this order and that maintenance and operating manuals, schedules, and record keeping programs have been established.
- (6) **Initial Authorization.** When the requirements of this order are met, and following coordination with the regional Flight Standards Division and concurrence from AFS-400, the CHDO for the air carrier or the FSDO assigned the FAR Part 91 operator is authorized to issue approval (through operations specifications or Letter of Authorization) for the operator to conduct IFR DGPS Special Instrument Approach Procedures.
- (7) **Continuing Compliance.** For DGPS ground facilities in the United States, the responsible regional Airway Facilities Division shall perform the required periodic facility technical inspections, and assure that the sponsor complies with the Operations and Maintenance Manual (OMM) and the Memorandum of Agreement (MOA) for operation of DGPS ground installation. For DGPS ground facilities outside the United States, the CHDO or FSDO shall assure that the sponsor initially complies and continues to comply with the requirements of Chapters 6 and 9 of this order. The sponsor's approval to use a particular DGPS ground facility to conduct DGPS operations shall be withdrawn if there is evidence of noncompliance.
- (8) **Annual Review.** DGPS Category I instrument approach authorizations for all FAR Part 91 operators shall be renewed on an annual basis.

CHAPTER 7. AIRBORNE SYSTEMS

7-1. AIRBORNE SYSTEMS

The following is a listing of criteria that shall be used to determine the acceptability of airborne systems for DGPS Category I instrument approach operations. Testing activities will be coordinated with other FAA organizations to assure efficient use of flight time.

- a. General DGPS Criteria.** Until national criteria for routine field approval of DGPS installations have been established, approvals for airborne DGPS equipment installations shall be made by the Type Certificate (TC) or Supplemental Type Certificate (STC) process through the cognizant ACO and AEG. Acceptable total system performance (including sensor accuracy, equipment operation, integrity, crew interface, etc.) shall be demonstrated by a combination of approved bench, ground, and flight tests. Airborne equipment shall meet applicable requirements specified in RTCA DGNSS MASPS, FAA TSO-C129 (except equipment designated Category D by the RTCA DGNSS MASPS), AC 20-138, AC 20-130A, or equivalent criteria. The Aircraft Flight Manual (AFM) or AFM Supplement should state that the DGPS installation meeting the criteria of this order.

NOTE: When receiving DGPS information RAIM should not be used.

- h. Differential GPS Capability.** It shall be demonstrated that the airborne equipment is protected from using data transmitted by differential stations which are not compatible with the avionics design. This is normally done by comparing the station identification received from the ground with the station identifications associated with the instrument approach selected from the data base. The following criteria shall also be met:
- (1) Interoperability.** Interoperability shall be demonstrated between the facilities, facility types, and the differential correction methods that the applicant intends to use. Information from all other facilities not compatible with the airborne system shall be rejected.
 - (2) Simultaneous Use Demonstration.** Simultaneous use of multiple DGPS ground facilities shall be demonstrated if it is

permitted by the avionics design, even if operational usage of this feature is not intended. Simultaneous use of multiple DGPS facilities is prohibited during the FAS or the MAS or DGPS Category I instrument approach.

- (3) Station Identification.** Station selection methods and methods to positively identify any ground station(s) used shall be established. The system shall compare the station identification received from the ground with the station identification associated with the instrument approach selected from the database, and automatically determine that the proper facility is being used. Pilot action should not be required to properly identify the facility or to preclude the system from using improper information. In the future, the system may be required to either determine the level of service available and advise the crew, or advise the crew if the selected operation cannot be performed.
- (4) Coordinate Datum.** DGPS corrections should always be based on use of the coordinate frame used to determine the ground differential stations “survey” location and the pertinent TCWP. This is to remove any possibility of reference datum differences which would introduce additional errors. All data shall be based on World Geodetic System WGS-84 coordinates.

REFERENCE O1

FAA ORDER 8400.10

Air Transportation Operations Inspector's Handbook

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

**VOLUME 1. GENERAL CONCEPTS, DIRECTION,
GUIDANCE, AND DEFINITIONS**

**CHAPTER 4. GENERAL DIRECTION, GUIDANCE, AND
PROCEDURES**

**SECTION 6. THE GENERAL PROCESS FOR APPROVAL OR
ACCEPTANCE**

205. GENERAL.

- A. The general process of approval or acceptance of certain operations, programs, documents, procedures, methods, or systems is an orderly method used by Flight Standards inspectors to ensure that such items meet regulatory standards and provide for safe operating practices. It is a modular, generic process that can be applied to many types of approval or acceptance tasks. The process consists of five distinct yet related phases and can result in approving or not approving, accepting or not accepting an operator's proposal. It is important for an inspector to understand that the process described in this section is not all-inclusive, but rather a tool to be used with good judgment in conducting day-to-day duties and responsibilities.
- B. This section provides direction and guidance for understanding and applying this process. The logic diagram (figure 1.4.6.1.TBD) should be used for reference while reviewing the process.

FYI: It is essential for the inspector to understand that this process may result in a decision to not approve or not accept an operator's proposal. The process described is used to assist in making either positive or negative determinations.

- C. This general process applies to many tasks described throughout this handbook. Each chapter or section describing an approval or

acceptance task supplements the general process by outlining specific task requirements for each phase. For example, the specific items or actions required of the Federal Aviation Administration (FAA) and the operator for each phase of the process concerning proving tests are delineated in volume 3, chapter 9. The five phases of the operational approval or acceptance process are as follows:

207. PHASE ONE. The first phase starts when an operator, a person, an aviation interest, or the FAA inquires about or states a need for a change in some aspect of an aviation activity. Phase one is initiated by the following two possible actions:

A. A person or operator conveys to the FAA a need that is related to its operation. This “need” may be a requirement for FAA approval or acceptance. For example, an operator may need, want, or be required to have a minimum equipment list (MEL) change. The operator initiates the process by inquiring about the correct procedures to receive approval from the FAA for the change. During initial inquiries, it is important for the FAA and the operator to become familiar with the subject matter. If, for example, an operator requests an operational approval, the inspector must take the following actions:

- Become thoroughly familiar with existing FAA policy and approval requirements
- Become familiar with the appropriate technical material
- Accurately assess the character and scope of the proposal
- Determine if a demonstration is required
- Determine the need for any coordination requirements
- Ensure that the operator has a clear understanding of the minimum requirements that constitute an acceptable submission
- Determine the date the operator intends to implement the proposal

B. Phase one may also begin when the FAA conveys to the operator or person a requirement related to its operation which must be approved or accepted. For example, a principal inspector may require an operator to publish, in the company aircraft operating manual, information on low-speed buffet. The operator must research and understand that subject area before submitting a proposal to the FAA for evaluation. The principal inspector should act in an advisory capacity to the operator during the preparation of the submission. Such advice may include the following:

- The necessity for a deviation, authorization, waiver, or exemption
- The necessity for required demonstrations
- Clarification of Federal Aviation Regulations (FAR) or handbook information
- Sources of specific technical information
- Acceptable standards for submission

C. The common element, regardless of whether an action is initiated by an operator or the FAA, is the effort expended by the operator.

NOTE: It is essential (particularly in phase one) for the operator to have a clear understanding that, although the inspector may provide advice and guidance to the company, the development of the final product submitted to the FAA is solely the responsibility of the operator.

D. In phase one, the inspector must ensure that the operator clearly understands the form, content, and documents required for the submission to be acceptable to the FAA. The operator must be informed of the need and benefits of submitting required documents as early as possible and of its responsibility to advise the FAA, in a timely manner, of any significant changes in the proposal. Phase one of the process is illustrated as follows:

- Operator makes inquiry or request to FAA

-OR-

- FAA requires operator to take an action
- FAA and operator develop understanding of subject area
- Operator understands form, content, and documents required for acceptable submission

209. PHASE TWO. Phase two begins when the operator formally submits a proposal for FAA evaluation. The request may be submitted in a variety of ways. The inspector's first action, in phase two, is to review the operator's submission to ensure that the proposal is clearly defined, and the documentation specified in phase one has been provided. The required information must be complete and detailed enough to permit a thorough evaluation of the operator's capability and competence to fully satisfy the applicable regulations, national policy, and safe operating practices. Phase two does not include a detailed operational and technical evaluation or analysis of the submitted information (see phase three). However, in phase two the submission must be examined in sufficient detail to assess the completeness of the required information. If the operator's submission is not complete or the quality is obviously unacceptable, it must be immediately returned with an explanation of the deficiencies, before any further review and evaluation is conducted. Normally, unacceptable submissions should be returned with a written explanation of the reasons for its return. In many complex cases, a meeting with the operator and its key personnel may be necessary to resolve issues and agree on a mutually acceptable solution. If mutual agreements cannot be reached, the inspector must terminate the meeting, inform the operator that the submission is unacceptable, and return the submission. If all parties are able to reach agreement on measures to correct omissions or deficiencies, and the principal inspectors (operations, airworthiness, and avionics, if applicable) determine that the submission is acceptable, the operator will be so informed and phase three begins. Phase two of the process is illustrated as follows:

- Operator submits proposal
- FAA makes initial examination of the documents for completeness with respect to requirements established in phase one
- FAA returns submitted proposal

-OR-

- FAA accepts submitted proposal

NOTE: It is important for the inspector involved to keep the operator advised of the status of its proposal. If the inspector takes no other action, or if the submission is deficient and not returned in a timely manner, the applicant may assume that the FAA has tacitly accepted the submission and is continuing with the process. Timeliness of action depends on the situation as well as inspector judgment and is discussed in pertinent sections of this handbook.

211. PHASE THREE.

- A. Phase three is the FAA's detailed analysis, review, and evaluation of the operator's proposal. These actions may take place entirely within a field office, at the site of operations, or at both facilities. In phase three the FAA evaluation is focused on the form, content, and technical quality of the submitted proposal to determine that the information in the proposal meets the following criteria:
- Is not contrary to any applicable FAR
 - Is not contrary to the direction provided in this handbook or other safety-related documents
 - Provides for safe operating practices
- B. Criteria for evaluating the formal submission is found in the applicable chapters of this handbook. The inspector must ensure that the documents adequately establish the operator's capability and competence to safely conduct operations in accordance with the submitted proposal.
- C. During phase three the FAA inspector must, in a timely manner, address any deficiencies in the submitted material before proceeding to subsequent phases. Discussion with the operator may be sufficient to resolve certain discrepancies or questions, or to obtain additional information. It may be necessary to return certain sections of the submission to the operator for specific changes. However, when an inspector determines that, for specific reasons, the material is grossly deficient or unacceptable, the inspector must return the entire submission to the operator with an

appropriate explanation, and immediately terminate this phase. If the results of the evaluation are acceptable and a demonstration requirement exists, the inspector may need to grant some form of conditional, initial, or provisional approval to the proposal before continuing with the process.

D. An important aspect of phase three is for FAA inspectors to begin planning the conduct of phase four. While evaluating the operator's formal submission, inspectors should begin to formulate plans to observe and evaluate the operator's ability to perform. These plans must be finalized before the actual demonstrations. Phase three is illustrated as follows:

- FAA evaluates the formal submission for compliance with FAR, compliance with the direction provided in this handbook, other safety-related documents and safe operating practices
- When results of FAA evaluation are unsatisfactory, return submission to the operator for correction and/or terminate the phase
- Begin planning phase four (if required)
- When results of FAA evaluation are satisfactory, proceed with phase four (if demonstration required) and if appropriate, grant conditional approval or acceptance

-OR-

- Proceed to phase five if demonstration not required

213. PHASE FOUR.

A. In phase four the FAA finalizes plans to observe and evaluate the operator's demonstration of its ability to perform in accordance with the procedures, guidelines, and parameters described in the formal proposal. Phase four is an operational evaluation of the operator's ability to function in accordance with the proposal evaluated in phase three. Usually, these demonstrations are required by regulation, and some examples include the following:

- Training programs
 - Proving tests
 - Emergency evacuation demonstration
 - All-weather terminal operations
 - Air navigation operations
- B. Criteria and procedures for evaluating an operator's demonstrated ability are described in applicable chapters of this handbook. The inspector must plan for the conduct and observation of the demonstration to include such factors as participants, evaluation criteria, and sequence of events. During these demonstrations it is normal for minor discrepancies to occur. Discrepancies can often be resolved during the demonstration by obtaining commitments from responsible company officials. The inspector responsible for overseeing a demonstration must evaluate each discrepancy in terms of its overall impact on the operator's ability and competence to conduct the proposed operation. The inspector must stop the demonstration in phase four when gross deficiencies or unacceptable levels of performance are observed. The inspector must identify the phase of the general process for approval or acceptance to which the applicant must return, or decide to terminate the process entirely when it is clear that continuation would not result in approval or acceptance. For example, if an emergency evacuation demonstration is unsatisfactory due to equipment failure (a slide fails to inflate) it may be appropriate to require the operator to reenter the process at phase four and conduct another demonstration. If the demonstration is unacceptable because crewmembers were unable to perform their assigned duties, it may be appropriate to advise the operator that the process is terminated pending review and evaluation of the operator's emergency training program, and that the operator may need to reenter the process at phase two (that is, submit a new proposal).
- C. If the FAA evaluation of the operator's demonstrated ability is acceptable, the process continues. Phase four of the process is illustrated as follows:

- FAA plans for the conduct and observation of the demonstration
- Operator demonstrates ability
- Demonstration unsatisfactory

-OR-

- Demonstration satisfactory

NOTE: An operator shall not, under any circumstances, be authorized or otherwise approved to conduct any particular operation until all airworthiness and operations requirements are met and the operator is clearly capable of conducting a safe operation in compliance with FAA regulations and safe operating practices.

215. PHASE FIVE.

- A. In phase five the FAA approves or accepts the operator's proposal. If the proposal is not approved or accepted, the operator is notified in phase three or four.
- B. Approval is granted by letter, by a stamp of approval, by the issuance of operations specifications, or by some other official means of conveying approval. Each section of this handbook that discusses a requirement for approval provides specific guidance concerning approval procedures and documentation. The following are examples of approvals granted by the FAA:
 - All-weather terminal operations
 - Training programs
 - MEL
 - Cockpit checklist
 - Company Aircraft Operating Manual (limitations, performance, and operating procedures)
 - Air navigation operations

C. Other proposals, submissions, or requests not requiring specific FAA approval but required to be submitted to the FAA are items that are presented for acceptance. Acceptance of an operator's proposal may be accomplished by various means, including a letter, verbal acceptance, or by taking no action, which indicates there is no FAA objection to the proposal. Methods and procedures used to accept operation proposals or submissions, when appropriate, are discussed in the applicable chapters of this handbook. Phase five is illustrated as follows:

- FAA approves submission

-OR-

- FAA accepts submission

FYI: Sometimes FAA approval or acceptance of an operator's proposal may be conditional in nature. For example, a training program may be initially approved provided that the flight simulator to be used in that program receives approval from the National Simulator Evaluation Team.

217. SUMMARY OF PROCESS. The general operational approval or acceptance process, as described, is referenced throughout this handbook (in terms of the five phases) with the specific task requirements for each applicable job function. It is important for the inspector to understand the modular concepts inherent in the process, the overall interrelationship of the phases, and that this general process is not all-inclusive, but a tool to be used in the inspector's day-to-day duties and responsibilities. The logic diagram in figure 1.4.6.1. (TBD) is intended to clarify this general process.

**VOLUME 3. AIR OPERATOR TECHNICAL
ADMINISTRATION**

CHAPTER 1. OPERATIONS SPECIFICATIONS

**SECTION 7. AMENDMENT, SURRENDER, AND
SUSPENSION OF OPERATIONS SPECIFICATIONS**

261. APPLICABILITY. FAR 121.79 and FAR 135.17 specify that operation specifications (OpSpecs) can be amended as a result of an operator's request or because the FAA determines that safety in air transportation or air commerce (in the case of a commercial operator) is affected and the change is in the public interest. In addition, an operator's OpSpecs may be amended by the FAA due to a change in the operator's operating environment. This section contains direction and guidance to be used by principal inspectors for the amendment, surrender, and suspension of OpSpecs for Part 121 and Part 135 air carriers and commercial operators (see volume 2, chapter 4 of this handbook for information on the processing of Part 129 foreign flag air carrier OpSpecs).

263. AMENDMENT PROCESS USING AUTOMATED OPSPECS. Regardless of who initiates the amendment of an operator's OpSpecs, the automation process involves the same basic procedures. The amendment of the OpSpecs may involve the principal inspector doing any of the following: entering new data to the Vital Information System (VIS), changing the OpSpecs checklist, changing the worksheets, or changing only an OpSpecs paragraph. When making such changes using the automated OpSpecs, principal inspectors should use the procedures that follow.

- A. *Entry of New Data to VIS.* If new VIS data is required, the principal inspector must obtain the new data from the computer along with a copy of the current checklist. If new VIS data is not required, then the principal inspector must obtain a copy of the current checklist or, if neither the VIS nor the checklist have to be changed, then the principal inspector must obtain a set of worksheets for any affected paragraphs.
- B. *Changing OpSpecs Checklist.* When the OpSpecs checklist must be changed, the principal inspector should enter or delete the appropriate statements and should also generate a set of worksheets for the affected paragraphs.

- C. *Changing Worksheets.* The principal inspector should change the worksheets (whether obtained from the input of VIS or the checklist, or from the computer) by making appropriate selections and entering user-specific information. The principal inspector should then generate a draft set of the affected OpSpecs paragraphs.
- D. *Changing a Standard OpSpecs Paragraph.* When Washington Headquarters changes a standard OpSpecs paragraph, the VIS data entry guide, checklists, and worksheets do not have to be changed; only the amended standard paragraph must be changed and a new page issued. In most cases, however, any change to an OpSpecs paragraph will require that the principal inspector make a corresponding change to the worksheets.

265. AMENDMENT OF OPSPECS. When amending OpSpecs, a principal inspector should take into account the extent and complexity of the amendment. If the amendment is uncomplicated and involves only one or two paragraphs, then it may be practical to print only the affected paragraphs. If the amendment is extensive and involves entering VIS data or changing the checklist and worksheets (such as when an operator upgrades from Part 135 operations to Part 121 operations), then the principal inspector should generate a complete set of OpSpecs. The principal inspector should review the draft set of OpSpecs with the operator and, if necessary, make any corrections and resolve any conflicts. After the final corrections are made, the principal inspector should print and issue two sets of the amended OpSpecs to the applicant; one set for the applicant's review and files, and one set for receipt and return. An amendment may be initiated either at the operator's request or by FAA initiation. The procedures for these two methods of initiating an amendment as follows:

**VOLUME 3. AIR OPERATOR TECHNICAL
ADMINISTRATION**

**CHAPTER 2. TRAINING PROGRAMS AND AIRMAN
QUALIFICATIONS**

SECTION 2. TRAINING APPROVAL PROCESS

311. GENERAL.

- A. Training curriculum approvals follow the five-phase general process for approval or acceptance described in volume 1, chapter 4, section 6. The basic steps of this process must be followed. Each phase, however, may be adjusted to accommodate existing circumstances. Depending on the complexity of the operator's request and the availability of FAA resources, the approval process may be accomplished in only a few days, or the process may last many months. The approval process applies to each operator requesting approval of a new curriculum or a revision to a currently approved curriculum. Inherent in the approval process is the FAA's responsibility to deny approval of any training which does not meet regulatory requirements or which has been found deficient. Training curriculums which have been granted approval and later found either to be in conflict with regulatory requirements or to be ineffective, must be appropriately modified by the operator, or FAA approval must be withdrawn. This section establishes procedures for granting approval or withdrawing approval of all or part of a training curriculum. When appropriate, job aids have been developed to assist inspectors in the approval process of curriculum segments. These job aids are discussed in subsequent sections of this chapter.

315. INITIATING THE APPROVAL PROCESS - PHASE ONE.

- A. The training approval process can be initiated by either the operator or the FAA as follows:
- (1) *Operator Initiated.* The operator informs the FAA that it is planning to establish a new training curriculum or to change an existing curriculum.

(2) *FAA Initiated*. The FAA informs an operator that revisions to its training program are required based on recently acquired information relative to training techniques, aviation technology, aircraft operational history, operator performance, or regulatory changes.

B. When a proposal is initiated by the operator, one of the first steps the POI or certification project manager (CPM) should take is to obtain the following basic information:

- Type of operation
- Type of equipment to be operated
- Geographic areas of operation
- Proposed training schedules
- Proposed date of revenue operations
- Proposed contract training, if any
- Type of simulator to be used, if any
- Facilities to be used

317. FAA INVOLVEMENT IN PHASE ONE.

A. Early in the process, the FAA and the operator should establish, through discussion, a common understanding of both the regulatory training requirements and the direction and guidance provided in this handbook. The POI or CPM and the operator must examine the entire operation to ensure that any training necessitated by operational requirements, authorizations, or limitations (such as those in the operations specifications, minimum equipment lists, deviations, and exemptions), is included in the operator's training curriculums. The training program is the area most affected by operational changes. The POI should review all general requirements in the regulations and in this handbook that apply to the proposed operation. The POI should be aware of changes to the information initially provided by the operator. The POI should discuss with the

operator the sequence and timing of events which occur in the development and the granting of initial and final approval of a training curriculum. If the operator's proposal involves complex operations (such as long-range navigation or polar navigation operations), the POI must consult appropriate sections of this handbook and other relevant documents and be prepared to advise the operator during this phase. In such a case, the POI should also determine whether assistance from an FAA specialist is necessary.

- B. An FAA inspector should be prepared to provide advice to an operator during training curriculum development. During phase one, the operator must be informed of the procedure for requesting initial approval and of the types of additional supporting information which the POI will require the operator to submit. An inspector should be prepared to provide advice and guidance to the operator on the following:
- The general format and content of curriculums, curriculum segments, training modules, and flight maneuvers and procedures documents
 - Courseware
 - Facilities
 - Qualifications of instructor personnel
 - Other areas of the operator's proposed training program

319. REQUESTS FOR INITIAL APPROVAL - PHASE TWO.

- A. Phase two begins when the operator submits its training proposal in writing, for initial approval, to the FAA. The operator is required to submit to the FAA an outline of each curriculum or curriculum segment and any additional relevant supporting information requested by the POI. These outlines, any additional supporting information, and a letter must be submitted to the FAA. This letter should request FAA approval of the training curriculum. Two copies of each curriculum or curriculum segment outline should be forwarded along with the letter of request to the FAA.

B. Each operator must submit its own specific curriculum segment outlines appropriate for its type of aircraft and kinds of operations. These outlines may differ from one operator to another and from one category of training to another in terms of format, detail, and presentation. Each curriculum should be easy to revise and should contain a method for controlling revisions, such as a revision numbering system. Curricula for different duty positions are specifically identified and any differences in instruction are specified for each duty position. Each curriculum and curriculum segment outline must include the following information:

- Operator's name
- Type of aircraft
- Duty position
- Title of curriculum and/or curriculum segment including the category of training
- Consecutive page numbers
- Page revision control dates and revision numbers

C. Each curriculum and curriculum segment must also include the following items, as appropriate:

- Prerequisites prescribed by the FARs or required by the operator for enrollment in the curriculum
- Statements of objectives of the entire curriculum and a statement of the objective of each curriculum segment
- A list of each training device, mockup, system trainer, procedures trainer, simulator, and other training aids which require FAA approval (The curriculum may contain references to other documents in which the approved devices, simulators, and aids, are listed.)
- Descriptions or pictorial displays of normal, abnormal, and emergency maneuvers and procedures which are intended for use in the curriculum, when appropriate. (These descriptions

or pictorial displays, when grouped together, are commonly referred to as the flight maneuvers and procedures document. The operator may choose to present detailed descriptions and pictorial displays of flight maneuvers and procedures in other manuals. For example, the flight maneuvers and procedures document may be described in an aircraft operating manual. However, as a required part of the training curriculum, it must either be submitted as part of the curriculum or be appropriately referenced in the curriculum.)

- An outline of each training module within each curriculum segment (Each module should contain sufficient detail to ensure that the main features of the principal elements or events will be addressed during instruction.)
- Training hours which will be applied to each curriculum segment and the total curriculum
- The checking and qualification modules of the qualification curriculum segment used to determine successful course completion, including any FAR qualification requirements for crewmembers or dispatchers to serve in Part 121 or Part 135 operations (such as initial operating experience, line checks, operating familiarization)

321. ADDITIONAL RELEVANT SUPPORTING

INFORMATION - PHASE TWO. As specified in FAR 121.405(a)(2) and FAR 135.325(a)(2), an operator must submit any additional relevant supporting information requested by the POI. This information is that additional information the POI finds necessary for determining whether the proposed training program is feasible and adequately supported. It is information which would be difficult to include in a curriculum outline format. The type and amount of supporting information needed will vary depending on the type of training, aircraft types to be operated, and kinds of operations. The POI must determine the appropriate types of supporting information to be required. This should be limited to only that information critical to the determination of the proposed training program's acceptability. The following list of types of relevant supporting information is not all-inclusive, but includes information that is typical.

- A. A description of facilities is appropriate if the POI is unfamiliar with the facilities, or if the facilities are not readily available for examination.

- B. A list of ground and flight instructors and their qualifications may be requested. This information is particularly important if the operator intends to use contract instructors. The POI should determine whether the proposed instructors meet regulatory requirements and if they are qualified to conduct training.
- C. A detailed description of each flight simulator and training device is appropriate when the simulator or training device is not readily available for the POI's examination. This detailed description is particularly important when the operator intends to contract for a specific flight simulator or training device. This description should provide sufficiently detailed information to enable the POI to determine whether the training and checking to be conducted is appropriate for the level of the flight simulator or training device to be used.
- D. A detailed description of minimum student qualifications and enrollment prerequisites is appropriate when such prerequisites are not described in detail in the curriculum. Examples of these prerequisites which may need to be detailed as supporting information include: type of airman certificate, aircraft type qualifications, previous training programs, minimum flight hours, experience with other Part 121 or Part 135 operators, and recency of experience. This description may be useful to the POI when determining whether the proposed amount of detail outlined in training modules and the proposed training hours are adequate.
- E. Copies of training forms and records to be used for recording student progress and the completion of training may be required. This ensures the operator has planned for the FAR recordkeeping requirements. This type of supporting information shall be required of applicants for an air operator certificate. It may also be required of operators with any significant revision to existing training programs. These forms, records, or computer transmittal worksheets must be designed so that attendance and course-completion information is recorded and retrievable for verifying regulatory compliance.

- F. Supporting information may include samples of courseware, such as lesson plans and instructor guides. Descriptions of other types of courseware, such as home study, computer-based instruction, and line oriented flight training (LOFT) scenarios, should be in enough detail to provide an understanding of how the training will be administered and of the proposed instructional delivery method. This information should describe the instructor-student interaction and indicate methods for measuring student learning.

323. INITIAL REVIEW OF REQUESTS FOR APPROVAL - PHASE TWO. In phase two the POI must review the submitted training curriculum and supporting information for completeness, general content, and overall quality. A detailed examination of the documents is not required during phase two. If, after initial review, the submission appears to be complete and of acceptable quality, or if the deficiencies are immediately brought to the operator's attention and can be quickly resolved, the POI may begin the phase three in-depth review. If the submission is determined to be incomplete or obviously unacceptable, the approval process is terminated and the POI must immediately return the documents (preferably within 5 working days) with an explanation of the deficiencies. The documents must be immediately returned, so the operator will not erroneously assume the POI is continuing the process to the next phase. The approval process can be resumed when the revised training curriculum or curriculum segment is resubmitted.

327. IN-DEPTH REVIEW OF SUBMITTED CURRICULUMS - PHASE THREE.

- A. Phase three is initiated when the FAA begins a detailed analysis and evaluation of a training curriculum or curriculum segment. The purpose of this phase is to determine the acceptability of training curriculums for initial approval. This phase ends either with the initial approval or with the rejection of all or part of the training curriculum. To complete an evaluation in a timely manner the POI may need to involve other FAA personnel early in this phase. Certain specialists or offices may be required to participate in the approval process as follows:
- The principal security inspector (PSI) should be involved in security and hazardous materials training issues.

- Various aviation safety inspector specialists should be involved when appropriate. For example, navigation specialists should be involved with evaluating special navigation operations.
 - The POI may need to contact the Flight Standardization Board (FSB) and the Flight Operations Evaluation Board (FOEB) for information on training recommendations and minimum equipment list procedures. See volume 8 (TBD).
 - The POI's district office manager and certain regional headquarters personnel may need to be involved with locating and directing additional FAA resources to accomplish the approval process.
 - Washington headquarters may be requested to provide assistance with obtaining training quotas for selected inspectors or with obtaining information concerning exemptions.
- B. Before granting initial approval for a specific curriculum or curriculum segment, the POI must ensure that the following evaluations are accomplished:
- (1) A side-by-side examination of the curriculum outline with the appropriate regulations and with the direction provided in this handbook must be performed. This examination is to ensure that training will be given in at least the required subjects and in-flight training maneuvers. It should also ensure that appropriate training will be given on safe operating practices.
 - (2) An examination of the courseware developed or being developed by the operator must be performed. This review should include a sampling of available courseware such as lesson plans, audiovisual programs, flight maneuvers and procedures documents, and student handouts. The courseware must be consistent with each curriculum and curriculum segment outline. From this review, the POI should be able to determine whether the operator is capable of developing and producing effective training courseware.

- (3) An inspection of training facilities, training devices, and instructional aids (which will be used to support the training) must be performed if the POI is not familiar with the operator's training program capabilities.
- (4) The training hours specified in each curriculum segment outline must be evaluated. An inspector should not attempt to measure the quality or sufficiency of training by the number of training hours alone. This can only be determined by direct observation of training and testing (or checking) in progress, or by examination of surveillance and investigation reports. The specified training hours must be realistic, however, in terms of the amount of time it will take to accomplish the training outlined in the curriculum segment so as to achieve the stated training objectives. During the examination of courseware, an inspector should note the times allotted by the operator for each training module. These times should be realistic in terms of the complexity of the individual training modules. The number of training hours for any particular curriculum segment depends upon many factors. Some of the primary factors are as follows:
- The aircraft family in which the specific aircraft belongs
 - Complexity of the specific aircraft
 - Complexity of the type of operation
 - Amount of detail that needs to be covered
 - The experience and knowledge level of the students
 - Efficiency and sophistication of the operator's entire training program (including items such as instructor proficiency, training aids, facilities, courseware, and the operator's experience with the aircraft)
- C. If, after completing these evaluations, the POI determines that the curriculum or curriculum segment is satisfactory and adequately supported, and that the training hours are realistic, initial approval should be granted. Sometimes a portion of the submittal may appear to be satisfactory. However, if that portion is dependent upon another undeveloped portion or another unsatisfactory

portion, initial approval must be withheld. For example, a PIC BE-100 initial equipment, flight training curriculum segment is satisfactory but related training modules within the initial equipment ground training curriculum segment are unsatisfactory. In such a case, it may be inappropriate to grant initial approval to the initial equipment flight training curriculum segment until the ground training curriculum segment is determined to be satisfactory.

- D. During phase three of the approval process, the POI must establish priorities to ensure that, if appropriate, the granting or initial approval, is not unnecessarily delayed. These priorities should assure that deficiencies are resolved so that initial approval can be granted before the operator's planned starting date for training.

329. EXPIRATION DATES FOR INITIAL APPROVALS. When the POI determines that a training curriculum or curriculum segment should be initially approved, the POI must also determine an appropriate expiration date for the initial approval. The expiration date is important throughout phase four of the approval process. FAR 121.401(a)(1) and FAR 135.323(a)(1) require the operator to obtain final approval of training curriculums. The expiration date provides an incentive to the operator for refining all aspects of the program to assure that this regulatory requirement is met. The expiration date also provides the POI with a time frame with which to plan evaluation activities for determining the effectiveness of the training. The expiration date assigned to an initially approved training curriculum must not exceed 24 months from the date of initial approval. The expiration date of initial approval may be reduced by the POI if it is apparent that a 24-month time frame will unnecessarily delay final approval. The POI should be aware that shortening the initial approval expiration date will commit him to completing the final approval phase within the shorter time period. The POI may grant final approval any time before the expiration date. Except when unforeseen circumstances preclude an adequate evaluation of training effectiveness, an extension to the initial approval expiration date should not be permitted. A new expiration date, however, may be established for a curriculum segment when there are significant revisions to an initially-approved curriculum segment.

331. METHOD OF GRANTING INITIAL APPROVAL.

- A. Initial approval is granted by letter. Sample letters granting initial approval are included at the end of this paragraph (figures 3.2.2.1 and 3.2.2.2). The initial approval letter must include at least the following information:
- Specific identification of the curriculums and/or curriculum segments initially approved, including page numbers and revision control dates
 - A statement that initial approval is granted, including the effective and expiration dates
 - Any specific conditions affecting the initial approval, if applicable
 - A request for advance notice of training schedules so that training may be evaluated in accordance with FAR 121.405 or FAR 135.325, as appropriate
 - If the POI is authorizing a reduction in the programmed hours specified by Part 121, a statement concerning the basis for reduction
- B. An initial approval letter serves as the primary record of curriculum or curriculum segment pages that are currently effective. In the past, initial approval was stamped on each page of a curriculum. Although this method is no longer necessary, the POI and each operator may agree to use the method to account for revisions to training documents. If this method is used, the stamp must clearly indicate initial approval and the expiration date. Other acceptable methods include a list of effective curriculum or curriculum segment pages, or pages with a preprinted signature and date blocks.
- C. The original pages of the curriculum or curriculum segment shall be returned to the operator with the transmittal letter. These documents should be retained by the operator as an official record. A copy of the training curriculum or curriculum segment, with a copy of the transmittal letter granting initial approval attached, shall be maintained on file in the CHDO by the POI during the period that the initial approval is valid. The POI shall

also maintain on file with the curriculum all additional relevant supporting information.

333. METHOD OF DENYING INITIAL APPROVAL. If the POI determines that initial approval of a proposed training curriculum or curriculum segment must be denied, the operator shall be notified in writing of the reasons for denial. This letter must contain an identification of the deficient areas of the training curriculum and a statement that initial approval is denied. It is not necessary that each minor deficiency which resulted in the denial be identified, however the major deficiencies should be outlined in the letter. It is the operator's responsibility to redevelop or correct the deficient area before resubmission to the FAA. A copy of the denial letter and a copy of the proposed training curriculum or curriculum segment shall be kept on file in the CHDO. Figure 3.2.2.3 is a sample letter of a denial of initial approval.

335. EVALUATING INITIALLY-APPROVED TRAINING CURRICULUMS - PHASE FOUR.

A. Phase four begins when the operator starts training under the initially-approved curriculum. This phase should provide the operator with adequate time to test the program and the flexibility to adjust the program during FAA evaluation. The POI must require an operator to provide ongoing schedules of all training and checking to be accomplished under an initially-approved training curriculum. The POI must closely monitor training conducted under initial approval. Whenever possible, the first session of training conducted under initial approval should be monitored by the POI or a qualified operations inspector. An FAA inspector does not need to observe every training session. A sufficient sampling of the training sessions, however, should be observed as a basis for a realistic evaluation. Inspectors qualified in the type aircraft, and other individuals knowledgeable of the curriculum subject matter, should assist in evaluating the training. During training under initial approval, the operator is expected to evaluate and appropriately adjust training methods as needed. Often adjustments can be made by changing courseware and instructional delivery without (or with only minor) revisions to the initially approved curriculum. Conversely, it may be necessary for the operator to substantially change the curriculum which may require another initial approval action by the POI before the changes can be put into effect. Sometimes proposed revisions may be transmitted to the POI just before the initial approval

expiration date. If the change is significant, the POI may need to establish a different expiration date for the curriculum segment, or for the revised portions, to allow adequate time for a proper evaluation.

- B. During phase four, the operator must demonstrate the ability to effectively train crewmembers and dispatchers. Each deficiency identified during the evaluation of training conducted under an initially approved curriculum must be discussed with the operator. If the deficiencies are significant, they must be documented and kept on file. In most cases, when the cause of a deficiency has been accurately identified, the operator will make the necessary changes to correct the deficiency to obtain final approval. Each significant deficiency which has been accurately identified must be immediately corrected. If an operator does not take appropriate corrective action, the POI shall advise the operator in writing that initial approval is withdrawn. See paragraph 343.

337. ELEMENTS AVAILABLE FOR EVALUATING

TRAINING - PHASE FOUR. The POI must develop a plan for systematically evaluating training given under the initially approved training curriculum. This plan should remain in effect throughout the initial approval period. There are five elements which can be evaluated when assessing the overall effectiveness of training programs. These five elements are: curriculum segment outlines, courseware, instructional delivery methods and training environment, testing and checking, and surveillance and investigation of operator activities. These elements are interrelated, however, each can be separately evaluated. See table 3.2.2.1 for a summary of the five elements.

- A. Before evaluating a training program, an inspector must become familiar with the contents of the curriculums or curriculum segments to be evaluated. This *preparation is essential* if an inspector is to determine whether an operator has developed an effective course of instruction from its initially approved training curriculum.
- B. Direct examination of courseware includes reviewing materials such as lesson plans, workbooks, or flight instructor guides. The inspector must determine whether the courseware is consistent with the curriculum or curriculum segment and that it has been organized to facilitate effective instructional delivery. Courseware is usually the training program element which is most adaptable to

revision or refinement. Inspectors must review at least a sampling of the courseware.

- C. Direct observation of instructional delivery includes surveillance of training methods, such as instructor lectures, computer-based instruction presentations, and inflight instruction. Effective learning can only occur when an instructor is organized, prepared, and properly uses the courseware and various training aids. The inspector must determine that the instructional delivery is consistent with the courseware. For example, the inspector should note whether the instructor teaches the topics specified in the lesson plan. Training aids and devices should function as intended during the instructional delivery. In addition, during training, the inspector should be sensitive to the type of questions being asked by students and should identify the reasons for any excessive repetition. These conditions may indicate ineffective instructional delivery or courseware. The inspector must also determine if the instructional environment is conducive to learning. Distractions which adversely affect instructional delivery, such as excessive temperatures, extraneous noises, poor lighting, cramped classrooms or workspaces, are deficiencies because they interfere with learning.
- D. Direct observation of testing and checking is an effective method for determining whether learning has occurred. Examining the results of tests, such as oral or written tests or flight checks, provides a quantifiable method for measuring training effectiveness. The POI must examine and determine the causal factors of significant failure trends.
- E. Direct observation of training and checking in progress is an effective method of evaluating training. Sometimes the opportunity for direct observation, however, will be limited. In such cases, the POI will have to rely more on his evaluation of other sources of information such as reports of surveillance and investigations. Results of inspection reports, incident or accident reports, enforcement actions, and other relevant information about the operator's performance should be reviewed by the POI for indications of training effectiveness. The POI must establish methods to evaluate these sources of information for trends that may develop while training is being conducted under initial approval. For example, repeated reports of deficiencies such as excessive taxi speed, navigation deviations, incomplete briefings, or incorrect use of the checklists, may be traceable to a lack of

specific training or ineffective training. Such information may provide indications that revisions or refinements are needed for a curriculum segment and/or training modules.

TABLE 3.2.2.1 ELEMENTS FOR TRAINING EVALUATION

	ELEMENTS AVAILABLE FOR EVALUATING TRAINING
CURRICULUM SEGMENT OUTLINES	Curriculum segment outlines contain the specific training modules and the amount of the time allocated for the curriculum segment. the modules must be consistent with regulatory requirements and safe operating practices. This element requires direct examination.
COURSEWARE	Courseware converts curriculum outline information into usable instructional material, Courseware must be consistent with the curriculum outline and be organized to permit effective instructional delivery. It is readily adaptable to adjustments and refinement by the operator. This element usually requires direct examination.
INSTRUCTIONAL DELIVERY METHODS AND TRAINING ENVIRONMENT	Instructional delivery methods are used to convey information to the student. Effective learning is maximized if the instructional delivery adheres to and properly uses the courseware. The training environment should be conducive to effective learning. This element requires direct observation.
TESTING AND CHECKING	Testing and checking is a method for determining whether learning has occurred. Testing and checking standards are used to determine that a desired level of knowledge and skill has been acquired. Testing and checking also measures the effectiveness of courseware and instructional delivery. This element requires direct observation. It can be supplemented by examining operating records of tests and checks.
SURVEILLANCE AND INVESTIGATION OF OPERATOR ACTIVITIES	Surveillance and investigations produce information about an operator's overall performance. A high rate of satisfactory performance usually indicates a strong, effective training program. Repeated unsatisfactory performances can often be traced to deficiencies in a training program. This element requires the examination and analysis of surveillance and investigative reports.

339. METHOD FOR GRANTING FINAL APPROVAL - PHASE FIVE. This phase involves the granting of final approval of an operator's training curriculum. Based on the results of the evaluation, the POI must determine whether to grant or deny final approval of a training curriculum. This determination must be made before the expiration date of the initial approval. If the POI decides not to grant final approval, the procedures outlined in paragraph 343 shall be

followed. If the POI decides that final approval should be granted, the following procedures apply:

A. *Programs that Contain a List of Effective Pages.* Although the method presently stated in this handbook may still be used in the approval process (that is, stamping each page), another procedure may also be used. Final approval of the training curriculum can be granted and documented by the POI on the List of Effective Pages. This means that the FAA has given final approval of every page of the operator's training curriculum, as listed on that page, but only one FAA approval block must be completed and signed.

(1) The stamped page that documents final approval of the training curriculum and/or curriculum segment shall be stamped for approval, dated, and signed by the POI. The approval stamp that appears on the page should be a facsimile of the stamp that appears in this paragraph.

(2) The original curriculum and/or curriculum segment must contain the one page that documents FAA approval on the List of Effective Pages. The curriculum and/or curriculum segment must be transmitted to the operator with an approval letter signed by the POI in accordance with handbook guidance.

B. *Programs that do not Contain a List of Effective Pages.* The original and a copy of each page of the training curriculum and/or curriculum segment shall be stamped for approval, dated, and signed by the POI. The approval stamp shall appear on each page and be a facsimile of the following stamp:

FAA FINAL APPROVAL
OFFICE DESIGNATOR: _____
EFFECTIVE
DATE: _____
NAME: _____
SIGNATURE: _____

- C. The original stamped curriculum or curriculum segment must be transmitted to the operator with an approval letter signed by the POI. This letter must specifically identify the curriculum or curriculum segment; contain a statement that final approval is granted; and provide the effective date of approval. This letter must also state that final approval shall remain in effect until otherwise notified by the FAA that a revision is necessary in accordance with FAR § 121.405(e) or FAR § 135.325(d), provided the operator continues to train in accordance with the approved curriculum. If the POI is authorizing a reduction in the programmed hours specified by FAR Part 121, the letter must contain a statement concerning the basis for reduction. A copy of the stamped curriculum or curriculum segment, and a copy of the approval letter must be kept on file in the CHDO. Figures 3.2.2.4. and 3.2.2.5. are sample letters of final approval.

VOLUME 3. AIR OPERATOR TECHNICAL ADMINISTRATION

CHAPTER 9. PROVING AND VALIDATION TESTS

SECTION 1. BACKGROUND

1551. GENERAL. Parts 121 and 135 of the Federal Aviation Regulations (FAR) required the Administrator of the Federal Aviation Administration (FAA) to evaluate each applicant's ability to conduct operations safely and in accordance with the applicable regulations before issuing an operating certificate to the applicant. The FAR also require the Administrator to determine that a certificate holder is capable of conducting operations safely and in compliance with applicable regulatory standards before authorizing the certificate holder to serve an area or route. The structured methods used by the FAA to determine an applicant's capabilities are proving and validation tests. This chapter contains direction and guidance to be used by inspectors for conducting these tests.

NOTE: The term, "applicant," as used in this chapter, means either a candidate applying for an operating certificate or a certificate holder requesting additional operating authority.

1555. VALIDATION TESTS. FAR 121.93, 121.113, and 135.13(a)(2) require an applicant to demonstrate the capability 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 the applicant to successfully complete validation testing in the following circumstances: (1) before being authorized to add any areas of operation beyond the 48 contiguous states to operations specifications (OpSpecs) paragraph B50 and, (2) before being issued any of the OpSpecs paragraphs listed in figures 3.9.8.1. through 3.9.8.3. that authorize special means of navigation. Though proving and validation tests satisfy different requirements, both test may be conducted simultaneously when appropriate.

SECTION 2. THE PROVING AND VALIDATION TEST PROCESS

1565. PHASE ONE. Phase one of the proving and validation test process begins when an applicant requests authorization from the FAA to conduct an operation for which proving or validation is required. The term, “applicant,” as used in this section, means either a candidate applying for an operating certificate or a certificate holder requesting additional operating authority. When applicant’s request requires proving or validation, the following steps apply:

NOTE: A general purpose job aid is included as figure 3.9.2.1., which may be adapted to proving or validation tests, as required. The proving and validation test process follows the general outline of the five-phase approval process that is described in volume 1, chapter 4, section 6.

A. *FAA Test Team.* The Certificate Management Office (CMO) manager or Flight Standards District Office (FSDO) manager (in absence of a CMO manager) shall organize a test team.

(1) *Team Leader.* The team leader should normally be one of the principal inspectors assigned to the applicant and shall be responsible for the conduct, coordination, and evaluation of the test. In addition, the team leader will be the spokesperson for the Administrator on all matters pertaining to the test.

(2) *Team Personnel.* The FAA test team should include the following personnel, as required:

- The team leader
- All assigned principal inspectors

- An aviation safety inspector (ASI) (operations) qualified on the equipment
- ASI's (maintenance and avionics) trained on the installed equipment
- A cabin safety specialist when, in Part 121, aircraft of 10 or more passenger seats are involved; or, in Part 135, when aircraft of 20 or more passenger seats are involved (If a cabin safety specialist is not available, the team should include an ASI with experience in cabin safety issues.)
- A representative from the Civil Aviation Security Field Office (CASFO)

(3) *Familiarization.* All members of the FAA inspection team must become familiar with the pertinent parts of the applicant's general operations manual (GOM), procedures, and policies.

NOTE: If qualified inspectors are not available within the CMO or FSDO, the manager must request assistance from the Regional Flight Standards Division (RFSD).

B. *Preliminary Coordination.* The FAA test team and the applicant must reach a common understanding of what the applicant must do, what role the FAA will play, and what reports and documents must be prepared during the testing process. Both the test team and the applicant must research applicable regulatory and advisory material. If the test concerns any of the operations listed in figure 3.9.8.1., then the test team should consult an FAA navigation specialist early in phase one at either of the two following locations: San Francisco (SFO) International Field Office (IFO) at (415) 876-2765 or New York (NYC) FSDO-15 at (718) 553-1848. The navigation specialist can provide advice on testing requirements. Test team leaders involved in validations that require special performance authorizations or special operational authorizations shall consult the operations section of AFS-510 at (703) 661-0333 (see paragraph 1657 of this volume).

C. *Program Tracking and Reporting Subsystem (PTRS) Entry.* When the test team is formed, the team leader shall ensure that a PTRS

record is opened for the applicant. This PTRS entry will remain open until the team completes its assignment. The record number of this entry shall be entered in the "Miscellaneous" field in all subsequent PTRS entries associated with the project. This procedure will create a complete record of proving and validation and will eliminate the need for a manually written report. (See section 6 of this chapter for step-by-step instructions for developing the PTRS record.)

1567. PHASE TWO. Phase two is initiated when the applicant submits the test plan to the FAA for evaluation. During this phase, the team leader must ensure that the plan is complete and in an acceptable format before a thorough review and analysis can be conducted.

1569. PHASE THREE. Phase three is initiated when the team starts an in-depth review and analysis of the applicant's test plan for regulatory compliance, safe operating practices, logic of sequence, and other areas (such as training programs, crew and dispatcher qualifications, acceptable participants, and schedules). During this phase, the FAA must plan to coordinate its activities with the demonstrations that the applicant will conduct during phase four.

A. *Team Leader.* The team leader's responsibilities include the following:

- Notifying the RFSD of proving flight dates, times, and locations (The RFSD shall notify other RFSD's affected by the proposed proving flights and any resulting scheduled operations proposed by the applicant.)
- Assigning appropriate sections of the test plan to inspectors or specialists for review and comment.
- Coordinating with the office of aviation security (as necessary) to obtain security inspector assistance for evaluating specific areas, such as hazardous materials and passenger screening.
- Ensuring that administrative requirements such as visas and diplomatic clearances are obtained in a timely manner.

B. *Team Members.* Team members are responsible for performing assigned tasks, keeping the team leader informed of all actions,

and ensuring that the team leader concurs with all agreements made with the applicant. In addition, team members are responsible for recording each activity accurately and completely in the PTRS and placing the assigned number in the “Miscellaneous” field.

1571. PHASE FOUR. Phase four is the major phase of the test process. For proving flights, the applicant will conduct the en route flight segment and the maintenance test portion of the proving plan. In the case of validation tests, the applicant will conduct specific operations to collect data for either validation or FAA observation purposes. Phase four is concluded when the test team is satisfied that all test objectives have been achieved or that the applicant is unable to complete them satisfactorily. Before concluding phase four, the team leader shall obtain the concurrence of the CMO/FSDO manager and the RFSD.

1573. PHASE FIVE. Phase five is accomplished after the successful completion or termination of the proving or validation tests. In this phase, the FAA team either grants approval and issues the appropriate operations specifications (OpSpecs) or sends a letter of disapproval to the applicant. In either case, the team leader’s final action is to complete the report by closing the original PTRS record that was opened in phase one (see section 6).

SECTION 8. VALIDATION TEST REQUIREMENTS

1655. GENERAL. This section contains guidance to be used by managers and inspectors for conducting validation tests. This guidance supplements the general guidance of section 2 and the reporting guidance of section 6 of this chapter.

- A. *Regulatory Background.* Various regulations, such as FAR 121.93, 121.113, and 135.13(a)(2), require applicants to show the capability to conduct specific line operations safely and in compliance with regulatory requirements. One process by which an applicant demonstrates this capability to the FAA has come to be known as validation testing.

NOTE: The term, “applicant,” as used in this section, means either a candidate applying for an operating certificate or a certificate holder requesting additional operating authority.

- (2) *Validation Testing.* The FAR do not require an applicant to conduct actual flights when flights are not necessary for safety, considering the availability of adequate facilities and of able personnel to conduct the operation. Validation flights are expensive for the FAA and for the applicant. Inspectors should, therefore, avoid requiring applicants to conduct flights when they are not required. This section contains guidelines for teams to use in making this determination. In the interest of standardized treatment, Regional Flight Standards Divisions (RFSD) shall concur with team recommendations before teams deviate from the guidelines of this section.
- (3) *Areas of Emphasis.* When the FAA conducts validation testing with or without an actual flight, an in-depth review is conducted of the applicable portions of the applicant’s proposed procedures (especially flight following), training programs, manuals, facilities, and maintenance programs.

1665. PLANNING THE VALIDATION TESTS. An applicant that is required to conduct a validation test must develop and submit a test plan. The plan and test objectives must be specifically tailored to the situation. The following guidelines should be followed by the FAA team and the applicant in planning validation tests:

- A. *Form and Content of the Test Plan.* The variety of operational situations and requirements that determine the make-up of validation tests makes it impossible to specify the form and content for each validation test plan. Regulations; AC’s; specific instructions in this handbook; FAA Order 8300.10, Airworthiness Inspector’s Handbook; and other official sources have been developed to assist the applicant and FAA inspectors in determining the necessity of validation testing and the planning of validation tests. In many situations, these documents contain specific procedures that must be followed or that provide acceptable methods that an applicant can use to acquire a special authorization.

- B. *FAA Test Team and Applicant Coordination.* The applicant and test team must agree on the form and content of the test plan, and they must establish mutual understandings of test objectives, the degree of demonstration required, and the criteria to be met. During development of the plan, the applicant should be encouraged to coordinate with and confer frequently with the FAA team concerning the make-up of the validation tests and the methods to be used in conducting them.
- C. *Operational Demonstrations.* Most validation tests will require some form of operational demonstration. When operational demonstrations are required, the validation test plan must include a schedule for those demonstrations.
- D. *Determining Number of Flight Hours.* A required number of hours for a validation flight is not specified by regulation and must be determined on a case-by-case basis. When the test objectives can be adequately met, the test team may reduce flight hours to zero.
- E. *Revisions to Applicant Documents and Training Program.* Most special authorizations require revisions to the applicant's checklists, minimum equipment lists (MEL), general operations manual (GOM), general maintenance manual (GMM), and training program. These revisions should be submitted with the validation test plan for FAA review and approval or acceptance, as appropriate.
- F. *Amendment to OpSpecs.* All special authorizations require an amendment to the OpSpecs; the applicant should apply for the amendment at the same time the validation plan is submitted.

1667. AREAS EVALUATED ON VALIDATION TESTS OR FLIGHTS. The types of activities and items that need to be inspected and evaluated on validation tests or flights vary with the type of authorization requested by the applicant. The following list provides example of activities and items requiring inspection and evaluation.

- Flight crew training (and flight attendant training, if applicable)
- Operations manual information and crew procedures
- Checklists and MEL's

- Maintenance manual information and maintenance program
- Equipment certifications and installation approvals
- Reliability and accuracy of applicable operational and maintenance records
- Operational flight control and company communication capabilities
- Flight crew competency in use of equipment, procedures, and techniques
- Coordination procedures between the flight crew, maintenance personnel, and other ground personnel

VOLUME 4. AIRCRAFT EQUIPMENT AND OPERATIONAL AUTHORIZATIONS

CHAPTER 1. AIR NAVIGATION AND COMMUNICATIONS

SECTION 5. SPECIAL NAVIGATION AREAS OF OPERATION

161. SPECIAL AREAS WHERE REDUNDANT LONG-RANGE NAVIGATION SYSTEMS ARE USUALLY NOT REQUIRED.

Certain special areas have been identified where long-range navigation can be conducted with a single long-range navigation system.

A. Concept. The provisions of the FAR related to Class II navigation do not specifically require redundant or dual long-range navigation systems. The primary Class II navigation requirements are related to the level of navigational performance necessary for the control of air traffic. The objective of requirements for redundant navigational systems is to permit the flight to continue to navigate to the degree of accuracy necessary for the control of air traffic in the event a failure occurs in the navigational system being used.

(1) In certain situations, Class II navigation can be safely conducted using ICAO standard NAVAIDs supplemented by

dead reckoning. See section 4. Operations can also be safely conducted in much larger areas using a combination of redundant ICAO standard NAVAIDs and a single, long-range navigation system. The basic concept for these operations considers the availability of ICAO standard NAVAIDs, the lateral separation minimums applied by ATC (the navigational performance required), the length of the route or route segment, the complexity of the route structure, and the density of the air traffic.

- (2) When the long-range navigation segment of the route flown is relatively short (several hours), the ATC lateral separation minimums are large (usually 90 NM or more), and the upper air winds are relatively stable, single long-range navigation systems may be adequate. The primary concern related to the use of single long-range navigation systems is preserving the ability to navigate to the degree of accuracy required for the control of air traffic following a failure in the long-range navigation system. Historically, the required navigational performance (following such failures) has been provided by the use of dead reckoning and ICAO standard NAVAIDs. Since dead reckoning is much less accurate than using a long-range navigation system, the period of time that dead reckoning must be used is the most critical factor. Operational experience and analysis has shown that turbojet operations can be safely conducted (within special areas described in this paragraph) with an approved, single long-range navigation system and the redundant means of using ICAO standard NAVAIDs.

B. Special Provisions for the Western Atlantic Ocean, Caribbean Sea, and Gulf of Mexico. The unique nature of the Western Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico permits operations with turbine-powered airplanes and certain offshore helicopter operations to be safely conducted with a single approved long-range system. Approval of the use of a single long-range navigation system is granted by entering a note in the limitations, provisions, and reference paragraphs column of paragraph B50 of the operations specifications. The note should indicate that a single system (specify the system make) is authorized. The areas of operation where these operations may be authorized in paragraph B50 of the operations specifications are as follows:

- The Gulf of Mexico
- The Caribbean Sea
- The North Atlantic Ocean west of the western boundary of NAT/MNPS airspace and west of a line from 27 degrees N/60W to 10 degrees N/55W

C. *Special Provisions for Certain Routes in NAT/MNPS Airspace.* Special contingency routes have been established in limited portions of NAT/MNPS airspace where aircraft equipped to use standard ICAO NAVAIDs can operate with a single long-range navigation system. These routes are specified in the International Flight Information Manual (IFIM). Operations over these routes can be authorized provided the operator shows that the long-range navigation system/aircraft combination used and the operational procedures used meets NAT/MNPS requirements (AC 120-33). The approval is granted in accordance with paragraph B39(d) of the operations specifications and by adding that area of en route operation to paragraph B50 of the standard specifications.

D. *Other Special Areas.* Inspectors shall not authorize operations with single long-range navigation systems in any other areas of operation without the review and concurrence of AFS-200. When a request to operate with single long-range navigation systems in areas not described in this paragraph is received, inspectors shall request assistance from one of the agency's navigation specialists. If the responsible inspector and the navigation specialist determine that the proposed operation can be safely conducted, a request for review and concurrence should be forwarded, through regional office, to AFS-200. AFS-200 will provide national direction and guidance for evaluating and approving or denying the proposed operation.

REFERENCE O2

**FAA ORDER 8400.10
APPENDIX 3 HBAT 95-02**

**Guidelines for Obtaining Operational Approval
for the Use of Global Positioning System (GPS)
in the Conduct of Air Carrier Operations;
Announcement of the Availability of
GPS Operations Specifications (OpSpecs)**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

1. **PURPOSE.** This bulletin describes the steps an operator must follow to obtain operational approval for the use of GPS in the conduct of its en route and terminal operations under FAR Parts 121 and 135. Terminal operations discussed herein do not include the approval of Differential GPS (DGPS) approaches.

2. **PROCESS.**

- A. Any GPS operation by U.S. air carrier and commercial operators under FAR Part 121 or 135 or by foreign air carriers under FAR Part 129 must be approved in accordance with the guidance contained in FAA Order 8400.10, "Air Transportation Operations Inspector's Handbook," Volume 3, Chapter 1, and this HBAT.
- B. Foreign Air Carriers conducting operations under FAR Part 129 shall not conduct GPS operations in the U.S. until operations specifications (OpSpecs) are developed under FAR Part 129, Appendix A, authorizing GPS operations. Prior to issuing these OpSpecs, principal operations inspectors (POI) should review written documentation provided by the operator's State civil aviation authority certifying that the GPS equipment, training, and operating procedures are equivalent to the requirements contained herein.
- C. When operational approval has been granted for the use of GPS in the [information missing in original], the appropriate OpSpecs paragraphs shall be issued to the operator which specify the GPS operations that the operator is authorized to conduct. All airworthiness approvals for GPS installations must be granted through the Type Certificate (TC) or Supplemental Type Certificate (STC) process. The operational suitability of the GPS airborne equipment must be demonstrated in accordance with the criteria in this HBAT.

- D. Each certificate holder must demonstrate its ability to conduct the type of GPS operations requested in accordance with this HBAT and FAA Order 8400.10, Volume 3, Chapter 9, “Proving and Validation Tests. “This demonstration is required to aid in the assessment of the operator’s training program and validate the performance of the GPS equipment used. Inspectors are advised that these requirements are for validation testing, not necessarily validation flights, and that proving tests are not required for operational use of GPS. Specific GPS background information and approval procedures follow:

4. APPROVAL TO CONDUCT GPS AREA/LONG RANGE NAVIGATION OPERATIONS AND NONPRECISION INSTRUMENT APPROACH PROCEDURES.

- A. To obtain approval to conduct GPS IFR operations, the operator must make application in accordance with FAA Order 8400.10, Volume 3, Chapter 9, “Proving and Validation Tests”; revise its manuals, procedures and checklists; and alter the flight training curriculums to include segments on GPS operations.
- B. The discussion in the following paragraphs provides specific direction and guidance related to GPS and is to be used in conjunction with existing area/long-range navigation guidance and nonprecision instrument approach guidance contained in FAA Order 8400.10, Volume 4, Chapter 1, “Air Navigation.” These conditions must be specified in the operator’s OpSpecs.

5. APPLICATION. The applicant must show that it has the ability to safely conduct GPS operations. The application must also provide documentation for the following items.

- A. Documentation must be provided which validates approval of the installed GPS airborne receiver in accordance with AC 20-138, and AC 20-130, as appropriate. When it has been established that the airborne system has been certified for the appropriate GPS IFR operations, the following criteria should be used to determine the operational suitability of airborne systems for GPS IFR operations in air carrier operations.
 - (a) 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.

- (b) The operator's manuals, policies, and procedures as described in FAA Order 8400.10, Volume 3, Chapter 15, "Manuals, Procedures, and Checklists" must incorporate the manufacturer's instructions for continuing airworthiness of the applicable GPS system.
 - (c) Revisions should be made to the operator's minimum equipment list (MEL) and operations and maintenance procedures to incorporate the GPS/DGPS equipment.
 - (d) FAR Parts 121 and 135 operators must ensure that service difficulties are reported in accordance with approved procedures under FAR Parts 121 and 135. FAR Part 125 operators must include GPS service difficulty reporting procedures in the manual required by FAR Section 125.73(f).
- B. The applicant must document the proposed pilot training and qualification program. This program must address at least the following training and qualification requirements.
- (a) Crew training and qualification for GPS instrument approach operations should be consistent with the qualifications required for the use of ILS, VOR/DME, RNAV, and multi-sensor RNAV flight management system (FMS) systems in FAA Order 8400.10, Volume 3, Chapter 2, "Training Programs and Airman Qualifications," AC 120-53, and FAR Parts 61, 91, 121, 125, 129, 135, and SFAR No. 58. Although these standards do not specifically address GPS systems, the principles are equivalent and these criteria can be used to evaluate crew knowledge, procedures, checking, and recency of experience until other criteria are available. No special crew qualification requirements, other than those necessary for RNAV and ILS instrument approach qualification are currently specified for GPS approaches.
 - (b) Ground training must assure that each flight crew member has the knowledge required for the GPS procedures to be

flown. FAR Parts 121 and 135 operators must successfully complete the approved training curriculum segment for GPS operations, as applicable.

The ground training should include at least the following subjects:

- The principles of GPS navigation;
 - Hardware operation and interface with other navigation equipment;
 - Software use;
 - Human factors issues e.g. displays, charts, and approach plates;
 - The limitations of the GPS equipment; and
 - The specific operating techniques and procedures to be used with the GPS equipment, including maintenance and dispatch procedures, and the contents of the OpSpecs.
- (c) Initial qualification, recurrent qualification, and requalification flight training must assure that each flight crew member has the skills and abilities necessary to safely conduct the proposed operations. Flight crew members must successfully complete that operator's approved flight training program for GPS.
- (d) GPS instrument approaches may be credited for other equivalent types of required approaches; e.g., nonprecision approaches. However the demonstration of any other nonprecision approaches may not be credited toward the OpSpecs requirement to demonstrate at least one nonprecision approach utilizing GPS during the competency check required by 135.297 and 121.441(a)(1).
- (e) Operators must provide written procedures in their manuals which are specific for their GPS operations. The manuals must be consistent with manufacturer's recommended procedures for the use of the installed GPS equipment.
- E. The operator must provide a validation program that ensures the GPS airborne system is operationally accurate and reliable.

F. The operator must incorporate into its maintenance program the GPS manufacturer's requirements for maintenance, and instructions for continued maintenance.

6. **POLICY.** POIs must evaluate and authorize their operators who intend to conduct GPS domestic en route, oceanic, and terminal IFR operations, including nonprecision IAPs in accordance with FAA Order 8400.10 and the direction and guidance contained in this HBAT. These authorizations are specified in the operator's OpSpecs. Coordination with the principal avionics inspector (PAI) is essential to ensure that the airborne system has been approved for the requested IFR operation. Acceptable equipment will either meet the requirements of TSO C-120 or be approved as part of the type certificate or supplemental type certificate process. PAIs must ensure that the equipment is installed and maintained in accordance with appropriate airworthiness requirements. U.S. operators and qualified foreign flag operators may be authorized to conduct GPS IFR operations if the requirements in this guidance are met.

7. **OPERATIONS SPECIFICATIONS-FAR Parts 121, 125, 129 and 135 Operators:**

A. To obtain approval, each operator must demonstrate its ability to conduct the type of GPS operations requested. All evaluations and approvals must be accomplished in accordance with this guidance. Operators should apply to their Certificate Holding District Office (CHDO) for original issuance or amendment of their OpSpecs authorizing GPS operations.

B. OpSpecs paragraphs B31 through B35, as appropriate, must be amended to authorize Class I and II en route navigation within the NAS, Class II Oceanic Navigation, Terminal area IFR operations, and specific nonprecision IAPs. POIs must ensure that the OpSpecs paragraphs listed in FSAT 95-XX entitled, "Operations Specifications (OpSpecs) Revisions: Global Positioning System (GPS)," are changed to properly authorize an operator's GPS operations.

8. **IFR EN ROUTE OPERATIONS - U.S. Domestic And Oceanic Navigation:** GPS equipment can be used to conduct IFR operations in the U.S. NAS when conducting en route and terminal Class I or Class II; and oceanic Class II navigation, if the provisions and

limitations of this HBAT are met. This approval permits the use of GPS in a manner that is consistent with current navigation requirements, provided there is compliance with the following restrictions:

- A. The GPS navigation equipment used must meet TSO C-129. The installation must be made in accordance with the latest Flight Standards Policy concerning GPS follow-on or approved as part of the TC, STC, or required navigation performance.
 - B. The basic GPS signal integrity for these operations must be provided by receiver autonomous integrity monitoring (RAIM) or by an equivalent method approved by the Aircraft Certification Office.
 - C. Procedures must be established for use in the event that significant GPS navigation outages occur. In situations where GPS signal outages occur or are predicted, the flight must rely on other approved navigation equipment, delay departure, or cancel the flight.
 - D. Aircraft navigating by GPS are considered to be RNAV-equipped aircraft. Therefore, the appropriate equipment suffix, i.e., “/R” or “/G”, must be included in the ATC flight plan.
 - E. 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, i.e., Omega, INS/IRS, Loran-C, VOR, etc. Active monitoring of the alternate navigation equipment is required unless the installation uses RAIM for integrity monitoring. For systems with RAIM, active monitoring of the alternate navigation equipment is required when the RAIM capability of the GPS equipment is lost.
9. **Domestic (U.S. Only) En Route Operations.** For GPS domestic en route and terminal IFR operations, the VOR, DME, TACAN, and/or NDB equipment necessary to receive the ground-based facilities appropriate for the route to the destination airport and any required alternate airport must be installed in the aircraft and

operational. The ground-based NAVAIDS that defined those routes must also be operational.

10. **Oceanic En Route (Class II Navigation).** Aircraft using GPS equipment under IFR must be equipped with and the crew must be trained in the use of an approved alternate means of navigation appropriate for the intended route to be flown. Outside of the national airspace system, GPS may be used as an LRNS. On those routes requiring two LRNS, a GPS installation with TSO C-129 approval and operational RAIM capability, may be used to replace or supplement one of the other approved means of LRNS, such as one unit of a dual INS or one unit of a dual Omega system. On those routes and for those operations approved for use of a single LRNS, a GPS unit which provides RAIM capability may be used as the LRNS. Active monitoring of the alternate equipment is only required when the RAIM capability is lost. GPS may not be approved for use in other countries unless authorized by the FAA Administrator and the appropriate sovereign state.

11. **Standard Instrument Approach Procedures (SIAP).** GPS equipment approved under TSO C-129 for nonprecision approaches, can be used to fly (TERPS, Chapter 15), RNAV instrument approach procedures. Under certain constraints, these systems can also be used to fly any VOR, VOR/DME, NDB, and NDB/DME nonprecision instrument approach based upon criteria in U.S. TERPS or ICAO PANS-OPS. The general approval to use GPS to fly instrument approaches is initially limited to the U.S. NAS. The use of GPS in any other airspace must be expressly authorized by the Administrator and by the appropriate sovereign authority.
 - A. The Department of Defense (DOD) currently uses a technique called Selective Availability (SA) to intentionally degrade the GPS accuracy provided to civil users. As a result, systems do not have the accuracy and integrity necessary to fly ILS, LOC, LDA, or SDF approaches unless additional means, such as differential corrections, are used to counteract its effects.

 - B. Several airborne systems calculate glide path information from barometric data. Since barometric information can, in certain environmental extremes, be less accurate than ILS glideslope information, the initial implementation of GPS IAPs does not provide a credit for vertical guidance.

- C. Single thread GPS navigation equipment (e.g., a GPS navigation system installation where any single failure could result in a loss of GPS navigation) operations may not predicate the obstacle assessment area or landing minima on GPS missed approach guidance. The obstacle assessment area and minima for these operations will be based on no course guidance or, when available, other approved navigation aids, as appropriate.
 - D. The basic GPS signal integrity for the nonprecision approach “overlay” program must be provided by receiver autonomous integrity monitor (RAIM) or another FAA-approved means of determining satellite status. If RAIM is unavailable, active monitoring of the underlying NAVAIDs is required.
12. **Operational Requirements:** In accordance with the “overlay program” GPS can be used as the primary IFR flight guidance during a nonprecision instrument approach without actively monitoring the underlying NAVAID(s) which define the approach being used if the following provisions and limitations must be met:
- A. The ground-based NAVAID(s) required for the published approach must be operating and the user avionics for the approach must be installed and operational but need not be operating during the approach if RAIM provides integrity for the approach navigation data. For systems that do not use RAIM for integrity, the ground-based NAVAID(s) and the airborne avionics needed to provide the equivalent integrity must be installed, operating, and monitored during the approach.
 - B. An approach cannot be flown unless that instrument approach waypoints are retrieved from a current avionics database. The GPS equipment must store the location of all waypoints, intersections, and/or navigation aids required to define the approach and present them in the order as depicted on the published nonprecision instrument approach procedure chart. Approaches must be flown in accordance with the FAA-approved flight manual or flight manual supplement.

13. **Compliance with FAR Sections 121.349 and 135.165.** Air carriers may be authorized to use single GPS navigation equipment as a navigation system for nonprecision approaches if the aircraft is equipped with two VOR receivers, and ground NAVAIDs are positioned such that the flight can continue safely to a suitable alternate airport by means of VOR NAVAIDs and complete an approach using the remaining airplane avionics system.
14. **Alternate Airport Requirements:** Any required alternate airport must have an approved instrument approach procedure, other than GPS or Loran-C, which is anticipated to be operational at the estimated arrival time. The ground-based facilities which support these approaches must also be operational.
15. **INQUIRIES.** Any questions concerning the information in this FSIB should be directed to AFS-200, at (202) 267-7579.
16. **EXPIRATION DATE.** This HBAT will remain in effect until the information contained herein is published as a part of a scheduled handbook change.

David R. Harrington

REFERENCE O3

**FAA ORDER 8400.10
APPENDIX 3 HBAT 95-03**

**Operations Specifications (OpSpecs) Revision:
Global Positioning Systems (GPS)**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

**OPERATIONS SPECIFICATIONS ISSUANCE
INSTRUCTIONS FOR OPERATORS AUTHORIZED TO USE
GLOBAL POSITIONING SYSTEMS (GPS)**

Principal operations inspectors having certificate management responsibilities for operators authorized to use GPS shall amend the operators' OpSpecs using the following instructions:

1. Issuance of En Route Authorization for Use of GPS for Class I Navigation.

- a. If the existing aircraft avionics installation **does not** include area navigation (RNAV) capability:
 - (1) Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
 - (2) Mark the Operations Specification checklist to check the appropriate block (paragraph B34 requires 6b or 12c and 5q to be checked; paragraph B35 requires 4a and [4c or 6b] and 5p to be checked).
 - (3) Proceed to instructions in paragraph 1b(2) through 1b(9), below.
- b. If the existing aircraft avionics installation **does** include RNAV capability:
 - (1) Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
 - (2) Using the "Additional Text" feature for paragraph B31, insert the following new subparagraph at the beginning of the "Additional Text" section:

“THE OPERATOR MAY USE APPROVED GPS NAVIGATION EQUIPMENT AS A SUPPLEMENT TO ICAO STANDARD NAVIGATION EQUIPMENT WHILE CONDUCTING CLASS I NAVIGATION.”

- (3) Change the signature block of paragraph B31 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- (4) Using the “Additional Text” feature for paragraph B34a, insert the aircraft model, and the make and model of the GPS receiver.
- (5) Change the signature block of paragraph B34 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- (6) If Class I navigation is authorized In Class A airspace (PCA) then, in paragraph B35a, insert the aircraft make, and make and model of GPS receiver in the existing table.
- (7) In paragraph B50, access the Limitations, Provisions, and limitations Paragraphs section for the specific areas authorized, and insert paragraph B35 adjacent to the existing referenced paragraphs.

NOTE: CLASS I NAVIGATION USING GPS SHALL ONLY BE AUTHORIZED IN THE U.S. NATIONAL AIRSPACE SYSTEM (NAS) UNLESS AUTHORIZED BY THE APPROPRIATE SOVEREIGN STATE. IF RNAV EQUIPMENT (OTHER THAN GPS) IS AUTHORIZED IN A FOREIGN STATE(S), PARAGRAPH B50 SHALL CONTAIN A LIMITATION TO PROHIBIT THE USE OF GPS FOR CLASS I NAVIGATION IN A FOREIGN STATE(S).

- (8) Change the signature block of paragraph B50 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.

- (9) Print paragraph B31, B34, B35 and B50, as appropriate, in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

2. Issuance of En Route Authorization for Use of only a Single GPS for Class II Navigation.

NOTE:

This authorization may only be issued for operations in the Caribbean Sea, Gulf of Mexico, and the Atlantic Ocean west of MNPS airspace.

- a. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
- b. Mark the Operations Specification checklist to check the appropriate block. Paragraph B36 requires question 4c and (5n or 5o) to be checked, as appropriate.
- c. In paragraph B36, subparagraph a(1), insert the aircraft make, make and model of GPS receiver.
- d. Change the signature block of paragraph B36 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- e. In paragraph B50, access the Limitations, Provisions, and limitations Paragraphs, section for the Caribbean Sea, Gulf of Mexico, and/or Atlantic Ocean West of MNPS airspace, as applicable, and enter the following statement adjacent to the existing referenced paragraphs:

"CLASS II NAVIGATION WITH THE APPROVED SINGLE GPS LISTED IN PARAGRAPH B36(1) IS LIMITED TO THIS SPECIFIC GEOGRAPHIC AREA."
- f. Change the signature block of paragraph B50 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- g. Print paragraph B36 and B50 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

3. Issuance of En Route Authorization for Use of GPS and A Second Long-Range Navigation System for Class II Navigation.

- a. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
- b. Mark the Operations Specification checklist to check the appropriate block. Paragraph B36 requires question 4c and (5n or 5o) to be checked, as appropriate.
- c. In paragraph B36, subparagraph a(1), insert the aircraft make, make and model of GPS receiver and the make and model of the second long-range navigation system.
- d. Change the signature block of paragraph B36 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- e. Print paragraph B36 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

4. Issuance of En Route Authorization for Use of GPS in Central East Pacific (CEPAC) Airspace, and Not in Northern Pacific (NOPAC) Airspace.

NOTE:

This authorization may only be issued if en route authorization for use of GPS and a second long-range navigation system for Class II navigation (OpsSpecs paragraph B36) has been issued as described in paragraph 3 of these instructions.

- a. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
- b. Mark the Operations Specification checklist to check the appropriate block. Paragraph B37 requires question 4a and 4c; and, 5n or 5o; and, 5l to be checked, as appropriate.

- c. Change the signature block of paragraph B37 to reflect the Effective Date anticipated for paragraph approval. Change the amendment Number field to reflect the next sequential number.
- d. Print paragraph B37 in final form.

NOTE: THE PURPOSE FOR ISSUANCE OF PARAGRAPH B37 USING THE OPSS SOFTWARE IS TO MAKE A PERMANENT RECORD OF ITS ISSUANCE IN THE NATIONAL DATA BASE. THE COMPUTER GENERATED PAGE WILL BE DISCARDED AND BE REPLACED AS DESCRIBED BELOW:

NOTE: REFERENCES TO PLATES IN THIS BULLETIN REFER TO THE OPERATIONS SPECIFICATIONS TEMPLATES CONTAINED IN THE ATTACHED MS WORD 2.0 FILE.

- e. Select from the attached replacement operations specifications pages the appropriate paragraph revisions to be issued.
- f. The selection made should include the Table of Contents (revision) page, PLATE 2.
- g. Fill by word processor or typewriter the spaces at the bottom of the Table of Contents (revision) page with the same information provided at the bottom of the printed OPSS Table of Contents page obtained in step "c" above. Enter the effective dates for the paragraph, in the space provided in the Effective Date column. Insert the Table of Contents (Revision) page behind the Table of Contents page generated by the OPSS.
- h. Find the Paragraph B37 (Revision) page, PLATE 5, in the attachments and fill in the information needed in the blanks provided. The Effective Date and Amendment Number should be the same as indicated on the B37 page generated by the OPSS. Insert the Paragraph B37 (Revision) page in place of, and discard the B37 page generated by the OPSS.

Present the documents to the operator for acceptance, and recover the existing documents.

5. Issuance of En Route Authorization for Use of GPS in Northern Pacific (NOPAC) Airspace, and Not in CEPAC Airspace.

NOTE: THIS AUTHORIZATION MAY ONLY BE ISSUED IF EN ROUTE AUTHORIZATION FOR USE OF GPS AND A SECOND LONG-RANGE NAVIGATION SYSTEM (OTHER THAN GPS) FOR CLASS II NAVIGATION HAS BEEN ISSUED AS DESCRIBED IN PARAGRAPH 3 OF THESE INSTRUCTIONS.

NOTE: THE PURPOSE FOR ISSUANCE OF PARAGRAPH B38 USING THE OPSS SOFTWARE IS TO MAKE A PERMANENT RECORD OF ITS ISSUANCE IN THE NATIONAL DATA BASE. THE COMPUTER GENERATED PAGE WILL BE DISCARDED AND BE REPLACED AS DESCRIBED BELOW:

NOTE: REFERENCES TO PLATES IN THIS BULLETIN REFER TO THE OPERATIONS SPECIFICATIONS TEMPLATES CONTAINED IN THE ATTACHED MS WORD 2.0 FILE.

- a. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
- b. Mark the Operations Specification checklist to check the appropriate block. Paragraph B38 requires question 4c and 5n, or 5o and 5m to be checked, as appropriate.
- c. Change the signature block of paragraph B38 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- d. Print paragraph B38 in final form.
- e. Select from the attachments of this bulletin the appropriate revisions to be issued.
- f. Select from the attached replacement operations specifications pages the appropriate paragraph revisions to be issued.
- g. The selection made should include the Table of Contents (revision) page, PLATE 4.

- h. Fill by word processor or typewriter the spaces at the bottom of the Table of Contents (revision) page with the same information provided at the bottom of the printed OPSS Table of Contents page obtained in step “c” above. Enter the effective dates for the paragraph, in the space provided in the Effective Date column. Insert the Table of Contents (Revision) page behind the Table of Contents page generated by the OPSS.
- i. Find the Paragraph B38 (Revision) page, PLATES 6 and 7, in the attachments, and fill in the information needed in the blanks provided. The Effective Date and the Amendment Number should be the same as indicated on the B38 page generated by the OPSS. Insert the Paragraph B38 (Revision) page in place of, and discard the B38 page generated by the OPSS.

Present the documents to the operator for acceptance, and recover the existing documents.

6. Issuance of En Route Authorization for Use of GPS in CEPAC Airspace and NOPAC Airspace.

NOTE:

This authorization may only be issued if en route authorization for use of GPS and a second long range navigation system (other than GPS) for Class II navigation has been issued as described in paragraph 3 of these instructions.

- a. Log on to the subject operator’s OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
- b. Change the signature blocks of paragraph B37 and B38 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number fields to reflect the next sequential number.
- c. Print paragraph B37 and B38 in final form.
- d. Select from the attachments of this bulletin the appropriate revisions to be issued.
- e. The selection made should include the Table of Contents (revision) page, PLATE 1. Fill by typewriter the spaces at the bottom of the Table of Contents (revision) page with the same

information provided at the bottom of the printed OPSS Table of Contents page obtained in step “c” above. Enter the effective dates for the paragraph, in the space provided in the Effective Date column. Insert the Table of Contents (Revision) page behind the Table of Contents page generated by the OPSS.

- f. Find the Paragraph B37 and B38 (Revision) pages, PLATES 5, 6, and 7, in the attachments, and fill in the information needed in the blanks provided. The Effective Dates and Amendment Numbers should be the same as indicated on the B37 and B38 pages generated by the OPSS. Insert the Paragraph B37 and B38 (Revision) pages in place of, and discard the B37 and B38 pages generated by the OPSS.

7. Issuance of En Route Authorization for Use of GPS in Northern Atlantic Minimum Navigation Performance Standards (MNPS) Airspace.

NOTE:

This authorization may only be issued if en route authorization for use of GPS and a second long-range navigation system (other than GPS) for Class II navigation has been issued as described in paragraph 3 of these instructions.

- a. If unrestricted routing is to be authorized:
 1. Log on to the subject operator’s OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
 2. Mark the Operations Specification checklist to check the appropriate block. Paragraph B39 requires question 4a and 4c checked; 5k checked and 5n or 5o checked, as appropriate.
 3. Change the signature block of paragraph B39 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
 4. In paragraph B39, subparagraph c, insert the aircraft make; make and model of GPS receiver and the make and model of the second long-range navigation system.

NOTE:

Normally operators receiving authorization under Paragraph B39c should also receive authorization in Paragraph B39d for ferry and contingency purposes.

- b. If restricted routing over special contingency routings (Blue Spruce Routes) with a single GPS is to be authorized:
 1. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
 2. Change the signature block of paragraph B39 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
 3. In paragraph B39, subparagraph d, insert the aircraft make, and the make and model of GPS receiver.
- c. Print paragraph B39 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

8. Issuance of En Route Authorization for Use of GPS in Areas of Magnetic Unreliability.

- a. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
- b. Using the "Additional Text" feature for paragraph B40, insert aircraft makes, make and model of the GPS receiver, and the make and model of the second long-range navigation system, in the navigation equipment table:
- c. Change the signature block of paragraph B40 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- d. Print paragraph B40 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

9. Issuance of Authorization for Use of GPS to Conduct Nonprecision Instrument Approach Procedures

NOTE:

This authorization may only be issued if en route authorization for use of GPS for Class I navigation has been issued as described in paragraph 1 of these instructions.

NOTE:

GPS navigation systems listed in operations specifications for Nonprecision Instrument Approach approval must be approved under TSO C129, classes A1, B1, B3, C1, or C3.

a. For airplanes, when RNAV and special terminal instrument approaches **are not** authorized:

1. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
2. Using the "Additional Text" feature for paragraph C52, insert the following new subparagraph "c" at the beginning of the "Additional Text" section:

"c. GPS NONPRECISION APPROACH PROCEDURE AUTHORIZATION. THE CERTIFICATE HOLDER IS AUTHORIZED TO CONDUCT VOR, VOR/DME, NDB, AND NDB/DME INSTRUMENT APPROACH OPERATIONS USING THE APPROVED GPS EQUIPMENT LISTED IN PARAGRAPH B34 OR B35. THE CERTIFICATE HOLDER SHALL NOT CONDUCT GPS INSTRUMENT APPROACH OPERATIONS UNLESS AUTHORIZED BY THESE OPERATIONS SPECIFICATIONS. APPROACHES USING GPS ARE SUBJECT TO THE FOLLOWING LIMITATIONS:

- (1) THE AIRBORNE GPS NAVIGATION EQUIPMENT USED MUST BE APPROVED AND CURRENT FOR IFR OPERATIONS, INCLUDING NONPRECISION APPROACHES, AND THE GPS CONSTELLATION AND THE REQUIRED AIRBORNE EQUIPMENT MUST BE PROVIDING THE LEVELS OF ACCURACY,

CONTINUITY OF FUNCTION AND INTEGRITY
REQUIRED FOR THAT OPERATION.

(2) THE FLIGHT CREW MUST HAVE SUCCESSFULLY COMPLETED THE CERTIFICATE HOLDERS APPROVED TRAINING PROGRAM CURRICULUM SEGMENTS FOR GPS OPERATIONS; AND THE PILOT IN COMMAND MUST BE CHECKED FOR COMPETENCY BY A AUTHORIZED CHECK AIRMAN OR FAA INSPECTOR FOR INSTRUMENT APPROACH OPERATIONS USING GPS IN EACH AIRCRAFT TYPE AND GPS COMBINATION.

(3) DURING THE INITIAL 6 MONTHS OF OPERATION WITH A PARTICULAR AIRCRAFT TYPE AND GPS COMBINATION, THE CERTIFICATE HOLDER SHALL NOT USE IFR APPROACH AND LANDING MINIMUMS, FOR THAT PARTICULAR AIRCRAFT AND GPS COMBINATION, LOWER THAN 200 FEET AND 1/2 STATUE MILE ABOVE THE LOWEST MDA AND VISIBILITY/RVR MINIMUMS AUTHORIZED FOR INSTRUMENT APPROACHES AND LANDINGS AT THAT AIRPORT USING GPS.”

3. Change the signature block of paragraph C52 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.

4. Print paragraph C52 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

B. For airplanes, if RNAV approaches using GPS **are** authorized:

1. Comply with the instructions set forth in paragraph 8a of this HBAT.

2. Change the signature block of paragraph C63 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.

3. In paragraph C63, insert the aircraft make, and the make and model of GPS receiver.

4. Print paragraph C63 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

c. For airplanes, if special terminal instrument approach procedures using GPS **are** authorized:

1. Comply with the instructions set forth in paragraph 8a of this document.
2. Change the signature block of paragraph C64 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
3. In paragraph C64e, insert the specific Special Terminal Instrument Approach Procedure authorized.
4. Print paragraph C64 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

d. For rotorcraft, when RNAV and special terminal instrument approaches **are not** authorized:

1. Log on to the subject operator's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operations Specifications Subsystem (OPSS).
2. Using the "Additional Text" feature for paragraph H102, insert the following new subparagraph "c" at the beginning of the "Additional Text" section:

"c. GPS NONPRECISION APPROACH PROCEDURE AUTHORIZATION. THE CERTIFICATE HOLDER IS AUTHORIZED TO CONDUCT VOR, VOR/DME, NDB, AND NDB/DME INSTRUMENT APPROACH OPERATIONS USING THE APPROVED GPS EQUIPMENT LISTED IN PARAGRAPH B34 OR B35. THE CERTIFICATE HOLDER SHALL NOT CONDUCT GPS INSTRUMENT APPROACH OPERATIONS

UNLESS AUTHORIZED BY THESE OPERATIONS SPECIFICATIONS. APPROACHES USING GPS ARE SUBJECT TO THE FOLLOWING LIMITATIONS:

(1) THE AIRBORNE GPS NAVIGATION EQUIPMENT USED MUST BE APPROVED AND CURRENT FOR IFR OPERATIONS, INCLUDING NONPRECISION APPROACHES, AND THE GPS CONSTELLATION AND THE REQUIRED AIRBORNE EQUIPMENT MUST BE PROVIDING THE LEVELS OF ACCURACY, CONTINUITY OF FUNCTION AND INTEGRITY REQUIRED FOR THAT OPERATION.

(2) THE FLIGHT CREW MUST HAVE SUCCESSFULLY COMPLETED THE CERTIFICATE HOLDERS APPROVED TRAINING PROGRAM CURRICULUM SEGMENTS FOR GPS OPERATIONS; AND THE PILOT IN COMMAND MUST BE CHECKED FOR COMPETENCY BY A AUTHORIZED CHECK AIRMAN OR FAA INSPECTOR FOR INSTRUMENT APPROACH OPERATIONS USING GPS IN EACH AIRCRAFT TYPE AND GPS COMBINATION.

(3) DURING THE INITIAL 6 MONTHS OF OPERATION WITH A PARTICULAR AIRCRAFT TYPE AND GPS SYSTEM OR MODEL COMBINATION, THE CERTIFICATE HOLDER SHALL NOT USE IFR APPROACH AND LANDING MINIMUMS, FOR THAT PARTICULAR AIRCRAFT SYSTEM COMBINATION, LOWER THAN 200 FEET AND 1/2 STATUE MILE ABOVE THE LOWEST MDA AND VISIBILITY/RVR MINIMUMS AUTHORIZED FOR INSTRUMENT APPROACHES AND LANDINGS AT THAT AIRPORT USING GPS.”

3. Change the signature block of paragraph H102 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.

4. Print paragraph H102 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

e. For rotorcraft, if RNAV approaches using GPS **are** authorized:

1. Comply **with** the instructions set forth in paragraph 8d of this HBAT.
2. Change the signature block of paragraph H112 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
3. In paragraph H112, insert the aircraft make, and the make and model of GPS receiver.
4. Print paragraph H112 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

f. For rotorcraft, if special terminal instrument approach procedures using GPS **are** authorized:

1. Comply with the instructions set forth in paragraph 8d of this document.
2. Change the signature block of paragraph H113 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
3. In paragraph H113e, insert the specific Special Terminal Instrument Approach Procedure authorized.
4. Print paragraph H113 in final form.

Present the documents to the operator for acceptance, and recover the existing documents.

End of Instructions.

U.S. Department of Transportation
Federal Aviation Administration
Form Approved
OMB No. 2120-00028

Operations Specifications

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*37. OPERATIONS IN CENTRAL EAST PACIFIC (CEPAC) AIRSPACE--AUTHORIZATIONS AND LIMITATIONS	05/11/95	_____
*38. OPERATIONS IN NORTH PACIFIC (NOPAC) AIRSPACE	05/11/95	_____

*=Authorized in A4

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*=Authorized in A4

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	<u>HQ CONTROL</u>	<u>EFFECTIVE</u>
	<u>DATE</u>	<u>DATE</u>
*38. OPERATIONS IN NORTH PACIFIC (NOPAC) AIRSPACE	05/11/95	_____

*=Authorized in A4

B37. Operations in Central East Pacific (CEPAC) Composite Airspace (05/11/95). The certificate holder is authorized to conduct operations in Central East Pacific (CEPAC) airspace (between the State of Hawaii and the 48 contiguous states) where composite separation is applied by ATC, provided the provisions of this paragraph are met. The certificate holder shall not conduct any other operations in this airspace under these operations specifications.

a. Required Navigation Capabilities. The certificate holder shall not takeoff an airplane for flight within CEPAC airspace, where composite separation is applied by ATC, unless at least one of the following navigation capabilities is available and operational:

- (1) Two independent approved Inertial navigation systems.
- (2) Two independent approved Omega navigation systems.
- (3) An approved redundant navigation capability consisting of an independent Inertial navigation system and an independent Omega navigation system.
- (4) An approved Doppler radar navigation system and either an approved Inertial navigation system or an approved Omega navigation system.

- (5) An approved redundant navigation capacity consisting of an independent Global Positioning System (GPS) and either an independent Inertial Navigation System/Inertial Reference System or an Independent Omega navigation system.
-

B38. Operations in North Pacific (NOPAC) Airspace (05/11/95). The certificate holder is authorized to conduct North Pacific (NOPAC) operations within the area of operation authorized in subparagraph a., provided any operation within this area meets the provisions of this paragraph. The certificate holder shall not conduct any other operation within this area of operation under these operations specifications.

a. Authorized Area of Operation. The area of operation authorized by this paragraph lies within the Anchorage and Tokyo FIR's. The southern lateral boundary of this area is 100 NM south of the southernmost route where composite separation is applied, and the northern lateral boundary is the northern boundaries of the Anchorage and Tokyo FIR's. The vertical boundaries include the airspace between the MEA and the MAA.

b. Airborne Weather Radar Limitations/Procedures. The certificate holder shall not takeoff for flight within this area of operation unless airborne weather radar approved for ground mapping, is installed and operational. The certificate holder shall use the radar on a full time basis for monitoring navigational system accuracy and weather avoidance while operating within this area.

c. Required Navigation and Capabilities. The certificate holder shall not takeoff for flight within the authorized area of operation unless at least the following navigation capabilities are available and operational.

(1) For all flights at FL 280 or above, at least one of the following:

(a) Two independent approved Inertial navigation systems.

- (b) Two independent approved Omega navigation systems.
 - (c) An approved redundant navigation capability consisting of an independent Inertial navigation system and an independent Omega navigation system.
 - (d) An approved Doppler radar navigation system and either an approved Inertial navigation system or an approved Omega navigation system.
 - (e) An approved redundant navigation capacity consisting of an independent Global Positioning System (GPS) and either an independent Inertial Navigation System/Inertial Reference System or an independent Omega Navigation System.
- (2) For all flights at FL 270 and below, either of the following conditions must be met:
- (a) The equipment specified in subparagraph c.(1) above is installed and operational.
 - (b) A flight navigator is used with the required navigation equipment specified in paragraph B36b.(1)(a) or B36b.(1)(b).

d. Special Routing Limitations. For westbound flights transitioning to North Pacific routes designated R-220 and R-580, the certificate holder shall accomplish all transitions to these routes via the published oceanic transition routes or published airways.

REFERENCE O4

**FAA ORDER 8400.10
APPENDIX 4 HBAT 95-09**

**Guidelines for Operational Approval of Global
Positioning System (GPS) to Provide the Primary
Means of Class II Navigation in Oceanic and Remote
Areas of Operation**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

1. **PURPOSE.** The purpose of this bulletin is to provide interim guidance to principal operations inspectors in granting operational approval of GPS to provide primary means of Class II navigation in oceanic and remote areas including North Atlantic Minimum Navigation Performance Specification (MNPS) airspace.
2. **BACKGROUND.** The approval of GPS to provide the primary means of Class II Navigation requires equipment approval, installation approval, and operational approval. This HBAT provide inspectors with information on the performance standards, procedures, and operational restrictions for using the GPS as a primary means of Class II navigation and guidance in the process to be used in granting operational approvals for the use of GPS.
4. **DEFINITIONS.**
 - A. **Primary Means of Navigation** - Navigation equipment which provides the only required means on the aircraft of satisfying the necessary levels of accuracy, integrity, and availability for a particular area, route, procedure or operation.
 - B. **Class II Navigation** - Any en route flight operation or portion of an en route operation (irrespective of the means of navigation) which takes place outside (beyond) the designated Operational Service Volume of ICAO standard airway navigation facilities (VOR, VOR/DME, NDB).
 - C. **Fault Detection and Exclusion (FDE)** - Capability of GPS to:
 - (1) detect a satellite failure which affects navigation; and
 - (2) automatically exclude that satellite from the navigation solution.
 - D. **Algorithm** - A step-by-step procedure for solving a problem.

5. GPS EQUIPMENT APPROVAL AND INSTALLATION. The POI must determine that the GPS equipment is approved and installed in accordance with the following.
 - A. GPS EQUIPMENT APPROVAL. The equipment must be approved by the FAA Aircraft Certification Office (ACO) in accordance with Advisory Circular (AC) 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment For Use As A VFR And IFR Supplemental Navigation System; or AC 20-130, Airworthiness Approval of Multi Sensor Navigation Systems for use in the U.S. National Airspace System (NAS) and Alaska; and Notice N8110.57, GPS As A Primary Means of Navigation For Oceanic/Remote Operations.
 - B. INSTALLATION. The applicant must obtain initial installation approval of GPS equipment for primary use on a specific make and model aircraft via the Type Certificate (TC) or the Supplemental Type Certificate (STC) certification process. The FAA Form 337 or forms acceptable to the Administrator for those operators with acceptable engineering organization will be used for the installation of the same GPS equipment in the same make/model aircraft provided the data developed for the initial certification is used.
 - C. AIRCRAFT FLIGHT MANUAL SUPPLEMENT (AFMS). Once the installation has been approved, the AFMS must be updated to state: "The _____ GPS equipment as installed has been found to comply with the requirements for GPS primary means of Class II navigation in oceanic and remote airspace, when used in conjunction with the _____ prediction program. This does not constitute operational approval." Detailed requirements for AFMS content are contained in FAA Notice N8110.57.
6. OPERATIONAL APPROVAL. The POI must use the following guidance in granting operational approval.
 - A. TECHNICAL/OPERATIONAL ASSISTANCE: POIs should contact one of the FAA Navigation Specialists to obtain assistance. The contacts are:
 - (1) David Maloy: New York City Flight Standards District Office (NYC.FSDO); phone (516) 228-8033 (ext. 229); and

- (2) Anderson Davie: San Francisco International Field Office (SFO.IFO); phone (415) 876-2771.
- B. TRAINING AND MANUALS: (Reference: FAR Part 121, Subpart N, and FAA Order 8400.10, Volume 3, Chapter 2). Crew training must be modified to include modules that ensure crews are familiar with navigation equipment operations, data base updating procedures, pre-departure procedures, standard en route procedures, and contingency procedures.
- C. CREW QUALIFICATION: (Reference: FAR Part 121, Subpart O, and FAA Order 8400.10, Volume 3, Chapter 2). The required flight crew must have received training in the use of dual GPS as the only means of long-range navigation when completing PIC/SIC Initial New Hire and Initial Equipment Flight Training or when completing the latest Recurrent Training.
- D. PRE-DEPARTURE PROCEDURES. POI's must ensure that the following policies and procedures are incorporated into pilot and where appropriate, dispatcher training/qualification programs and manuals:
- (1) FDE AVAILABILITY PREDICTION PROGRAM. All operators conducting GPS primary means of Class II navigation in oceanic/remote areas under FAR Parts 91, 121, 125 and 135 must utilize an FAA-approved FDE prediction program for the installed GPS equipment that is capable of predicting, prior to departure, the maximum outage duration of the loss of fault exclusion, the loss of fault detection, and the loss of navigation function for flight on a specified route. The "specified route of flight" is defined by a series of waypoints (to include the route to any required alternates) with the time specified by a velocity or series of velocities. Since specific ground speeds may not be maintained, the pre-departure prediction must be performed for the range of expected ground speeds. This FDE prediction program must use the same FDE algorithm that is employed by the installed GPS equipment and must be developed using an acceptable software development methodology (e.g., RTCA/DO-178B). The FDE prediction program must provide the capability to designate manually satellites that are scheduled to be unavailable in order to perform the prediction accurately. The FDE prediction program will be evaluated as part of the navigation

system's installation approval. The requirements for the FDE prediction algorithm can be found in FAA Notice N8110.57.

(2) OPERATIONAL CONTROL RESTRICTIONS:

- (i) Any predicted satellite outages that affect the capability of GPS equipment to provide the navigation function on the specified route of flight requires that the flight be canceled, delayed, or rerouted. (See paragraph 5D(3)).
- (ii) If the fault exclusion capability outage (exclusion of a malfunctioning satellite) exceeds the acceptable duration on the specified route of flight, the flight must be canceled, delayed, or rerouted. (See paragraph 5D(4)).

(3) DETERMINATION OF THE CAPABILITY TO NAVIGATE. Prior to departure, the operator must use the FDE prediction program to demonstrate that there are no outages in the capability to navigate on the specified route of flight (the FDE prediction program determines whether the GPS constellation is robust enough to provide a navigation solution for the specified route of flight).

(4) DETERMINATION OF AVAILABILITY OF EXCLUSION. Once navigation function is assured (the equipment can navigate on the specified route of flight), the operator must use the FDE prediction program to demonstrate that the maximum outage of the capability of the equipment to provide fault exclusion for the specified route of flight does not exceed the acceptable duration (fault exclusion is the ability to exclude a failed satellite from the navigation solution). The acceptable duration (in minutes) is equal to the time it would take to exit the protected airspace (one-half the lateral separation minimum) assuming a 35-nautical mile per hour cross-track navigation system error growth rate when starting from the center of the route. For example, a 60-nautical mile lateral separation minimum yields 51 minutes acceptable duration (30 nautical miles divided by 35 nautical miles per hour). If the fault exclusion outage exceeds the acceptable duration, the flight must be canceled, delayed, or rerouted.

- E. EN ROUTE PROCEDURES. POIs must ensure that the following policies and procedures are incorporated into pilot and where appropriate, dispatcher training/qualification programs, and manuals:
- (1) **DEGRADED NAVIGATION CAPABILITY.** If the GPS displays a loss of navigation function alert, the pilot should immediately begin using dead reckoning procedures until GPS navigation is regained. The pilot will report degraded navigation capability to Air Traffic Control (ATC) in accordance with FAR Section 91.187. Additionally, flight crew members operating under FAR Part 121 will notify the appropriate dispatch or flight following facility of any degraded navigation capability in accordance with the air carrier's FAA approved procedures.
 - (2) **SATELLITE FAULT DETECTION OUTAGE.** If the GPS displays an indication of a fault detection function outage (Receiver Autonomous Integrity Monitoring (RAIM) is not available), navigation integrity must be provided by comparing the GPS position with a position computed by extrapolating the last verified position with true airspeed, heading, and estimated winds. If the positions do not agree to within 10 nautical miles, the pilot should immediately begin using dead reckoning procedures until the exclusion function or navigation integrity is regained and report degraded navigation capability to ATC in accordance with FAR Section 91.187.
 - (3) **FAULT DETECTION ALERT.** If the GPS displays a fault detection alert (failed satellite), the pilot may choose to continue to operate using the GPS-generated position if the current estimate of position uncertainty displayed on the GPS from the FDE algorithm is actively monitored. If this number exceeds 10 nautical miles or is to available, the pilot should immediately begin using dead reckoning procedures until the failed satellite is excluded and report degraded navigation capability to ATC in accordance with FAR Section 91.187.

7. APPROVAL FOR OPERATION IN NORTH ATLANTIC
MINIMUM NAVIGATION PERFORMANCE SPECIFICATIONS
AIRSPACE.

- A. Until further notice, the Pass/Fail graphs contained in AC 120-33 should be used to confirm the operator's capability to meet the requirements of FAR Section 91.705. The FAA Navigation Specialists will provide guidance on process and procedures for the Pass/Fail graphs and aid the POI in determining whether Figure 2 or Figure 3 should be utilized. The operator is not required to collect navigation performance data in NAT MNPS AIRSPACE to apply to the Pass/Fail graphs.

8. VALIDATION TESTS.

- A. GENERAL. Validation Tests are required. Such tests may consist of a single flight or series of flights. The following references are provided:
- (1) FAR Sections 121.93, 121.113, 135.13(a)(2).
 - (2) FAA Order 8400.10:
 - (i) Volume 3, Chapter 9, Section 8
 - (ii) Volume 4, Chapter 1, Section 2
- B. PROGRAM/DOCUMENT EVALUATION. As an element of the evaluation process, the POI should ensure that operator training programs and manuals contain the policies and procedures detailed in paragraph 5 of this HBAT. (See FAA Order 8400.10, Volume 4, Chapter 1, Section 2).
- C. TECHNICAL SUPPORT. It is recommended that, whenever possible, one of the FAA Navigation Specialists participate in the validation of operator programs and procedures for use of GPS as the primary means of Class II navigation.
- D. FLIGHT(S) REQUIRED FOR VALIDATION TESTS.
- (1) GENERAL. The following is intended to provide broad guidance for the development of GPS/Class II navigation validation tests. The POI should consider each application

on its own merit and apply judgment when developing validation test requirements. The POI should communicate the objective, duration and number of validation test flights required to the operator during Phase One of the approval process (see FAA Order 8400.10, Volume 4, Chapter 1, Section 2).

- (2) OPERATOR WITHOUT PREVIOUS CLASS II NAVIGATION EXPERIENCE. If an operator is requesting approval to conduct Class II Navigation with GPS, but has no previous experience in conducting Class II navigation, then the operator must conduct at least one flight in the Class II area of navigation where it intends to operate. This flight must be conducted as a non-revenue operation with the exception that cargo may be carried.
- (3) OPERATOR WITH PREVIOUS CLASS II NAVIGATION EXPERIENCE. If an operator is requesting approval to conduct Class II Navigation with an aircraft/GPS equipment combination with which it has not previously conducted Class II operations, the operator should be required to conduct a validation test flight(s). If the flight(s) is conducted in a Class I navigation area to simulate operation in a Class II Navigation area, then the flight(s) may be conducted in revenue operations. If the flight is conducted in a Class II Navigation area, then it must be conducted as a non-revenue flight with the exception that cargo may be carried.
- (4) CONDITIONS OF VALIDATION TEST FLIGHTS. The following conditions apply to validation test flights:
 - (i) At least one flight should be observed by an FAA aviation safety inspector.
 - (ii) Dispatch procedures must be demonstrated for the Class II Navigation area(s) where operations are intended to be conducted.
 - (iii) The flight(s) should be of adequate duration for the pilots to demonstrate knowledge of dispatch requirements, capability to navigate with the system, and to perform normal and non-normal procedures.

- (5) POLICY DEVIATIONS. Requests to deviate from this policy should be forwarded to AFS-430, FAA National Headquarters, Washington, DC, for consideration.
9. ISSUANCE OF OPERATION SPECIFICATIONS: Operation specifications authorizing flight in Class II airspace using GPS as the only means of Long-Range Navigation must be issued or modified, as appropriate, prior to any air carrier operations being conducted in the Class II airspace. The operation specification paragraphs must be issued as indicated in Appendix 1 to this HBAT.
10. INQUIRIES. This HBAT was developed jointly by AFS-200 and AFS-400. Any questions or comments concerning the information in this bulletin should be directed to AFS-200 at (202) 267-7579 or AFS-400 at (202) 267-3734.
11. EXPIRATION. This HBAT will expire when incorporated into FAA Order 8400.10.

/s/

David R. Harrington

Appendix 1

1. Issuance of En Route Authorization for Use of only a Single GPS for Class II Navigation.

Note: This authorization may only be issued for operations in the Caribbean Sea, Gulf of Mexico, the Atlantic Ocean west of MNPS airspace, and for Special Contingency Routes in MNPS airspace.

- a. Log on to the subject's Operation Specifications (OpSpecs) in the Flight Standards Automation Subsystem (FSAS), Operation Specifications Subsystem (OPSS).
- b. Mark the Operation Specification checklist to check the appropriate block. Paragraph B36 requires Question 4c and (5n or 5o) to be checked, as appropriate.

- c. In paragraph B36, subparagraph a(1), insert the aircraft make, make, and model of GPS receiver.
 - d. Change the signature block of paragraph B36 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
 - e. In paragraph B50, access the Limitations, Provisions, and Reference Paragraphs, for the Caribbean Sea, Gulf of Mexico, Atlantic Ocean West of MNPS airspace, and/or for Special Contingency Routes in MNPS airspace, as applicable, and enter the following statement adjacent to the existing referenced paragraphs:

“CLASS II NAVIGATION WITH THE APPROVED SINGLE GPS LISTED IN PARAGRAPH B36(1) IS LIMITED TO THIS SPECIFIC GEOGRAPHIC AREA.”
 - f. Change the signature block of paragraph B50 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number to reflect the next sequential number.
 - g. Print paragraphs B36 and B50 in final form.
 - h. Present the documents to the operator for acceptance, and recover the existing documents.
2. Issuance of En Route Authorization for Use of a Dual GPS System as the Only Long-Range System for Class II Navigation.
- a. Log on to the subject’s OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operation Specifications Subsystem (OPSS).
 - b. Mark the Operation Specifications checklist to check the appropriate block. Paragraph B36 requires Question 4c and (5n or 5o) to be checked, as appropriate.
 - c. In paragraph B36, subparagraph a(1), insert the aircraft make and the makes and models of GPS receivers.

d. Change the signature block of paragraph B36 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.

e. Print paragraph B36 in final form.

f. Present the documents to the operator for acceptance, and recover the existing documents.

3. Issuance of En Route Authorization for Use of GPS in North Atlantic Minimum Navigation Performance Standards (MNPS) Airspace.

Note: This authorization may only be used if en route authorization for use of dual GPS for Class II Navigation has been issued as described in paragraph 2 of these instructions.

a. If unrestricted routing is to be authorized:

- (1) Log on to the subject's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operation Specifications Subsystem (OPSS).
- (2) Mark the Operation Specification checklist to check the appropriate block. Paragraph B39 requires question 4a and 4c, checked, 5k checked and 5n or 5o checked, as appropriate.
- (3) Change the signature block of paragraph B39 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- (4) In paragraph B39, subparagraph c, insert the aircraft make and the makes and models of both GPS receivers.

Note: Normally operators receiving authorization under paragraph B39c should also receive authorization in paragraph B39d for ferry and contingency purposes.

b. If restricted routing over special contingency routing:

- (1) Log on to the subject's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operation Specifications Subsystem (OPSS).
- (2) Change the signature block of paragraph B39 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- (3) In paragraph B39, subparagraph d, insert the aircraft make, and the make and model of GPS receiver.
- (4) Print paragraph B39 in final form.
- (5) Present the documents to the operator for acceptance, and recover the existing documents.

4. Issuance of En Route Authorization for Use of GPS in Areas of Magnetic Unreliability.

- a. Log on to the subject's OpSpecs in the Flight Standards Automation Subsystem (FSAS), Operation Specifications Subsystem (OPSS).
- b. Using the "Additional Text" feature for paragraph B40, insert the aircraft make and the makes and models of GPS receivers in the navigation equipment table.
- c. Change the signature block of paragraph B40 to reflect the Effective Date anticipated for paragraph approval. Change the Amendment Number field to reflect the next sequential number.
- d. Print paragraph B40 in final form.
- e. Present the documents to the operator for acceptance, and recover the existing documents.

REFERENCE O5

**FAA ORDER 8400.10
APPENDIX 3 FSAT 94-04**

**Certification of the Operational Use
of the U.S. Navstar Global Positioning
System (GPS)**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

3. **GENERAL REQUIREMENTS.** Authorization to conduct any GPS operation under IFR requires the following:

- A. The GPS avionics equipment used must be approved in accordance with the requirements specified in technical standards order (TSO) C-129, or equivalent, and the installation must be made in accordance with Notice 8110.47 or 8110.48, the equivalent advisory circular or the Flight Standards/Aircraft Certification (AFS/AIR) joint guidance memorandum dated July 20, 1992. Equipment approved to TSO C-115A does not meet the requirements of TSO C-129.
- B. Aircraft using GPS equipment under IFR must be equipped with an approved and operational alternate means of navigation appropriate to the flight. Active monitoring of the alternative navigation equipment is not required if the installation uses receiver autonomous integrity monitoring (RAIM) for integrity monitoring.

For these systems, active monitoring by the flight crews is only required when the RAIM capability of the GPS equipment is lost.
- C. Pilots must be aware of the procedures to be used in the event that the loss of RAIM capability is predicted to occur. When the loss of RAIM capability is predicted, a pilot must rely on the other approved equipment, delay the departure of the flight, or cancel the flight.
- D. The GPS operation must be conducted in accordance with the FAA-approved aircraft flight manual (AFM) or flight manual supplement (if required).
- E. Aircraft navigation under IFR by GPS is considered to be area navigation (RNAV), therefore, the appropriate equipment suffix (/R) must be included in the air traffic control (ATC) flight plan.

- F. Prior to any GPS IFR operation, the pilot should review the appropriate NOTAMs. NOTAMs will be issued to announce outages for specific GPS satellites. Pilots may obtain these NOTAMs from Flight Service Station (FSS) briefs upon request.
- G. Air carrier and commercial operators conducting GPS IFR operations shall meet the appropriate provisions of their approved operations specifications (OpSpecs). Instructions for issuance of OpSpecs authorizing use of GPS will be issued in a forthcoming bulletin.

4. **GPS OPERATIONS.** Provided the general requirements of this bulletin are met, GPS IFR operations in oceanic areas can be conducted as soon as the proper avionics systems are installed. Operations in special use air space (for example, MNPS) require either a letter of authorization (LOA) or OpSpecs authorizing a flight into and within that airspace using GPS equipment. A GPS installation with TSO C-129 authorization in class A1, A2, B1, B2, C1, or C2 may be used to replace or supplement one of the other approved means of long-range navigation, such as one unit of dual INS or one unit of dual Omega system. A single GPS installation with these classes of equipment that provides RAIM for integrity monitoring may also be used on short oceanic routes which have only required one means of long-range navigation.

Provided the general requirements of this bulletin are met, GPS domestic en route and terminal IFR operations can be conducted as soon as the proper avionics systems are installed. The avionics necessary to receive all of the ground-based facilities appropriate for the route to the destination airport and any required alternate airport must be installed and operational. The ground-based facilities necessary for these routes must also be operational.

The GPS Approach Overlay Program permits pilots to use GPS avionics under IFR for flying existing nonprecision instrument approach procedures, except localizer (LOC), localizer directional aid (LDA) and simplified directional facility (SDF) procedures. In the future, stand along GPS approaches will be developed and introduced into the National Airspace System (NAS).

GPS IFR approach operations can be conducted in accordance with Phase I, Phase II, or Phase III of the GPS Approach Overlay Program, as appropriate, as soon as the proper avionics systems are installed and the following requirements are met. This general

approval to use GPS to fly instrument approaches is limited to U.S. airspace. The use of GPS in any other airspace must be expressly authorized by the Administrator. GPS instrument approach operations outside the United States must also be authorized by the appropriate sovereign authority.

5. EQUIPMENT AND DATABASE REQUIREMENTS.

Authorization to fly approaches under IFR using GPS avionics systems requires the following:

- A. That the GPS avionics in use have TSO-C129 authorization in class A1, B1, B3, C1, or C3 (classes are defined in FAA Order 8700.1, Chapter 222, Change 10), and
- B. The specific approach procedure to be flown must be retrievable from the airborne navigation database associated with the TSO C-129 equipment.

NOTE: GPS avionics systems installed and operated in accordance with the AFS/AIR guidance dated July 20, 1992 are not approved for “overlay” program phase II or III.

6. PHASES OF THE APPROACH OVERLAY PROGRAM. In each of the following phases, any required alternate airport must have an approved instrument approach procedure that is anticipated to be operational and available at the estimated time of arrival. This approved instrument approach procedure must be one other than a GPS or Loran-C procedure.

- A. PHASE I. Under Phase I, GPS avionics can be used as the IFR flight guidance system for approaches as long as the ground-based nav aids required by the published procedure are operational and actively monitored while conducting the approach. Approach clearances must be requested and approved using the published title of the existing approach procedure such as “VOR Rwy 24.”
- B. PHASE II. Under Phase II, effective 2/17/94, GPS avionics can be used as the IFR flight guidance system for an approach without actively monitoring the ground-based nav aids that define the approach. However, the ground-based nav aids must be operational. In addition, the related avionics must be installed and operational but need not be turned-on during the approach.

Approaches must be requested and approved using the published title of the existing approach procedure, such as “VOR Rwy 24.”

- C. PHASE III. Phase III begins when FAR Part 97 instrument approach procedures are retitled “GPS of VOR Rwy 24.” When this phase begins, ground-based navaids are not required to be operational and the associated aircraft avionics need not be installed, operational, turned-on, or monitored. GPS approaches will be requested and approved using the GPS title, such as “GPS Rwy 24.” Pending the FAA’s publication of FAR Part 97 GPS approaches, stand-alone GPS approaches will be developed and authorized on a case-by-case basis.

7. **INQUIRIES.** Questions concerning this bulletin may be directed to James J. Crowling, Jr., AFS-430, at (202) 267-8452.

8. **EXPIRATION DATE.** This bulletin will remain in effect until canceled by this office.

/s/
Edgar C. Fell

REFERENCE O6

FAA ORDER 8400.11

**IFR Approval for
Differential Global Positioning System (DGPS)
Special Category I Instrument Approaches Using
Private Ground Facilities**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

CHAPTER 4. RESPONSIBILITIES AND PROCEDURES

4-1. ACTIONS, RESPONSIBILITIES, AND PROCEDURES

All special privately owned ground installations and all airborne installations used to conduct DGPS instrument approach operations shall be evaluated and approved in accordance with the interim national criteria contained in this order. Special private use DGPS ground installations shall be approved, if the requirements of this order are met, for use by U.S. and qualified foreign flag operators to fly DGPS instrument approaches. The responsibilities of AVR, the Associate Administrator for Airway Facilities (AAF), and Associate Administrator for Aviation Standards (AVS) organizations and the actions necessary to initially implement special private use DGPS instrument approach operations are as specified herein.

- a.** Until national criteria for routine approval of DGPS Category I instrument approach operations is established, all requests to establish a DGPS Category I instrument approach operation, or approve an operator to conduct these instrument approaches, shall be forwarded to the Flight Standards' Technical Programs Division, AFS-400 through the regional Flight Standards Division.

- e. DGPS Ground Facility Evaluations.** The regional Airway Facilities Divisions are responsible for evaluating DGPS ground facilities in the United States. The evaluation criteria for facilities in the United States is specified in this order. The evaluation process for these facilities are specified in FAA Order 6700.20A and the RTCA DGNSS MASPS. AFS is responsible for evaluating DGPS ground facilities outside the United States. The Principal Avionics Inspector for the air carrier or the FSDO assigned the FAR Part 91 operator shall designate an avionics specialist to evaluate and recommend approval of the special private use DGPS ground facilities outside the United States. Results of the facility evaluation shall be forwarded to AFS-400 through the regional

Flight Standards Division. During the evaluation of DGPS ground facilities outside the United States, inspectors may consult with FAA Aircraft Certification, Flight Standards' Aircraft Evaluation, or Airway Facilities' personnel at their option. Any deviations from the DGPS Operational Service Volume requirements specified in Appendix 4 of this order shall be approved by AFS-400.

h. Evaluation and Approval. Upon receiving an initial request from an operator to conduct DGPS Category I operations, the Certificate Holding District Office (CHDO) or FSDO shall assure that the operator is provided sufficient information to comply with the requirements of this order. The following evaluation and approval procedures should be followed:

- (1) Coordination.** Coordination with AFS-400 and the regional Flight Procedures Branch should begin concurrently with the beginning of approval activity. After receiving an operator's request, the CHDO or FSDO shall, as soon as possible, initiate coordination with the regional Flight Procedures Branch in order that they may determine the procedural requirements and coordinate flight inspection schedules. AFS-400 shall also be notified through the regional Flight Standards Division. The CHDO or FSDO is responsible for the coordination process specified for Special Instrument Approach Procedures in FAA Orders 8260.19 and 8400.10.
- (2) Type Acceptance.** The Associate Administrator for Airway Facilities, AAF-1, is the type acceptance approval authority for LDGPS ground facilities in the United States.
- (3) Airborne System Evaluation.** The responsible Aircraft Certification Office (ACO), in coordination with the appropriate Aircraft Evaluation Group (AEG), shall assure that the airborne equipment performs its intended function and meets the requirements of the RTCA DGNSS MASPS and this order for DGPS Category I instrument approach operations. This airworthiness certification does not constitute authority for an operator to conduct DGPS operations.
- (4) Ground System Evaluation.** For DGPS ground facilities in the United States, the responsible regional Airway Facilities Division shall assure that the ground station equipment is properly installed, performs its intended function, and meets all applicable provisions of this order and the RTCA DGNSS

MASPS. Successful completion of the ground system evaluation is required prior to commissioning flight inspection. For DGPS ground facilities outside the United States, AFS is responsible for this evaluation.

- (5) **Evaluation.** The CHDO or FSDO shall assure that the DGPS ground facility and the airborne system to be used have been properly approved IAW Chapter 7, Section 1 (h) and Chapter 8, Paragraph 1(a) of this order and that maintenance and operating manuals, schedules, and record keeping programs have been established.
- (7) **Continuing Compliance.** For DGPS ground facilities in the United States, the responsible regional Airway Facilities Division shall perform the required periodic facility technical inspections, and assure that the sponsor complies with the Operations and Maintenance Manual (OMM) and the Memorandum of Agreement (MOA) for operation of DGPS ground installation. For DGPS ground facilities outside the United States, the CHDO or FSDO shall assure that the sponsor initially complies and continues to comply with the requirements of Chapters 6 and 9 of this order. The sponsor's approval to use a particular DGPS ground facility to conduct DGPS operations shall be withdrawn if there is evidence of noncompliance.

CHAPTER 8. APPROVAL OF DGPS SPECIAL CATEGORY I OPERATIONS

8-1. APPROVAL TO CONDUCT DGPS SPECIAL CATEGORY I INSTRUMENT APPROACHES

The authority for a civil operator to use an FAA approved special private use DGPS ground facility to conduct DGPS instrument approaches shall be obtained from AFS. Approval to use a special private use DGPS ground installation is only issued to persons operating under FAR Part 91, 121, 125, 129, or 135.

- a. **Application.** To obtain approval to conduct DGPS Category I Special Instrument Approach Procedures, air carriers or FAR Part 91 operators shall submit to the CHDO or the assigned FSDO, respectively, a letter of application. The application shall

document the operators ability to safely conduct DGPS Category I operations. The application shall also provide documentation for the following items:

- (1) Avionics.** Documentation shall be provided which validates approval of the installed DGPS airborne system in accordance with AC 20-138 and AC 20-130A, Chapter 7 of this order, and other applicable airworthiness criteria established for DGPS Special Category I instrument approach operations. Specific airborne equipment availability requirements are not necessary for DGPS Special Category I instrument approach operations as long as the aircraft has the capability to continue the flight to any required alternate airport in the event of DGPS failure or service interruption. The applicant shall, however, perform an analysis using the data obtained in Chapter 5 or 6, as applicable, to demonstrate that 95% system availability (excluding the availability of avionics; i.e., assuming avionics availability of 100%) over a 24-hour continuous period is achieved. This analysis shall be performed for every location for which a DGPS Special Category I operation is intended. If this DGPS availability level of 95% is not met, the applicant shall demonstrate that the methods to be used to predict system unavailability and to notify the flight crew will result in an unpredicted unavailability of no more than 5%. Information regarding predicted unavailability shall be provided to the flight crew as required in Chapter 8 of this order.
- (2) Initial Installation and Continued Airworthiness.** The operator shall assure that the airborne equipment is installed and maintained. Also, the operator shall present evidence that the DGPS ground facility to be used is properly installed, maintained, and FAA approved for the operation to be conducted. No special requirements unique to GPS/DGPS, other than the standard practices currently applicable to navigation or landing systems, have been identified.

 - (a)** The operator's manuals, policies, and procedures shall incorporate the manufacturer's instructions for initial installation (TC/STC) and Instructions for Continued Airworthiness, or equivalent criteria, for the applicable GPS/DGPS airborne system.
 - (b)** Revisions should be made to the Master Minimum Equipment List (MMEL), Minimum Equipment List

(MEL), Maintenance Review Board (MRB), Configuration Deviation List (CDL), and dispatch deviation procedures to incorporate the GPS/DGPS equipment, as appropriate.

- (3) Pilot Training and Qualification.** The application shall document the proposed pilot training and qualification program. This program shall address at least the following training and qualification requirements:
- (a)** Crew training and qualification for DGPS Category I instrument approach operations should be consistent with the qualifications required for the use of ILS, VOR/DME, RNAV, and multi-sensor RNAV (FMS) systems in FAA Orders 8400.10 and 8700.1, FAA AC 120-53, and FAR Parts 61, 91, 121, 125, 129, and 135, and Special Federal Aviation Regulation (SFAR) 58. Although these standards do not specifically address DGPS systems, the principles are appropriate for DGPS operations and the criteria can be used to evaluate crew knowledge, procedures, checking, and recency or experience, until other criteria are available. No special crew qualification requirements, other than those necessary for RNAV and ILS instrument approach qualification, are currently specified for DGPS Category I approaches.
 - (b)** Ground training shall assure that each flight crew member has the knowledge required for the DGPS Special Instrument Approach Procedures to be flown. FAR Part 121, 125, and 135 operators shall successfully complete an FAA approved training curriculum segment for DGPS Category I operations, as applicable. The ground training should include at least the following subjects: principles of DGPS navigation; limitations of the DGPS equipment; specific operating techniques and procedures to be used with the equipment, including accuracy checks; and contents of the operations specifications. Field Inspector information and guidance will be made available on the Flight Standards Information Board pending updated guidance being included in future revisions of the inspector handbooks.
 - (c)** Initial qualification, continuing qualification, and requalification flight training shall assure that each flight

crew member has the knowledge, skills, and abilities necessary to safely conduct the proposed operations. Flight crew members of all FAR 121, 125, 129, and 135 operators shall successfully complete the operator's approved DGPS Category I flight training program, as appropriate.

- (d) Accomplishment of DGPS instrument approaches may be credited for recency of experience, if proper approval is obtained, for other equivalent types of required approaches. DGPS Category I approaches may be substituted for precision approaches.
- (4) **Operational Procedures.** The operator shall establish operational procedures which are compatible with its DGPS Category I capabilities and limitations.
- (a) "Before Departure Procedures" should specify how a crew will determine that the required DGPS approaches can be conducted at the takeoff airport (for an emergency return) and at the destination airport. A means shall be provided to evaluate, prior to departure, the airplane's capability to execute the planned operation. Procedures shall be established which prohibit the use of an airport as a required alternate airport if the only suitable instrument approach at that airport is a DGPS approach or a Loran-C.
 - (b) A procedure shall be established for the flight crew (and dispatcher, if applicable) to determine, prior to departure and inflight, that all required DGPS approaches will be available at the destination airport.
- (5) **Maintenance Program.** An acceptable maintenance program, documented in the operator's maintenance manual, shall be provided for the DGPS airborne system. Selected minimum contents of this manual are provided in Appendix 2 of this order.
- (6) **Accuracy and Reliability Data.** Sufficient operational/maintenance data will be collected to evaluate that the DGPS airborne system is operationally accurate and reliable.

(7) **Obstacle and Airport Data.** If the runway is not currently served by an instrument approach, the operator may also be required to provide the charts, airport layout plans, and other data required to perform obstruction clearance studies and formulate the Instrument Approach Procedure.

b.FAR Part 91 Operations. FAR Part 91 operators shall obtain a Letter of Authorization prior to conducting any DGPS special instrument approach operation. This Letter of Authorization shall specify the applicable DGPS Authorizations, Privileges, Limitations, and any required training and procedures. It shall also list the specific DGPS Special Instrument Approach Procedures authorized. The letter of application for this authorization should be submitted to the assigned FSDO.

(1) To obtain approval to fly DGPS Special Category I instrument approach operations, each applicant shall demonstrate, during a special practical test, the ability to conduct the type(s) of DGPS instrument approach(es) requested. All DGPS evaluations and approvals shall be accomplished in accordance with this order. The DGPS authorization for all FAR Part 91 operators shall be renewed on an annual basis.

c. FAR Part 121, 125, 129, and 135 Operators. To obtain approval, each operator shall demonstrate its ability to conduct the type(s) of DGPS operations requested for each aircraft type and DGPS equipment type used. This demonstration is required to assess the operator's training program and validate the performance of the DGPS equipment used. All evaluations and approvals shall be accomplished in accordance with this order. These operators should apply to the CHDO for original issuance or amendment to specifications authorizing DGPS Category I operations, as applicable.

The Automated Operations Specification Program and checklist does not facilitate including GPS and DGPS Category I instrument approaches operations in operations specification's paragraphs C52 for aircraft and H102 for rotorcraft. A new paragraph, Number C52-1 or H102-1, as appropriate, shall be added. Paragraphs C64e for aircraft and H114e for rotorcraft shall also be amended to include the specific Special Instrument Approach Procedures that are authorized to be conducted using DGPS. Until the Automated Operations Specification Program and checklist are changed to specifically address GPS and DGPS

operations, the following shall be added as paragraph C52-1 or paragraph H102-1, as applicable:

“The operator is authorized to conduct, in accordance with the authorizations, provisions, and limitations in these operations specifications, the following additional instrument approach operations. The certificate holder shall not conduct any other GPS or DGPS instrument approach operations under these operations specifications.

- a. The certificate holder is authorized to use GPS to conduct VOR, VOR/DME, NDB, and NDB/DME instrument approach operations.
- b. The certificate holder is authorized to conduct DGPS Category I instrument approach operations.”

d. Approval. The approval and any necessary limitations, conditions, and procedures are specified in operations specification or a Letter of Authorization issued to the operator, as appropriate. DGPS instrument approach operations are limited to those airports and runways on the national AFS-400 approved list. Therefore, approvals for a particular operator to conduct DGPS Category I operations are limited to those airports and runways and the aircraft/avionics types on the approved list. Processing and final approval of DGPS Special Category I Instrument Approach Procedures shall be coordinated with AFS-400 in accordance with this order and FAA Order 8260.19. Upon determining that the applicant meets the requirements of this order, and with the concurrence of AFS-400 and the regional Flight Standards Division, the FSDO or CHDO is authorized to issue the following:

- (1) **Letter of Authorization.** A Letter of Authorization can be issued to FAR Part 91 operators. A sample Letter of Authorization is provided in Appendix 3 of this order.
- (2) **Operations Specifications.** Operations specification can be issued to FAR Parts 121, 125, 129, and 135 operators. The operations specifications approval shall be issued in accordance with FAA Orders 8400.10, Volume IV, Chapter 2, Sections 1 through 4, and 8410.1A, Chapters 4 and 8, paragraph 190.

REFERENCE O7

ADVISORY CIRCULAR 90-94

**Guidelines for Using Global Positioning System
Equipment for IFR En Route and Terminal Operations
and For Nonprecision Instrument Approaches in the
U.S. National Airspace System**

SECTION 1. GENERAL.

1. BACKGROUND.

Satellite navigation systems provide global navigation that fully meets the civil aviation requirements for use as the primary means of navigation. Developments in satellite technology and its use for aircraft navigation are such that it may be expected that several satellite navigation systems will evolve in the future, each with its own unique characteristics. The International Civil Aviation Organization (ICAO) has adopted "Global Navigation Satellite System (GNSS)" as an umbrella term to identify any satellite navigation system where the user performs onboard position determination from satellite information. When this Advisory Circular (AC) was written, only two systems had filed with the International Frequency Registration Board (IFRB): the Global Positioning System (GPS) developed by the United States and the Global Orbiting Navigation Satellite System (GLONASS) now under development by the Federation of Russia. This AC provides guidance for the use of satellite navigation in the U.S. National Airspace System (NAS) and oceanic navigation. The terminology and guidelines are limited to the U.S. developed GPS technology. This document does not address the use of other GNSS systems in the U.S. NAS, nor the use of GPS in other civil aviation authority airspace.

2. SYSTEM DESCRIPTION.

GPS consists of three distinct functional elements: space, control, and user. GPS utilizes range measurements from the satellites to determine a position anywhere in the world.

- a. The space element consists of 24 Navstar satellites. This group of satellites is called a constellation. The satellites are in six orbital planes (with four in each plane) at about 11,000 miles above the earth. At least four satellites are in view at all times. The GPS constellation broadcasts a pseudo-random code timing signal and data message that the airborne equipment processes to obtain satellite position and status data. By knowing the precise location of each satellite and precisely matching timing with the atomic clocks on the satellites, the airborne receiver can accurately measure the time each signal takes to arrive at the receiver and, therefore, determine aircraft position.

- b. The control element consists of a network of GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks. In its present form, it has five monitoring stations, three ground antennas, and a master control station.
- c. The user element consists of antennas and receiver-processors onboard the aircraft that provide positioning, velocity, and precise timing to the user.
- d. A minimum of three satellites must be in view to determine lateral guidance (2D position). Four satellites must be in view to provide both lateral and vertical guidance (3D position).

3. GPS IN THE NATIONAL AIRSPACE SYSTEM (NAS)

- a. General. GPS Instrument Flight Rules (IFR) operations for en route (oceanic and domestic), terminal, and nonprecision approach phases of flight can be conducted when GPS avionics approved for IFR are installed in the aircraft. This equipment should be installed in accordance with AC 20-138 and the provisions of the applicable Approved Flight Manual (AFM) or Flight Manual supplement should be met. The required integrity for these operations is provided by Receiver Autonomous Integrity Monitoring (RAIM), or an equivalent method. For air carrier operations, operations specification approval is required to use GPS.
- b. Oceanic En Route. Aircraft using GPS equipment under IFR must be equipped with an approved and operational alternate means of navigation (such as VOR, NDB, or an approved long range navigation system such as Loran or Omega) appropriate for the intended route to be flown. Active monitoring (cross checking) of the alternate equipment is not necessary for installations which use RAIM for integrity monitoring. For these systems, active monitoring by the flight crew is only required when the RAIM capability is lost.

Note: Outside of the National Airspace System (NAS), GPS may be used as a Long Range Navigation System (LRNS). On those routes requiring two long range navigation systems, a GPS installation with TSO C-129 authorization in Class A1, A2, B1, B2, C1, or C2 may be used to replace or supplement one of the other approved means of LRNS's, such as one unit of a dual INS

or one unit of a dual Omega system. On those routes requiring a single LRNS, a GPS unit which provides for integrity monitoring may be used as the LRNS and active monitoring of the alternate equipment is only required when the RAIM capability is lost. GPS may not be approved in other countries. Pilots should ensure that GPS is authorized by the appropriate sovereign state prior to its use within that state.

- c. Domestic En Route. The aircraft must also have navigational equipment installed and operational that can receive the ground-based facilities required for the route to the destination airport and any required alternate. The ground-based facilities necessary for these routes must also be operational. These ground-based systems do not have to be actively used to monitor the GPS avionics unless RAIM failure occurs. Within the contiguous United States, Alaska, Hawaii, and surrounding coastal waters, this requirement may be met with an operational independent VOR, NDB, TACAN, or Loran-C receiver in addition to the GPS system for IFR operation.

Note: GPS may not be approved for IFR use in other countries. Pilots should ensure that GPS is authorized by the appropriate sovereign state prior to its use.

- d. Terminal. GPS IFR operations for the terminal phases of flight, Standard Instrument Departures (SIDs), and Standard Terminal Arrival Routes (STARs) should be conducted the same as existing RNAV procedures dictate. The aircraft also must have navigational equipment installed and operational that can receive all the ground-based facilities appropriate to the route of flight. The ground-based facilities necessary for these routes must also be operational; however, they do not have to be actively used to monitor the GPS avionics unless the RAIM fails.
- e. Approach Overlay Program. To accelerate the availability of instrument approach procedures to be flown using certified GPS equipment, the FAA developed the GPS Approach Overlay Program. This program allows pilots to use GPS equipment to fly existing VOR, VOR/DME, NDB, NDB/DME, TACAN, and RNAV nonprecision instrument approach procedures. The approach overlay program is limited to U.S. airspace. GPS instrument approach operations outside the U.S. must be authorized by the appropriate sovereign state. The purpose of the

approach overlay program is to permit pilots to transition from ground-based to satellite-based navigation technology for instrument approaches. GPS equipment may be used to fly all nonprecision instrument approach procedures that are retrieved from a database, except localizer, localizer directional aid (LDA), and simplified directional facility (SDF) approach procedures. Any required alternate airport must have an approved instrument approach procedure, other than GPS or Loran-C, which is anticipated to be operational at the estimated time of arrival. The approach overlay program consists of three phases. Each phase has specific provisions and limitations as presented below.

- (1) Phase I. This phase ended in February 1994, the date when the FAA declared GPS operational for civil operations.
- (2) Phase II. This phase began on February 17, 1994 when the FAA declared the system suitable for civil operations. Certified GPS equipment can be used as the primary IFR flight guidance to fly an overlay to an existing nonprecision approach without actively monitoring the applicable NAVAID(s) which define the approach being used. However, the underlying ground-based NAVAID(s) required for the published approach must be operational and the associated avionics must be installed and operational. The avionics need not be operating during the approach if RAIM is providing integrity. Pilots can tell that Phase II applies because "GPS" is not included in the title of the approach.
- (3) Phase III. Phase III began April 28, 1994, when the first instrument approach procedures were published to include "or GPS" in the title of the published approach procedure. Neither the aircraft traditional avionics nor the underlying ground station NAVAID(s) need be installed, operational, or monitored to fly the nonprecision approaches at the destination airport. For GPS systems that do not use RAIM for integrity, the ground-based NAVAID(s) and the airborne avionics that provide the equivalent integrity must be installed and operating during the approach. For any required alternate airport, the traditional ground-based and airborne navigational equipment that defines the instrument approach procedure and route to the alternate must be installed and operational.

- f. GPS Stand-Alone Approaches. Stand alone nonprecision approaches, which are not overlaid on an existing approach, are the next step beyond the overlay program. The first stand-alone GPS approaches were published on July 21, 1994. The airborne and ground-based NAVAID requirements are the same for GPS stand alone approaches as for Phase III overlay approaches.
- g. Overlay and Stand-Alone Approaches. There will continue to be a mixture of nonprecision Phase II, Phase III, and GPS stand-alone approaches in the U.S. NAS for some time. Most nonprecision instrument approach procedures in the U.S. (except localizer, LDA, and SDF) are available under Phase II of the overlay program. Eventually, these approaches may become Phase III approaches as they change to include "or GPS" in their titles. Additionally, the FAA will continue to develop and authorize stand alone GPS approaches.

4. GPS EQUIPMENT CLASSES A(), B(), AND C().

GPS equipment is categorized into the following classes:

- a. Class A(). Equipment incorporating both the GPS sensor and navigating capability. This equipment incorporates Receiver Autonomous Integrity Monitoring (RAIM). Class A1 equipment includes en route, terminal, and nonprecision approach (except localizer, localizer directional aid (LDA), and simplified directional facility (SDF)) navigation capability. Class A2 equipment includes en route and terminal navigation capability only.
- b. 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 (except localizer, LDA, and SDF) 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 (except localizer, LDA, and SDF) 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.

c. 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 errors Class C1 equipment includes RAIM and provides en route, terminal, and nonprecision approach (except localizer, LDA, and SDF) 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 (except localizer, LDA, and SDF) 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.

GPS IFR EQUIPMENT CLASSES/CATEGORIES (TSO-C129)						
Equipment Class	RAIM	Integrated Navigation System to Provide RAIM Equivalent	Oceanic	En Route	Terminal	Non-Precision Approach Capable
<i>Class A - GPS sensor and navigation capability</i>						
A1	yes		yes	yes	yes	yes
A2	yes		yes	yes	yes	no
<i>Class B - GPS sensor data to an integrated navigation system (i.e., FMS, multi-sensor navigation system, etc.)</i>						
B1	yes		yes	yes	yes	yes
B2	yes		yes	yes	yes	no
B3		yes	yes	yes	yes	yes
B4		yes	yes	yes	yes	no
<i>Class C - GPS sensor data to an integrated nav. System (as in Class B) which provide enhanced guidance to an autopilot, or flight director, to reduce flight technical errors</i>						
C1	yes		yes	yes	yes	yes
C2	yes		yes	yes	yes	no
C3		yes	yes	yes	yes	yes
C4		yes	yes	yes	yes	no

Figure 1. GPS Equipment Classes

5. GPS SYSTEM ACCURACY/ERRORS.

GPS equipment determines its position by precise measurement of the distance from selected satellites in the system, and the satellites' known location. Accuracy measurements are affected by satellite geometry which multiplies the effect of other errors in the system, slight inaccuracies in the satellite clocks, receiver processing, signal reflections, and predictions of current satellite position that are transmitted to the receiver in the satellite data message.

- a. Selective Availability (SA). A method by which the DOD can artificially create errors in the signals from the satellites. This feature is designed to deny a potential enemy the use of precise GPS positioning data. This is the largest source of error in the GPS system. When SA is active, the DOD guarantees that the horizontal position accuracy will not be degraded beyond 100 meters (328 feet) 95 percent of the time and 300 meters (984 feet) 99.99 percent of the time.
- b. Reducing Errors. The accuracy of GPS position data can be affected by equipment and the satellite geometry being received. Many of these errors can be reduced or eliminated with mathematics and sophisticated modeling provided by the airborne receiver. Other sources of error cannot be corrected.

SECTION 2. AIRBORNE NAVIGATION DATABASES.

1. REQUIREMENT FOR A DATABASE.

To conduct IFR operations using GPS equipment to navigate in the U.S. NAS and oceanic airspace, the aircraft GPS equipment must include an updatable navigation database. That database will support en route and terminal operations; or en route, terminal, and nonprecision instrument approach (except localizer, LDA, and SDF) operations.

- a. Geographic Area of Content. Airborne navigation databases contain data covering the geographic areas where GPS navigation systems have been certified for IFR use. Data may cover large geographic areas or small user-defined areas within the U.S. NAS and related oceanic areas.
- b. Database Description. GPS airborne navigation databases are provided initially by the receiver manufacturer and updated by the manufacturer or a designated data agency. The databases contain records of location information by latitude and longitude to a resolution of 0.01 minutes or better for the area(s) in which IFR operations are approved. The database is user selectable which allows the pilot to make specific selections during flight operations to support navigational needs. The database may also

be user defined in that the information is tailored to the requirements of a user.

Note: Manual entry/update of data in the navigation database shall not be possible. (This requirement does not prevent the storage of "user-defined data" within the equipment.)

- c. Update of Data. Waypoint information is provided and maintained by the National Flight Data Center (NFDC). The data is typically updated at regular intervals such as the internationally agreed upon Aeronautical Information Regulation and Control (AIRAC) cycle of every 28 days.
- d. Geodetic Reference Datum. The GPS equipment derives position information referenced to the World Geodetic System of 1984 (WGS-84). Databases produced for use in the contiguous United States, Alaska, and Hawaii contain coordinates of location information referenced to the North American Datum of 1983 (NAD 83). For this Advisory Circular, coordinates of locations referenced to NAD 83 are compatible with the coordinates of the same locations referenced to WGS-84.

2. EN ROUTE (OCEANIC AND DOMESTIC) AND TERMINAL NAVIGATION.

Navigation databases supporting GPS equipment certified for en route (including en route oceanic and en route domestic) and terminal operations contain, as a minimum, all airports, VORs, VORTACs, NDBs, and all named waypoints and intersections shown on en route and terminal area charts, SIDs, and STARs. The databases incorporate information from the geographic areas of the contiguous United States, Alaska, Hawaii, and surrounding coastal waters including waypoints and intersections for oceanic flight between the United States and Hawaii. For oceanic flights outside the NAS, user selectable data is available for most GPS receivers.

- a. In the terminal area, the database will include waypoints for SIDs and STARs as well as other flight operations from the beginning of a departure to the en route structure or from an en route fix to the beginning of an approach procedure.
- b. All named waypoints are identified with a five-letter alpha character name provided by the NFDC. Waypoints unnamed by

the NFDC, such as a DME fix, are assigned a coded name in the database (refer to the sample approach plates in appendix 1).

- c. Waypoint latitude and longitude coordinates are typically displayed in degrees, minutes, and tenths of minutes or hundredths of minutes. However, this may vary between equipment manufacturers.

3. INSTRUMENT APPROACH PROCEDURE NAVIGATION.

In addition to the data which supports en route and terminal operations, a navigation database that supports GPS overlay nonprecision instrument approaches (except localizer, LDA, and SDF) contains coordinates for the waypoints, fixes, and NAVAIDs published in FAR Part 97, Standard Instrument Approach Procedures. Special instrument approach procedure data may be included at the request of those operators authorized to use the procedures. Data for approach procedures into military airports also may be included if the procedures are available, and authorized for civil operations. In addition, all waypoints to support GPS stand alone approaches are also contained in the database.

4. THE GPS APPROACH OVERLAY PROGRAM.

The navigation database coding should not change during any phase of the GPS Approach Overlay Program, except for modifications necessary to support changing rules and/or technology. Approaches coded into the database are limited to U.S. airspace. Approaches for other airspace will not be included until authorized by the FAA as well as the appropriate sovereign authority. Whether or not an approach is included in the database depends on its codability and flyability using GPS equipment. Therefore, FAR Part 97, military, and special approaches are classified into codable and non-codable nonprecision instrument approaches.

Note: An aircraft is not authorized to fly any IFR approach using GPS unless that instrument approach procedure is retrievable from the navigation database.

- a. Codable Approach Procedures. The navigation database contains latitude and longitude coordinates for waypoints, fixes, and NAVAIDs for those FAR Part 97 civil use, and military, nonprecision approaches considered codable for database purposes

and considered safe to fly by the FAA using normal piloting techniques. Special approaches may be included at authorized user request.

- b. Non-Codable Approach Procedures. Certain FAR Part 97 nonprecision instrument approaches as well as some military and special procedures may present an unresolvable coding situation relating to database or equipment interface constraints. An approach may be determined to be not codable or not flyable by the regulatory agency having jurisdiction (FAA), by the database coding agency, or by the manufacturer of the navigation equipment. In addition, some procedures may, in the opinion of the FAA, present a potential safety hazard to normal piloting techniques using GPS equipment. These procedures will not be included in navigation databases. Approach procedures that are omitted from the database can not be legally flown using GPS navigation equipment.
- c. Waypoints. As a minimum, the GPS Approach Overlay Program requires that the databases contain waypoints representing the IAF, FAF, MAP, and the missed approach holding point for each VOR, VOR/DME, NDB, NDB/DME, TACAN, and RNAV nonprecision instrument approach procedure. Intermediate Fixes (IFs) and all named fixes are also included. All waypoints are displayed in the same sequence as they are presented on the published nonprecision instrument approach procedure charts.

Note: User modification or entry of data associated with published instrument approach procedures is not possible, and not authorized.

- (1) Waypoint data utilized in nonprecision instrument approach procedures is stored by name or ident, and latitude and longitude. The waypoints are not designated in terms of bearing (or radial) and distance to/from a reference location.
- (2) Waypoints that define the MAP and Missed Approach Holding Point (MAHWP) are always coded as "fly over." This type of waypoint requires the aircraft to pass directly over it.
- (3) When turn anticipation is expected at an IAF or other waypoint the waypoint is coded as "fly by."

d. Waypoint Names Coded in the Navigation Database. Flying an FAR Part 97 or military nonprecision instrument approach procedure using GPS equipment should be transparent to air traffic control. Therefore, if a pilot has a clearance for the VOR/DME to runway 35, the same track is flown whether using GPS equipment or VOR and DME equipment. Therefore, waypoints coded in the navigation database reflect exactly those names appearing on the instrument approach procedure. For example, if an IAF or other fix is assigned a pronounceable five-letter alpha character name, it will be the same name coded in the database, the name which will appear on the avionics display, the name appearing on a chart, and the name verbally used by ATC. If no five character name is published for the approach waypoint or fix, it will normally be coded with a database identifier. A pilot must associate the coded name appearing on the display with the position shown on the chart. However, these coded names may not be known or used by ATC.

(1) Initial Approach Waypoint.

- (i) If the IAF is a named waypoint or fix, then the same name is used for the IAF waypoint in the database. If the IAF is a NAVAID, the IAF waypoint is coded with the NAVAID identifier.
- (ii) A database identifier is provided for an unnamed IAF.
- (iii) When an IAF is the beginning of a DME arc segment, the IAF is often unnamed, but is marked by a radial intersecting the arc. In these cases, the unnamed IAF waypoint is coded in the database to represent the beginning of the DME arc. An example of one method of identifying the beginning of the arc is shown in the Lake Charles, LA chart example in appendix 1.

(2) Turning points in the Initial Segment. An initial segment may incorporate a named or unnamed turn point to intercept a course.

- (i) In some cases, a waypoint may be established at a turn point where a dead reckoning heading intersects the course. This waypoint is coded into the waypoint

sequence for GPS navigation, but may not be named on a chart.

- (ii) A turn point may be defined by the intersection of two NAVAID radials or bearings. In this case, a waypoint name appears in the sequence.
- (3) Intermediate Waypoint. If the IF is a named waypoint or fix, then the same name is used for the IF waypoint in the database. If the IF is a NAVAID, the IF waypoint is coded with the NAVAID identifier. An unnamed IF is assigned a database identifier.
- (4) Final Approach Waypoint.
- (i) Procedures With a Final Approach Fix (FAF). If the FAF is a named waypoint or fix, the same name is used for the FAF waypoint in the database sequence. If the FAF is a NAVAID, the waypoint is coded with the NAVAID identifier in the waypoint sequence. An unnamed FAF, such as a DME fix, is coded with a descriptive FAF waypoint related to the NAVAID providing final approach course guidance. It also appears in the waypoint sequence.
 - (ii) Procedures Without a Final Approach Fix. Procedures without a FAF and without a stepdown fix have a Sensor FAF waypoint coded in the database at least 4 nm to the MAP waypoint. (The MAP, in this case, is always located at the NAVAID facility.) A Sensor FAF is a final approach waypoint created and added to the database sequence of waypoints to support GPS navigation of an FAA published, no-FAF, nonprecision instrument approach procedure. The coded name or Sensor FAF appears in the waypoint sequence. If a stepdown fix exists on the published procedure and it is greater than 2 nm to the MAP, the stepdown fix is coded in the database as the Sensor FAF waypoint for the waypoint sequence. If a stepdown fix distance is 2 nm or less to the MAP, a Sensor FAF waypoint is coded at least 4 nm to the MAP.
- (5) Missed Approach Waypoint. When a missed approach point is located at the NAVAID, the MAP waypoint is coded in the

sequence at the NAVAID position using the NAVAID identifier. When the missed approach is initiated near the runway threshold (timed approach) or at a specified DME distance from a NAVAID, a MAP waypoint is created and coded in the database (see approach plates in appendix 1).

- (6) Missed Approach Holding Points. Missed approach holding points are normally at a NAVAID or named fix. Therefore, the NAVAID identifier or the fix name is coded in the database as the missed approach holding waypoint and appears in the waypoint sequence.
 - (7) Waypoints and Fixes not Coded for the GPS Approach Overlay Program. A Visual Descent Point (VDP) is a fix appearing on some published nonprecision approach procedures that is not included in the sequence of waypoints. Pilots are expected to use normal piloting techniques for beginning the visual descent. In addition, unnamed stepdown fixes in the final approach segment will not be coded in the waypoint sequence unless the stepdown fix is used as a Sensor FAF on a no-FAF procedure.
- e. Approach Selection Process/Menu Sluing. Pilots normally retrieve instrument approach procedures from the database through a menu selection process. An example of a menu selection is included in the Pilot Operations/Procedures section of this AC. No manual waypoint loading will be required or allowed, although some pilot action is required during certain segments of the approach.
- Note: This process may vary from one avionics manufacturer to another; therefore, pilots must be thoroughly familiar with the FAA Approved Flight Manual or Flight Manual supplement.
- f. Waypoint Sequence. The sequence of waypoints in the database and those displayed by the equipment will consist of, as a minimum, waypoints representing the selected IAF and its associated IFs (when applicable), FAF, MAP, and the MAHWP.
- g. Relationship of Avionics Displayed Waypoints to Charted Data. The GPS Approach Overlay Program waypoints contained in the database represent the waypoints, fixes, NAVAIDs, and other points portrayed on a published approach procedure beginning at

the initial approach fix. Certain unnamed points and fixes appearing on a chart are assigned a database identifier. There is no requirement to furnish charts with these database identifiers; however, charting agencies may incorporate them at their discretion.

Note: Database identifiers should not be used for pilot/controller communications and flight planning.

- h. Differences Between Displayed and Charted Navigation Information. There may be slight differences between the navigation information portrayed on the chart and the GPS navigation display. Course differences will occur due to an equipment manufacturer's application of magnetic variation. Distance differences will occur due to the mismatch between GPS ATD values and the DME values published on underlying procedures.

5. THE GPS STAND ALONE APPROACH.

A sequence of waypoints defining the point to point track to be flown will be coded in the database including the initial approach waypoint, intermediate waypoint, final approach waypoint, missed approach waypoint, missed approach turning waypoint, and missed approach holding waypoint. All waypoints, except a missed approach waypoint at the runway threshold, will be named with a five-letter alpha character name. Missed approach waypoints at the threshold will be assigned a database identifier. The sequence of waypoints appearing in the display should be identical to the waypoint sequence appearing on an associated approach chart.

SECTION 3. PILOT OPERATIONS/PROCEDURES.

1. APPLICABILITY.

- a. The guidance provided in this AC applies to instrument rated pilots using GPS and operating under Federal Aviation Regulations (FAR) Part 91.
- b. Pilots conducting GPS IFR operations under FAR Parts 121, 129, and 135 should meet the appropriate provisions of their approved operations specifications.

2. PREFLIGHT.

- a. General. All GPS IFR operations should be conducted in accordance with the FAA Approved Flight Manual (AFM) or Flight Manual Supplement. Prior to an IFR flight using GPS, the pilot should ensure that the GPS equipment and the installation are approved and certified for the intended IFR operation. The equipment should be operated in accordance with the provisions of the applicable AFM. All pilots must be thoroughly familiar with the GPS equipment installed in the aircraft and its limitations.
- b. GPS Receivers. The pilot should follow the specific start-up and self-test procedures for the GPS receiver as outlined in the FAA AFM or Flight Manual Supplement.
- c. NOTAMs. Prior to any GPS IFR operation, the pilot should review the appropriate NOTAMs. NOTAMs will be issued to announce outages for specific GPS satellite vehicles, by pseudo random noise (PRN) number and satellite vehicle number (SVN). GPS NOTAMs are issued under the identifier "GPS". Pilots may obtain GPS NOTAM information by request to the FSS briefer or by requesting NOTAMS, using the identifier "GPS", through the Direct User Access Terminal System (DUATS). Pilots should review the NOTAMs for the underlying approach procedure. When executing a Phase II approach, pilots should ensure the ground-based facilities upon which the approach is based are operational. If an approach is not authorized due to an inoperative navigation facility, the associated Phase II GPS approach is not authorized.
- d. The pilot must select the appropriate airport(s), runway/approach procedure, and initial approach fix on the aircraft's GPS receiver to determine RAIM integrity for that approach. Air Traffic Control specialists are not provided any information about the operational integrity of the system. This is especially important when the pilot has been "Cleared for the Approach." Procedures should be established by the pilot in the event that GPS navigation outages are predicted or occur. In these situations, the pilot should rely on other approved equipment, delay departure, or cancel the flight.

- e. Aircraft that are navigating by GPS are considered to be RNAV-equipped aircraft and the appropriate equipment suffix should be included in the Air Traffic Control (ATC) flight plan. Most GPS equipment would file as a /R. Users should consult the latest edition of the Airmen's Information Manual (AIM) for the proper equipment suffix. If the GPS avionics becomes inoperative, the pilot should advise ATC and amend the equipment suffix.

3. EN ROUTE OCEANIC.

Oceanic operation is defined as that phase of flight between the departure and arrival terminal phases with an extended flight path over oceanic areas. In addition to the criteria outlined in paragraph 3.b.(1), the aircraft should be equipped with other approved means of navigation appropriate for the intended route of flight, such as INS or Omega. This navigation equipment must be operational, but it does not have to be actively monitored unless the RAIM capability of the system fails. The purpose of the backup system is to ensure that the flight has the capability to continue to the destination if something unforeseen occurs to the GPS constellation.

4. EN ROUTE DOMESTIC AND TERMINAL.

Domestic en route operations are defined as that phase of flight between departure and arrival terminal phases, with departure and arrival points within the U.S. NAS. Terminal area operations include those flight phases conducted on charted Standard Instrument Departures (SIDs), on Standard Terminal Arrival Routes (STARs), or during other flight operations between the last en route fix/waypoint and an initial approach fix/waypoint. In addition to the criteria outlined in paragraph 3.b.(1), the following criteria applies:

- a. Other navigation equipment should be installed and operational to receive the intended ground-based facilities which define the route to be flown to the destination and any required alternate.
- b. Ground-based facilities which define these routes must also be operational.
- c. Aircraft should be equipped with an approved and operational alternate means of navigation appropriate to the route being

flown. This navigation equipment must be operational, but it does not have to be actively monitored unless the RAIM capability of the system fails. The purpose of these backup systems is to ensure that the aircraft can continue to the destination if something unforeseen occurs to the avionics or GPS constellation.

5. OVERLAY APPROACH.

In order to accelerate the availability of nonprecision instrument approach procedures that can be flown using certified GPS equipment, the FAA has authorized the GPS Approach Overlay Program. This program allows pilots to use GPS equipment to fly existing VOR, VOR/DME, NDB, NDB/DME, and RNAV nonprecision instrument approach procedures. The purpose of this program is to permit pilots to transition from ground-based to satellite-based navigation technology for instrument approaches. Approach operations are defined as that phase of flight from the Initial Approach Fix (IAF) to the Missed Approach Point (MAP) when flying an established nonprecision procedure. The approaches to be flown with GPS must be retrieved from the avionics database. (Refer to Section 2, "Airborne Navigation Databases" for a more detailed description of the required database.) GPS equipment may be used to fly all codable nonprecision instrument approach procedures, except localizer (LOC), localizer directional aid (LDA), and simplified directional facility (SDF) approach procedures. Any required alternate airport should have an approved instrument approach procedure (other than GPS or LORAN-C) which is anticipated to be operational at the estimated time of arrival. The program has progressed through three phases. Each phase has specific provisions and limitations.

- a. Phase I. This phase ended in February 1994 when the FAA declared GPS operational for civil operations.
- b. Phase II. This phase began on February 17, 1994 when the FAA declared the system suitable for civil IFR operations. GPS equipment can be used as the primary IFR flight guidance during a nonprecision approach without actively monitoring the applicable NAVAID(s) which define the approach being used. However, the traditional ground-based NAVAID(s) required for the published approach and alternate should be operational and the associated avionics should be installed and operational. The avionics need not be operating during the approach if RAIM provides integrity for the approach. Equipment that does not use

RAIM for approach integrity is required to use ground-based NAVAIDs and operational airborne avionics. The approach should be requested and approved by its published name, such as "NDB Runway 24," "VOR Runway 24." Modification of the published instrument approach name is not required for Phase 11.

- c. Phase III (After Name Modification). Phase III requires modification of the instrument approach procedure name to include "or GPS" in the title of the published approach procedure. Neither the aircraft traditional avionics nor the ground station NAVAID(s) need be operational or monitored to fly nonprecision approaches at the destination airport if RAIM is providing integrity for the approach. For systems that do not use RAIM for approach integrity the ground-based NAVAIDs and operational airborne avionics needed to provide RAIM equivalency should be installed and operational. For any required alternate airport, the ground-based and airborne navigational equipment that defines the instrument approach procedure and route to the alternate should be installed and operational. The Phase III published approach will include the underlying NAVAID and GPS in the title; however, the type of approach must be specifically requested and approved. For example, when electing to use GPS for the "VOR or GPS RWY 24" approach, the approach should be requested and approved as "GPS RWY 24". When electing to use the VOR for the approach, the approach should be requested and approved as "VOR RWY 24".
- d. Additional criteria for all Phases. For all phases of the Approach Overlay Program, civil aircraft are not authorized to use GPS to fly any segment of any instrument approach under IFR weather conditions unless the following criteria are met:
- (1) The GPS avionics used to fly any nonprecision instrument approach must be certified to TSO C129 or equivalent criteria. The installation in the aircraft should be in accordance with AC 20-138 and the provisions of the applicable Approved Flight Manual (AFM) or Flight Manual supplement should be met.
 - (2) The airborne navigation database should contain all waypoints for the published nonprecision approaches to be flown. The use of non-differential GPS equipment is not authorized for LOC, LDA, and SDF approaches.

- (3) The approach cannot be flown unless that instrument approach is retrievable from the avionics database. Some approach procedures are not included in the database due to safety reasons or non-codability. It is the responsibility of the pilot to determine if the intended approach procedure is in the database.
- (4) The GPS avionics should store all waypoints depicted in the approach to be flown, and present them in the same as the published nonprecision instrument approach procedure chart.
- (5) Approaches must be flown in accordance with the FAA AFM or Flight Manual Supplement and the procedure depicted on the appropriate instrument approach chart.
- (6) Any required alternate airport should have an approved instrument approach procedure, other than GPS or Loran-C, which is anticipated to be operational at the estimated arrival time. The aircraft should have the appropriate avionics installed and operational to receive the navigational aids. The pilot is responsible for checking NOTAMs to determine the operational status of the alternate airport navigational aids.
- (7) The general approval to use GPS to fly overlay instrument approaches is initially limited to the U.S. National Airspace System (NAS). GPS instrument approach operations outside the United States also should be authorized by the appropriate sovereign authority.
- (8) Procedures should be established by the pilot in the event that GPS outages occur. In these situations, the pilot should rely on other approved equipment, delay departure, or discontinue IFR operations.

6. PILOT OPERATIONS.

- a. Usually, flying a GPS overlay nonprecision instrument approach procedure is identical to a traditional approach. The differences include the navigational information displayed on the GPS equipment and the terminology used to describe some of the features. Flying the GPS stand-alone approach is normally point

to point navigation and independent of any ground-based NAVAIDs. Appendix I contains sample charts with a brief explanation of how pilot operations are affected by the GPS approach operations. Appendix 2 contains a glossary with definitions to some of the unique terminology of GPS approaches.

- (1) Straight line (TO-TO) flight from waypoint to waypoint, as sequenced in the database, does not assure compliance with the published approach procedure. Should differences between the approach chart and database arise, the published approach chart, supplemented by NOTAMs, holds precedence.
- (2) Pilots should be aware that when flying a GPS overlay approach, a charted track defined by a VOR may differ slightly from the course to be flown as indicated by the GPS avionics. All magnetic tracks defined by a VOR radial are determined by the application of a VOR station variation; however, GPS operations use an algorithm to apply the current local magnetic variation. Therefore, a difference between the charted course and the GPS display may occur. Either method of navigation, VOR or GPS, should produce the same desired ground track.

b. Selecting the Approach.

- (1) To begin the overlay or stand-alone approach, the pilot must first select the appropriate airport, runway/approach procedure, and initial approach fix.

Note: The actual procedures, for making these selections, may vary from one avionics manufacturer to another; therefore, the pilot must be thoroughly familiar with the avionics manufacturer specifications.

- (2) Pilots must arm (enable) approach mode prior to the IAF. This enables the equipment CDI sensitivity to increase from 5 nm either side of centerline to 1 nm at the appropriate time. Where the IAF is beyond the 30 mile point, CDI sensitivity will not change until the aircraft reaches 30 miles. Where the IAF is at or inside the 30 mile point, CDI sensitivity change will occur at the time approach mode is armed. Should the pilot fail to arm approach mode prior to the IAF, the

equipment will provide an aural and/or visual alarm to warn the pilot to do so. Should the pilot ignore the warning and fail to arm approach mode, the equipment will provide a 2nd and final warning at approximately 3 nm from the FAF. If the pilot yet fails again to arm approach mode, the equipment will flag and GPS navigation guidance will not be provided beyond the FAF. The specific method by which the GPS equipment provides these warnings is up to the manufacturer, and is explained in the Flight Manual Supplement.

- (3) The equipment will automatically present the waypoints from the initial approach fix to the missed approach holding point. An example of the selection process that a pilot should make and the automatic presentation of waypoints is shown in figure 2 which was taken from the Lake Charles, Louisiana overlay approach chart in appendix 1. The example is for illustration purposes only.
 - (4) At the MAP, the equipment will not automatically sequence to the next required waypoint; therefore, the pilot must manually sequence the GPS equipment to the next waypoint.
 - (5) With Radar Vectors (RV), the pilot may be required to manually select the next waypoint so that GPS is correctly using the appropriate database points and associated flight paths.
- c. Initial Approach Segment. The following are some of the unique characteristics a pilot should be aware of during the initial approach segment of a nonprecision GPS approach.
- (1) Arc Procedures. Arc procedures will only be encountered with overlay approaches. The method for navigating on arcs may vary with the manufacturer and pilots should use the procedures specified in the applicable AFM. It is not uncommon for an aircraft to be vectored onto the arc by ATC at a point other than the IAF for the arc. In these cases, the pilot should manually sequence the waypoints to the arc segment of the approach.
 - (2) Course Reversal Procedure. When performing a course reversal, such as a procedure turn or holding pattern in lieu of a procedure turn, the GPS equipment provides the capability

for the pilot to change from the automatic waypoint sequencing to manual. The course reversal is flown using normal piloting techniques. The reversal and the return to automatic sequencing should be completed when established inbound on the final approach course to, but outside of the active waypoint.

Note: The method or procedure used to switch the equipment from automatic sequencing to manual may vary between manufacturers. Pilots should use the procedure specified in the applicable AFM.

- (3) Turn Points in the Initial Segment. In some cases, a turn point is incorporated in the initial approach segment. Note: It is important to recognize that the turn point may be either a named or coded waypoint.
- d. Intermediate Approach Segment. If an Intermediate Fix (IF) or waypoint is part of the instrument approach procedure, it is included in the database and is used the same as in a ground-based procedure.
 - e. Final Approach Segment. The following are some of the unique characteristics a pilot should be aware of during the final approach segment of a nonprecision GPS approach.
 - (1) Final Approach Fix (FAF) - Overlay Approach. In the Approach Overlay Program, the GPS equipment may display a FAF waypoint not depicted on the approach chart. Procedures without a FAF and without a stepdown fix have a sensor FAF waypoint coded in the database. This sensor FAF waypoint is at least 4 nm to the MAP waypoint. In this case, the MAP waypoint is always located at the NAVAID facility. If a stepdown fix exists on the published procedure that is greater than 2 nm to the MAP, the stepdown fix becomes the sensor FAF waypoint. If a stepdown fix is 2 nm or less to the MAP, a sensor FAF waypoint is established 4 nm to the MAP. The sensor FAF is necessary to transition the display sensitivity on the GPS equipment from terminal to approach sensitivity. During communications with ATC, the pilot should make position reports based on charted positions, not the display on the GPS equipment, since the controller does

not have access to this information. Examples of these situations are shown in the sample charts in appendix 1.

- (2) Final Approach Waypoint - GPS Stand-Alone Approach. The final approach waypoint for a GPS stand alone approach will be a standard named waypoint normally located 5 nautical miles from the runway end.
- (3) Course Sensitivity. The Course Deviation Indicator (CDI) sensitivity related to GPS equipment varies with the mode of operation. In the en route phase, prior to the execution of the instrument approach, the display sensitivity full-scale deflection is 5 nm either side of centerline.
 - (i) Upon activation of the approach mode, the display sensitivity transitions from a full scale deflection of 5 nm to 1 nm either side of centerline.
 - (ii) At a distance of 2 nm inbound to the FAF waypoint, the display sensitivity begins to transition to a full scale deflection of 0.3 nautical miles either side of centerline. Some GPS avionics may provide an angular display between the FAF and MAP that approximates the course sensitivity of the localizer portion of an ILS.
 - (iii) When navigation to the missed approach holding point is activated, the display sensitivity transitions to provide a full-scale deflection of 1 nautical mile either side of centerline.
- (4) Stepdown Fixes. A stepdown fix is flown in the same manner as a ground-based approach. Stepdown fixes on overlay approaches will not be identified with a waypoint unless it is named by the FAA. An unnamed stepdown fix will not appear in the database sequence of waypoints. Pilots should be aware that the distance readout in the GPS display equates to the distance-to-go to the active waypoint. If the stepdown fix has not been assigned a waypoint name in the database (for overlay approach stepdown fixes), the distance-to-go readout may not correspond to the DME distance of the stepdown fix shown on the published approach chart. The pilot should monitor the along track distance (ATD) to the MAP to identify the stepdown fix. For stand alone GPS

procedures, any required stepdown fixes prior to the missed approach waypoint will be identified by along track distances.

Note: An approach fix identified by a DME will not be displayed on the GPS receiver unless there is a published name assigned to the DME fix. If the fix is not assigned a waypoint name, the distance-to-go (ATD) displayed on the GPS receiver may not agree with the approach chart DME reference distance.

f Missed Approach Segment. The following are some of the unique characteristics a pilot should be aware of during the missed approach segment of a nonprecision GPS approach.

- (1) Missed Approach Point (MAP). The MAP waypoint on an overlay approach may be located at the runway threshold, the underlying facility, or at a specified distance from the runway or facility. There may be a difference between the along track countdown to the waypoint in the GPS equipment and the DME distance from a facility shown on the chart. Pilots need to take into account any differences when interpreting the distance shown in the GPS display against the charted values.
- (2) Manual Activation of Missed Approach Function. After passing the missed approach point, the GPS equipment will not automatically sequence to the missed approach holding waypoint. When initiating a missed approach the pilot, upon passing the MAP, should manually sequence the GPS equipment to the next active waypoint. This may not necessarily be a missed approach holding waypoint, but may be a turn waypoint en route to the missed approach holding waypoint. The missed approach should be flown as charted using the same piloting techniques as a traditional missed approach.

REFERENCE O8

FAA NOTICE N8110.60

**GPS as a Primary Means of Navigation for
Oceanic/Remote Operations**

1. **PURPOSE.** This notice proposes interim guidance for approving the installation of global positioning system (GPS) equipment to be used as a primary means of navigation for oceanic/remote operations (including minimum navigation performance specifications (MNPS) airspace). To clarify terminology, this guidance adopts the term “primary means of navigation” as opposed to “sole means of navigation” to identify navigation equipment which provides the only required means on the aircraft of satisfying the necessary level of accuracy, integrity, continuity and availability for a particular area, route, procedure or operation. The failure of a primary means of navigation may require reversion to a non-normal means of navigation (e.g., dead reckoning). Examples of systems which can provide a primary means of navigation include: very high frequency omnidirectional range (VOR) for domestic en route, terminal, and nonprecision approach where it is available; VOR/distance measuring equipment (DME) for domestic en route above flight level 240, terminal, and nonprecision approach where it is available; Omega for oceanic operation; and inertial navigation systems (INS) for oceanic operation. The GPS installations which revert to another long-range navigator, such as Omega or INS, need not apply for GPS primary means approval; they may utilize GPS under supplemental Instrument Flight Rules (IFR) approval.
2. **DISTRIBUTION.** This notice is distributed to the branch level in Washington headquarters, Aircraft Certification Service, section level in all Aircraft Certification Directorates; and maximum distribution in all the Aircraft Certification Offices (ACO), with limited distribution in the General Aviation District Offices, Air Carrier District Offices, Flight Standards District Offices, and Aeronautical Quality Assurance Field Offices.
3. **CANCELLATION.** Notice 8110.57, GPS as a Primary Means of Navigation for Oceanic/Remote Operations, dated 7/7/95 is canceled.
4. **PERFORMANCE REQUIREMENTS.** The following requirements must be met by the GPS equipment, in addition to the performance requirements of RTCA/DO-208, Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment Using Global Positioning System, as modified by Technical Standards Order (TSO)-C129. The approval process for evaluating compliance to these requirements is discussed in paragraph 6.

- a. The GPS equipment must be capable of detecting and excluding a GPS satellite failure by means of a fault detection and exclusion (FDE) algorithm including receiver autonomous integrity monitoring (RAIM) for detection. The exclusion of a satellite failure must be automatic, thus pilot action is not permitted to accomplish exclusion. The specific requirements of the exclusion function can be found in appendix 1.
- b. In addition to FDE, the equipment must use an acceptable means to detect and exclude from the navigation solution, any satellite which is being tracked that experiences a failure which causes a pseudorange step function. The requirements for detection and exclusion of a pseudorange step function can be found in appendix 2.
- c. The GPS equipment must exclude, without pilot action, any satellite designated unhealthy by any of the GPS navigation data. The satellite must be excluded within 5 minutes of the designation as unhealthy by the satellite. See appendix 3 for specific requirements on what portions of the GPS navigation data shall be used to determine GPS health.
- d. If a GPS satellite failure results in loss of GPS navigation (due to the failure to exclude or a hard satellite failure which results in an inadequate number of satellites), an appropriate indication (TSO-C129, paragraphs (a)(3)(xiii)1c, (a)(4)(iv)10, and (a)(5)(iv)9) of the failure must be provided to the aircraft crew.
- e. The equipment must provide, upon request, an indication of the current estimate of position uncertainty in terms of nautical miles. This estimate must be based on measurement inconsistency and must bound the true error with high confidence (approximately 99.9 percent). It is related to the test statistic calculated as part of FDE. This estimate will not be available if there are only four measurements available (because there is no redundancy). This output is intended to be used to provide information about the approximate magnitude of a potential positioning failure, when the horizontal integrity limit (HIL) exceeds the alert limit or when a positioning failure has been detected and not excluded.
- f. The loss of the long-range navigation function must be demonstrated to be improbable according to Advisory Circular

(AC) 23.1309-1A, Equipment, Systems, and Installations in Part 23 Airplanes, or AC 25.1309-1A, System Design Analysis. For many oceanic/remote operations, this requirement must be met by equipping the aircraft with at least two (or more) independent (i.e., dual control display unit, dual GPS antenna, dual power sources, dual GPS sensors, etc.) navigation systems with a mean time between failures of at least 1000 hours each (for dual equipage).

g. A prediction program is required to support operational departure restrictions. See appendix 4 for specific requirements for this program.

5. DESIRED PERFORMANCE. In addition to the required features described above, it is recommended that the GPS equipment provide the following features. These features increase the versatility and availability of the GPS receiver and may facilitate obtaining future operational benefits.

- a. The installed GPS equipment should be capable of acquiring and tracking satellites above a threshold that is at or below the horizon (no mask angle) in the oceanic/remote mode. However, the introduction of this capability also incurs a requirement to provide an automatic and/or manual method of switching between the oceanic/remote mode of operation (lower mask angle) and the standard mode of operation. If the selection is manual, the selected value must be continuously displayed to the flight crew and must not inhibit the required automatic changes specified in TSO-C129.
- b. The GPS equipment should provide an oceanic/remote mode of operation in which the alert limit for RAIM, as defined in RTCA/DO-208, can be increased up to 4 nautical miles (nm) to improve FDE availability. Care must be taken in the design of the crew annunciations so that there is a clear distinction between loss of FDE availability and loss of navigation (this may be due to a detected satellite failure that cannot be excluded.) The time-to-alert in the oceanic/remote mode of operation can be greater than 30 seconds, but shall not exceed 5 minutes.
- c. The GPS equipment should also continue to process the FDE algorithm when the internal HIL exceeds the alert limit in order to provide some level of integrity monitoring; any detected failure

should be annunciated even if the HIL exceeds 4 nm. When the HIL is greater than 4 nm, the equipment must enunciate that integrity monitoring is inadequate (TSO-C129 paragraphs (a)(3)(xiii)2a, (a)(4)(iv)10, and (a)(5)(iv)9).

- d. During normal operation, the equipment should be capable of computing and displaying the current wind speed and wind direction.
- e. The GPS equipment should have the capability to accept forecast wind conditions at waypoints along a route in order to improve estimated time of arrival performance.
- f. The navigation system should include an automatic dead reckoning (DR) navigation mode that becomes active when GPS navigation capability is lost. The system, if provided, must include electronic inputs of true airspeed, altitude, and stabilized heading for use in generating the DR position. The system should use calculated winds from the last valid GPS data and incorporate the ability for the crew to input forecast winds. The system should be demonstrated to be capable of navigation with drift rates of no more than 14 nm per hour (assuming no wind changes).
- g. If the system provides a DR mode, then it should automatically revert to the dead reckoning mode when a GPS navigation solution cannot be provided, and should provide an alert to the pilot. The system should also allow the pilot to select DR when FDE has detected a satellite failure and the failure cannot be excluded. An indication that the system has reverted to dead reckoning mode must be continuously provided to the aircraft crew if the mode is provided. The dead reckoning mode of the GPS equipment shall retain the capability to couple with the flight guidance system (autopilot / flight director), if provided, and should not disconnect when switching between GPS and dead reckoning modes. The GPS equipment must automatically revert to normal navigation as soon as a navigation solution can be provided. Both transitions must be clearly annunciated (GPS to DR and DR to GPS).

6. APPROVAL PROCESS.

- a. The GPS equipment manufacturer or aircraft manufacturer obtains a TSO-C129 authorization (Class A1, A2, B1, B2, C1, or C2) from the cognizant Aircraft Certification Office (ACO). The manufacturer may also demonstrate compliance with the requirements in paragraph 4 of this notice and any of the additional functions specified in paragraph 5. The FDE prediction capability defined in appendix 4 must also be evaluated to comply with the requirements in appendix 4 and to accurately predict the availability of the FDE algorithm. In this case, the aircraft certification office engineer should issue a separate letter of design approval, stating that the appliance (including part number) and software prediction program (including revision number) has been found to comply with this notice. It is assumed that the appliance will be manufactured under a TSO authorization (TSOA). Alternatively, the applicant must demonstrate that the performance requirements of TSO-C129 are met as part of the installation approval.
- b. The applicant obtains installation approval of the GPS navigation system via the amended Type Certificate (TC) or Supplemental Type Certificate (STC) certification process. An acceptable means of compliance to determine airworthiness can be found in AC 20-138, Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System, or AC 20-130A, Airworthiness Approval of Navigation or Flight Management Systems (FMS) Integrating Multiple Navigation Sensors.
 - (1) If the manufacturer has previously obtained a TSOA and obtained a letter of design approval as described in paragraph 6a of this notice, no additional testing is required beyond AC 20-138 or AC 20-130A.
 - (2) If the manufacturer has not obtained a TSOA or letter of design approval as described in paragraph 6a of this notice, then the applicant must demonstrate compliance with the requirements in paragraph 4 of this notice and any of the additional functions specified in paragraph 5. The FDE prediction capability defined in appendix 4 must also be evaluated to comply with the requirements in appendix 4 and to accurately predict the availability of the FDE algorithm.

- c. Once the installation has been approved, the aircraft flight manual supplement (AFMS) must be updated to state : “The XXX GPS equipment as installed has been found to comply with the requirements for GPS primary means of navigation in oceanic and remote airspace, when used in conjunction with the XXX prediction program. This does not constitute an operational approval.” Appropriate operational procedures assumed for aircraft certification, as well as procedures for operating any additional features (such as dead reckoning) must be identified in the AFMS. These procedures must include the use of the FDE prediction algorithms.
- d. The FAA Form 337, Major Alteration or Repair, process may be used for follow-on installations of the same navigation system for which there is a TC or STC in the same model aircraft and the engineering data developed for the initial certification is used to accomplish the follow on installation approval.
- e. The applicant should be aware that an operational approval must be obtained before conducting Class II navigation (remote/oceanic). Applicants should contact the appropriate Flight Standards District Office to seek approval.

John K. McGrath, Manager, Aircraft Engineering Division

APPENDIX 1. REQUIREMENTS FOR FAULT DETECTION AND EXCLUSION

1. INTRODUCTION. GPS equipment shall have a fault detection and exclusion (FDE) capability that utilizes GPS measurements to provide independent integrity monitoring. The detection function refers to the capability to detect a satellite failure which affects navigation, while the exclusion function refers to the capability to exclude one or more failed satellites from the solution and prevent a satellite failure from affecting navigation. The FDE algorithm must meet the following requirements under the standard assumptions of GPS performance specified in paragraph 4 of this appendix. The detection and exclusion functions must be accomplished without pilot interaction. The FDE algorithm must be aided by barometric altimetry measurements, as required by TSO-C129. Additional augmentations (such as clock aiding) are not precluded.

2. DEFINITIONS. In order to assist in the interpretation of these definitions, figure 1 shows a fault tree relating the FDE events to each other for a snapshot in time. Wrong exclusion is not possible, since there is no real failure to incorrectly exclude.

Figure 1. FDE Event Tree (snapshot in time)

- a. Alert. An alert is defined to be an indication that is provided by the GPS equipment that the navigation performance achieved by the equipment is not acceptable. The conditions for this alert are defined below. Note that an alert refers only to those indications that are provided by the sensor, and does not refer to any internal processing associated with the FDE algorithm.
- b. Horizontal Alert Limits. The horizontal alert limit for oceanic/remote navigation mode is defined to be at least 2 nm, but shall not exceed 4 nm. RTCA/DO-208 specifies a limit of 2 nm, but a higher limit of 4 nm increases availability and is adequate for oceanic/remote operation (see paragraph 5b of this notice).
- c. Time-to-Alert. The time-to-alert for oceanic/remote navigation mode is defined to be at least 30 seconds, but shall not exceed 5 minutes. RTCA/DO-208 specifies a time-to-alert of 30 seconds, but a higher time-to-alert of 5 minutes increases availability and is adequate for oceanic/remote operation (see paragraph 5b of this notice).
- d. Positioning Failure. A positioning failure is defined to occur whenever the difference between the true position and the output position exceeds the applicable horizontal alert limit.
- e. Missed Detection. A missed detection is defined to occur when a positioning failure is not detected (internal to the FDE algorithm).
- f. False Detection. A false detection is defined to occur when a positioning failure does not exist, but a failure is detected (internal to the FDE algorithm).
- g. Wrong Exclusion. A wrong exclusion is defined to occur when a positioning failure is detected and the positioning failure still exists, but is undetected after exclusion, resulting in a missed alert.

- h. Missed Alert. Positioning failures which are not annunciated (as an alert) within the time-to-alert are defined to be missed alerts. Both missed detection and wrong exclusion conditions are missed alerts.
- i. False Alert. A false alert is defined as the indication of a positioning failure when a positioning failure has not occurred.

NOTE: The term, false alert, refers to actual alerts that are issued by the GPS equipment.

- j. Horizontal Integrity Limit. The horizontal integrity limit (HIL) is the radius of a circle in the horizontal plane, with its center being at the indicated position, which describes the region which is assured to contain the true position. It is the horizontal region for which the missed alert and false alert requirements can be met. It is only a function of the satellite and user geometry and the expected error characteristics: it is not affected by actual measurements. Therefore, this value is predictable.
- k. Availability of Detection. The detection function is defined to be available when the constellation of satellites provides a geometry for which the missed alert and false alert requirements can be met on all satellites for the alert limit and time-to-alert. When the constellation is inadequate to meet these requirements (paragraphs 3a and 3b of this appendix), the fault detection function is defined to be unavailable. Thus the availability of detection for a specific time, location, and constellation is defined to be the product of satellite-specific terms, as follows:

$$\text{Detection Availability} = \prod_{i=1}^N D(i), \text{ where}$$

N = number of satellites used in the sensor,

D(i) = 1, if Pr(detection given ith satellite failed) \geq 99.9%
and Pr(false alert) \leq 0.002/hour

D(i) = 0, if Pr(detection given ith satellite failed) $<$ 99.9%
or Pr(false alert) $>$ 0.002/hour.

NOTE: For a given geometry and navigation mode, the detection function is either available or unavailable. The detection function is expected to operate whenever sufficient measurement redundancy exists, even when the probability of missed alert cannot be assured for the alert limit. Therefore, it may operate when the

missed detection rate is greater than required for the alert limit, but the false alert rate must continue to meet requirements.

- l. Failed Exclusion. A failed exclusion is defined to occur when a true satellite failure is detected and the detection condition is not eliminated within the time-to-alert (from the onset of the positioning failure). A failed exclusion results in an annunciation of a detected satellite failure. A failed exclusion does not imply that the exclusion must be correct, only that it eliminates the detection condition and therefore prevents an indication of loss of integrity monitoring. The probability of false exclusion is included in the probability of missed alert. In addition, failed exclusion of false internal detections are not included, because they are included in the false alert rate.
- m. Availability of Exclusion. The exclusion function is defined to be available when the constellation of satellites provides a geometry for which the FDE algorithm can meet the failed exclusion requirement, and prevent the indication of a positioning failure or a loss of integrity monitoring function. Therefore, exclusion must occur before the duration of a positioning failure exceeds the time-to-alert, and the detection function as defined above must be available after exclusion. Note that for a given geometry and a given failed satellite, the success of the exclusion function to prevent an alert condition (duration of positioning failure exceeds time-to-alert) may be probabilistic. For example: given a particular exclusion algorithm, a satellite geometry, and a failed satellite, the algorithm could have a 99 percent probability of successfully preventing a warning condition. However, the exclusion function is only defined to be available if the probability of excluding a satellite and preventing an alert (given a satellite failure has occurred and has been detected) satisfies the failed exclusion requirement. Thus the availability of exclusion for a specific time, location, and constellation is defined to be:

$$\text{Exclusion Availability} = \prod_{i=1}^N E(i), \text{ where}$$

N = number of satellites used in the sensor,

$E(i) = 1$, if $\text{Pr}(\text{failed exclusion}) \leq 10^{-3}$ given i th satellite failed,

$E(i) = 0$, if $\Pr(\text{failed exclusion}) > 10^{-3}$ given i th satellite failed.

NOTE: For a given geometry and navigation mode, the exclusion function is either available or unavailable. The exclusion function is expected to operate whenever sufficient measurement redundancy exists, regardless of whether or not it is "available" by the definition above. Therefore, it may operate when the missed detection rate is greater than required for the appropriate alert limit, but the false alert rate must continue to meet requirements.

3. FDE REQUIREMENTS

- a. Missed Alert Probability. The probability of missed alert shall be less than or equal to 0.001 for every geometry and every navigation mode. If this requirement is not met for a given geometry, then the detection function is defined to be unavailable for that geometry (see paragraph 2k of this appendix). This requirement is on the missed alert rate external to the GPS equipment. When related to the internal algorithm, it includes both probabilities of missed detection and false exclusion.
- b. False Alert Probability. The probability of false alert shall be less than or equal to 0.002/hour. If this requirement is not met for a given geometry, then the detection function is defined to be unavailable for that geometry (see paragraph 2m of this appendix). Note that a false alert rate of 10^{-5} is more consistent with the requirement for loss of navigation. This requirement is relaxed to the RTCA/DO-208 requirement for oceanic operations, since the duration of the false alert will be short. This requirement is on the false alert rate external to the GPS equipment. When related to the internal algorithm, it includes both probabilities of false detection and the failure to exclude the false detection.
- c. Failed Exclusion Probability. The probability of failed exclusion shall be less than or equal to 10^{-3} for every geometry and every navigation mode for which exclusion is implemented. Exclusion must be implemented for the oceanic mode. If this requirement is not met for a given geometry, then the exclusion function is defined to be unavailable for that geometry (see paragraph 2m). This requirement is on the alert rate external to the GPS equipment due to failed exclusion. It is equivalent to the

probability that a positioning failure is announced when a GPS satellite failure occurs and is detected internally.

For some algorithms, this probability may be zero in that exclusion is always conducted when a failure is detected. However, note that such an algorithm must also meet the missed detection requirement above, which includes the probability of false exclusion.

4. GPS STANDARD ASSUMPTIONS.

- a. Selective Availability. Selective Availability (SA) shall be modeled as the sum of (1) a second-order Gauss-Markov process with an auto-correlation time of 120 seconds and a standard deviation of 23 m, and (2) a random constant with normal distribution, a mean of zero and a standard deviation of 23 m. The SA processes on all satellites are to be statistically independent. When modeling a single independent SA sample (for a single snapshot or for samples greater than 2 minutes apart), SA can be modeled by a Gaussian random variable with a mean of zero and a standard deviation of 30.5 m. Note that any additional errors must be added to this model, yielding a typical value of 33 m.
- b. Satellite Failure. The probability of a satellite integrity failure is 10^{-4} per hour for the GPS position solution (based on 3 satellite major service failures/year/constellation, assuming 8 satellites in view). A satellite integrity failure is defined to be a failure that can contribute to a hazardously misleading situation. For the purpose of testing, a slow-ramp failure of 5 meters/second may be used as described in RTCA/DO-208, paragraph 2.5.2.5.2.2.

APPENDIX 2. STEP DETECTOR REQUIREMENTS

1. STEP DETECTOR.

- a. The equipment shall detect a pseudorange step error greater than 1000 meters, including steps which cause loss of lock for less than 10 seconds. A pseudorange step is defined to be a sudden change in the measured distance to a satellite. It can be written as:

$$PR_{STEP} = | PR_{PREDICTED} - PR_{MEASURED} |$$

where $PR_{PREDICTED}$ is the predicted pseudorange at the time of measurement, based on previous measurements, and $PR_{MEASURED}$ is the pseudorange at the time of the measurement.

- b. If a pseudorange step is detected for a satellite, that satellite shall be excluded from use in the navigation algorithm until its integrity can be verified through fault detection (RAIM). The manufacturer is free to choose any method to calculate the predicted pseudorange. However, any method used should properly take into account satellite movement and aircraft dynamics up to a groundspeed of 750 knots (kts) and accelerations up to 14.7 meters/second/second (1.5 g's).

APPENDIX 3. REQUIREMENTS FOR USING GPS NAVIGATION DATA

1. In addition to monitoring by using FDE and the step detector, the GPS equipment shall monitor the GPS navigation data to detect any of the following conditions within 5 minutes of the onset of the condition. Any satellite which meets any of the following criteria shall not be used for navigation for the duration of the condition.
 - a. Ephemeris health word in subframe 2 or 3 set to the "not healthy" state.
 - b. Failure of parity on 3 successive words.
 - c. User range accuracy (URA) of 128 meters or more.
 - d. Bit 18 of the hand-over word (HOW) set to 1.
 - e. Default navigation data is being sent (alternate 0's and 1's).
 - f. Navigation data is all 1's (could inadvertently cause all satellites to be declared unhealthy).
 - g. Mismatching issue of data ephemeris (IODE) and issue of data clock (IODC).

APPENDIX 4. REQUIREMENTS FOR FDE PREDICTION ALGORITHM

1. A prediction program is required to support the operational requirement for a pre-departure outage check. This prediction program can be provided on any processing platform (in the GPS equipment or not), but it must employ an identical FDE algorithm as the one that is utilized in the GPS equipment.
2. The prediction program must have the capability to manually designate GPS satellites which will be out of service during the operation. This will include GPS satellites scheduled to go out of service for maintenance, as well as satellites already out of service (if the program does not have access to that information directly through a GPS receiver and the almanac data).
3. The prediction program must have the capability for the operator to designate a route, defined by a series of waypoints. It must also allow for designation of a departure time and expected ground speeds. Since specific ground speeds may not be maintained, this pre-flight check will have to be performed for a range of ground speeds (expected ground speed ± 100 kts in 20 kt increments). Finally, it must allow for the entry of the route spacing (centerline to centerline) on the intended oceanic/remote route. This information will be used to determine the maximum length of an outage on the intended route.
4. For the route that is specified, the program must determine and output a bound for the outage durations specified below. This bound must be accurate for the complete range of flight times/speeds as described in paragraph 3 of this appendix. Note that this requirement is not intended to imply that the equipment must always compute these parameters in real time. This information may be precompiled and available via a look-up table within the equipment. For example, if the maximum worldwide outage with 24 satellites operating were 30 minutes, then the equipment could use that information as a conservative bound of the actual performance. Another example is the reduction in the velocity variation computation; if the applicant only computes the boundary conditions, and can prove that the conditions which are evaluated truly are the boundary conditions, then no additional calculations would be necessary.

- a. The maximum outage duration of the loss of fault exclusion to within 5 minutes. An outage of exclusion is defined to occur when the exclusion function is unavailable (as defined in paragraph 2m of appendix 1).
 - b. The maximum outage duration of the capability to navigate (provide a position solution) to within 5 minutes.
5. If the maximum outage of exclusion (in hours) is greater than half the route spacing (in nm) divided by 35 or there is an outage of the ability to navigate, the program shall indicate that the operation should not be conducted.
 6. This program can be used by the operator for planning purposes, and will be used prior to departure to determine if GPS has sufficient availability to conduct the operation.

REFERENCE O9

**CODE OF FEDERAL REGULATIONS (FORMERLY
FEDERAL AVIATION REGULATIONS)
PART 121 AND PART 135**

CAUTION!! Please be aware that the materials in the following section are excerpts. It is assumed that the person using this material has read the complete parent document. Important details regarding the use of or policies covering the application of this information may be available only in the complete document from which the excerpts were taken.

121.347 RADIO EQUIPMENT FOR OPERATIONS UNDER VFR OVER ROUTES NAVIGATED BY PILOTAGE.

- (a) No person may operate an airplane under VFR over routes that can be navigated by pilotage, unless it is equipped with the radio equipment necessary under normal operating conditions to fulfill the following:
 - (1) Communicate with at least one appropriate ground station from any point on the route.
 - (2) Communicate with appropriate traffic control facilities from any point within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designed for an airport in which flights are intended.
 - (3) Receive meteorological information from any point en route by either of two independent systems. One of the means provided to comply with this subparagraph may be used to comply with paragraphs (a)(1) and (2) of this section.
- (b) No person may operate an airplane at night under VFR over routes than can be navigated by pilotage unless that airplane is equipped with the radio equipment necessary under normal operating conditions to fulfill the functions specified in paragraph (a) of this section and to receive radio navigational signals applicable to the route flown, except that a marker beacon receiver or ILS receiver is not required.

121.349 RADIO EQUIPMENT FOR OPERATIONS UNDER VFR OVER ROUTES NOT NAVIGATED BY PILOTAGE OR FOR OPERATIONS UNDER IFR OR OVER-THE-TOP.

- (a) No person may operate an airplane under VFR over routes that cannot be navigated by pilotage or for operations conducted under IFR or over-the-top, unless the airplane is equipped with that radio equipment necessary under normal operating conditions to fulfill the functions specified in 121.347(a) and to receive satisfactorily by either of two independent systems radio navigational signals from all primary en route and approach navigational facilities intended to be used. However, only one marker beacon receiver providing visual and aural signals and one ILS receiver need be provided. Equipment provided to receive signals en route may be used to receive signals on approach, if it is capable of receiving both signals.
- (b) In the case of operation over routes on which navigation is based on low-frequency radio range or automatic direction finding, only one low-frequency radio range or ADF receiver need be installed if the airplane is equipped with two VOR receivers, and VOR navigational aids are so located and the airplane is so fueled that, in the case of failure of the low-frequency radio range receiver or ADF receiver, the flight may proceed safely to a suitable airport, by means of VOR aids, and complete an instrument approach by use of the remaining airplane radio system.
- (c) Whenever VOR navigational receivers are required by paragraph (a) or (b) of this section, at least one approved distance measuring equipment unit (DME) capable of receiving and indicating distance information from VORTAC facilities must be installed on each airplane when operated in the 50 states and the District of Columbia.
- (d) If the distance measuring equipment (DME) becomes inoperative en route, the pilot shall notify ATC of that failure as soon as it occurs.
- (e) No person may operate an airplane having a passenger seat configuration of 10 to 30 seats, excluding each crew member seat, and a payload of 7,500 pounds or less under IFR or in extended overwater operations unless it has, in addition to any other required radio communications and navigation equipment appropriate to the facilities to be used which are capable of transmitting to, and

receiving from, at any place on the route to be flown, at most one ground facility, two microphones, and two headsets or one headset and one speaker.

121.441 PROFICIENCY CHECKS.

- (a) No certificate holder may use any person nor may any person serve as a required pilot flight crew member unless that person has satisfactorily completed either a proficiency check, or an approved simulator course of training under 121.409 as follows:
 - (1) For a pilot in command, a proficiency check within the preceding 12 calendar months and, in addition, within the preceding 6 calendar months, either a proficiency check or the simulator training.
 - (2) For all other pilots--
 - (i) Within the preceding 24 calendar months either a proficiency check or the line-oriented simulator training course under 121.409; and
 - (ii) Within the preceding 12 calendar months, either a proficiency check or any simulator training course under 121.409.

The satisfactory completion of a type rating flight check under 61.157 of this chapter satisfies the requirement for a proficiency check.

- (b) Except as provided in paragraphs (c) and (d) of this section, a proficiency check must meet the following requirements:
 - (1) It must include at least the procedures and maneuvers set forth in appendix F to this part unless otherwise specifically provided in that appendix.
 - (2) It must be given by the Administrator or a pilot check airman.
- (c) An approved airplane simulator or other appropriate training device may be used in the conduct of a proficiency check as provided in appendix F to this part.
- (d) A person giving a proficiency check may, in his discretion, waive any of the maneuvers or procedures for which a specific waiver authority is set forth in appendix F to this part if--
 - (1) The Administrator has not specifically required the particular maneuver or procedure to be performed;

- (2) The pilot being checked is, at the time of the check, employed by a certificate holder as a pilot;
 - (3) The pilot being checked is currently qualified for operations under this part in the particular type airplane and flight crew member position or has, within the preceding six calendar months, satisfactorily completed an approved training program for the particular type airplane.
- (e) If the pilot being checked fails any of the required maneuvers, the person giving the proficiency check may give additional training to the pilot during the course of the proficiency check. In addition to repeating the maneuvers failed, the person giving the proficiency check may require the pilot being checked to repeat any other maneuvers he finds are necessary to determine the pilot's proficiency. If the pilot being checked is unable to demonstrate satisfactory performance to the person conducting the check, the certificate holder may not use him nor may he serve in operations under this part until he has satisfactorily completed a proficiency check.

However, the entire proficiency check (other than the initial second-in-command proficiency check) required by this section may be conducted in an approved visual simulator if the pilot being checked accomplishes at least two landings in the appropriate airplane during a line check or other check conducted by a pilot check airman (a pilot-in command may observe and certify the satisfactory accomplishment of these landings by a second-in-command). If a pilot proficiency check is conducted in accordance with this paragraph, the next required proficiency check for that pilot must be conducted in the same manner, or in accordance with appendix F of this part, or a course of training in an airplane visual simulator under 121.409 may be substituted therefor.

**135.165 RADIO AND NAVIGATIONAL EQUIPMENT:
EXTENDED OVERWATER OR IFR OPERATIONS.**

- (a) No person may operate a turbojet airplane having a passenger seating configuration, excluding any pilot seat, of 10 seats or more, or a multi-engine airplane in a commuter operation, as defined in part 119 of this chapter, under IFR or in extended overwater operations unless it has at least the following radio communications and navigational equipment appropriate to the facilities to be used

which are capable of transmitting to, and receiving from, at any place on the route to be flown, at least one ground facility:

(1) Two transmitters, (2) two microphones, (3) two headsets or one headset and one speaker, (4) a marker beacon receiver, (5) two independent receivers for navigation, and (6) two independent receivers for communications.

(b) No person may operate an aircraft other than that specified in paragraph (a) of this section, under IFR or in extended overwater operations unless it has at least the following radio communication and navigational equipment appropriate to the facilities to be used and which are capable of transmitting to, and receiving from, at any place on the route, at least one ground facility:

(1) a transmitter, (2) two microphones, (3) two headsets or one headset and one speaker, (4) a marker beacon receiver, (5) two independent receivers for navigation, (6) two independent receivers for communications, and (7) for extended overwater operations only, an additional transmitter.

(c) For the purpose of paragraphs (a)(5), (a)(6), (b)(5), and (b)(6) of this section, a receiver is independent if the function of any part of it does not depend on the functioning of any part of another receiver. However, a receiver that can receive both communications and navigational signals may be used in place of a separate communications receiver and separate navigational signal receiver.

135.297 PILOT IN COMMAND: INSTRUMENT PROFICIENCY CHECK REQUIREMENTS

(a) No certificate holder may use a pilot, nor may any person serve, as a pilot in command of an aircraft under IFR unless, since the beginning of the sixth calendar month before that service, that pilot has passed an instrument proficiency check under this section administered by the Administrator or an authorized check pilot.

(b) No pilot may use any type of precision instrument approach procedure under IFR unless, since the beginning of the sixth calendar month before that use, the pilot has satisfactorily demonstrated that type of approach procedure. No pilot may use any type of nonprecision approach procedure under IFR unless, since the beginning of the sixth calendar month before that use, the pilot has satisfactorily demonstrated either that type approach procedure or any other two different types of nonprecision

approach procedures. The instrument approach procedure or procedures must include at least one straight-in approach, one circling approach, and one missed approach. Each type of approach procedure demonstrated must be conducted to published minimums for that procedure.

- (c) The instrument proficiency check required by paragraph (a) of this section consists of an oral or written equipment test and a flight check under simulated or actual IFR conditions. The equipment test includes questions on emergency procedures, engine operation, fuel and lubrication systems, power settings, stall speeds, best engine-out speed, propeller and supercharger operations, and hydraulic, mechanical, and electrical systems, as appropriate. The flight check includes navigation by instruments, recovery from simulated emergencies, and standard instrument approaches involving navigational facilities which that pilot is to be authorized to use. Each pilot taking the instrument proficiency check must show that standard of competence required by § 135.293(d).

(1) The instrument proficiency check must --

(i) For a pilot in command of an airplane under § 135.243(a), include the procedures and maneuvers for an airline transport pilot certificate in the particular type of airplane, if appropriate; and

(ii) For a pilot in command of an airplane or helicopter under § 135.243(c), include the procedures and maneuvers for a commercial pilot certificate with an instrument rating and, if required, for the appropriate type rating.

(2) The instrument proficiency check must be given by an authorized check airman or by the Administrator.

(d) If the pilot in command is assigned to pilot only one type of aircraft, that pilot must take the instrument proficiency check required by paragraph (a) of this section in that type of aircraft.

(e) If the pilot in command is assigned to pilot more than one type of aircraft, that pilot must take the instrument proficiency check required by paragraph (a) of this section in each type of aircraft to which that pilot is assigned, in rotation, but not more than one flight check during each period described in paragraph (a) of this section.

(f) If the pilot in command is assigned to pilot both single-engine and multiengine aircraft, that pilot must initially take the instrument proficiency check required by paragraph (a) of this section in a multiengine aircraft, and each succeeding check alternately in single-engine and multiengine aircraft, but not more than one flight check during each period described in paragraph (a) of this section. Portions of a required flight check may be given in an aircraft

simulator or other appropriate training device, if approved by the Administrator.

(g) If the pilot in command is authorized to use an autopilot system in place of a second in command, that pilot must show, during the required instrument proficiency check, that the pilot is able (without a second in command) both with and without using the autopilot

to --

(1) Conduct instrument operations competently; and

(2) Properly conduct air-ground communications and comply with complex air traffic control instructions.

(3) Each pilot taking the autopilot check must show that, while using the autopilot, the airplane can be operated as proficiently as it would be if a second in command were present to handle air-ground communications and air traffic control instructions. The autopilot check need only be demonstrated once every twelve calendar months during the instrument proficiency check required under paragraph (a) of this section.

Global Positioning System: A guide for the Approval of the GPS Receiver Installation and Operation

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HOW TO NAVIGATE THROUGH THE ELECTRONIC VERSION OF THIS DOCUMENT.

What types of navigation aids are available?

There are two navigation aids available in the document to make reading what you want easier.

- 1) Bookmarks. In Adobe Acrobat Reader, under the "View" menu, select "Bookmarks and Page". You will see several general sections listed along the left-hand side of the screen. Clicking on one of these choices with your cursor will bring you to the first page of the section listed.
- 2) Roll-on Links. Within the text of the first four chapters, there are hundreds of links to other points within the chapters as well as to points in the large reference section at the end. [Note: there are other navigation aids available through Acrobat Reader that are common to any Acrobat file. If you are unfamiliar with these aids, go to the help menu in Acrobat.]

How do I find the Roll-on Links?

These links are not highlighted, underlined, or in any other way obvious to find if you simply look at the page. The way to find the links is to move the cursor onto a word, group of words, a letter, or a number. If the text your cursor is on is a link, the cursor will change from its default appearance to a hand with a pointing index finger. When the cursor looks like a hand with a pointing index finger, click on the text and it will bring you to the new section.

What types of words, groups of words, letters, and numbers have Roll-on Links?

There are four types of information activated with links:

- 1) All lines in the Table of Contents, List of Tables, Checklists, and References have links to their corresponding page number. Click on any line and it will bring you to the section or table you have selected.
- 2) References within the text to tables or other sections of the text. For example, in the sentences, "...this

five-phase process to GPS installations is shown in table 2.1.1. Section 2.1.2 presents..." Moving your cursor onto "table 2.1.1" and clicking will bring you to that table and moving your cursor onto "Section 2.1.2" and clicking will bring you to that section.

3) Requirements and Guidelines endnotes within the text. Within every section of chapters 3 and 4 are endnotes indicated by bolded numbers in parentheses [(1)]. These are all links to the section's corresponding Requirements and Guidelines page, which is a mini-endnote page for the section.

4) Requirements and Guidelines listings. These listings, at the end of most sections in Chapters 3-4 all have links to the references in the back of the report. You can click on the reference section description or its corresponding page number to get to the reference. There are numerous links on these pages, so be careful that the index finger is pointing at exactly the reference you want to see.

Hints:

Some links are very close to others, so be sure that you have the index finger of the cursor in the middle of the text you want.

To make it easier to read and find links, Select "Fit Width" from the "View" menu.

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