ORDER

8400.11

IFR APPROVAL OF DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS) SPECIAL CATEGORY I INSTRUMENT APPROACHES USING PRIVATE GROUND FACILITIES

August 19, 1994

FOREWORD

Industry's rapid development of Global Positioning System (GPS) technology has created the need to establish procedures for approving Differential Global Positioning System (DGPS) operations using commercial and private navigation facilities. Special DGPS procedures are currently being developed at several sites as part of a Federal Aviation Administration (FAA)/Industry GPS implementation effort. These facilities and the associated Special Instrument Approach Procedures are not available for general public use.
This order establishes interim procedures to approve special instrument approach operations using privately owned DGPS installations at U.S. and foreign airports/runways.

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CHAPTER 1. GENERAL

1-1. PURPOSE

This order identifies specific criteria, not presently found in existing standards, which shall be satisfied before Instrument Flight Rules (IFR) operations can be authorized using DGPS Special Instrument Approach Procedures (not for public use) that are based on Instrument Landing System (ILS), Microwave Landing System (MLS), Localizer (LOC), Localizer Type Directional Aid (LDA), and Simplified Directional Facility (SDF) criteria. Also, this order assigns responsibilities for determining that the criteria specified herein are satisfied, or an equivalent level of safety has been demonstrated. These criteria are to be used by all regions, district offices, and field offices for approving the IFR use of special private use DGPS operations based on Special Instrument Approach Procedures. These procedures include approaches based on ILS, MLS, LOC, LDA, and SDF criteria in FAA Order 8260.3, HEREIN AFTER REFERRED TO AS TERPS, FAA Order 8260.36, or International Civil Aviation Organization (ICAO) PANS-OPS. Approach Procedures are not available for general public use. Special private use DGPS ground facilities shall be approved on a case-by-case basis in accordance with this order.

1-2. DISTRIBUTION

This order is distributed to branch level in the Washington headquarters, regions, and centers and to all field offices and facilities.

1-3. AUTHORITY TO CHANGE THIS ORDER

The Associate Administrator for Regulation & Certification, AVR-1 is responsible for this order. Changes to criteria of this order related to DGPS ground facilities in the United States, that involve organizations other than those of AVR shall be coordinated with those organizations. AVR-1 has sole responsibility for criteria related to the use of DGPS ground facilities outside the United States.

1-4. LISTING OF ACRONYMS

The following is a listing of the acronyms contained in this order:
AAF - Associate Administrator for Airway Facilities
AC - Advisory Circular
ACO - Aircraft Certification Office
AEG - Aircraft Evaluation Group
AFM - Aircraft Flight Manual
AFS - Flight Standards Service
AIR - Aircraft Certification Service
AND - Associate Administrator for NAS Development
ANN - Program Director for Navigation and Landing
ASB - Approach Surface Baseline

ASR - Office of Spectrum Policy and Management
AVN - Office of Aviation System Standards
AVR - Associate Administrator for Regulation & Certification
AVS - Associate Administrator for Aviation Standards
CDL - Configuration Deviation List
CG - Center of Gravity
CHDO - Certificate Holding District Office
DA(H) - Decision Altitude (Height)
DGNSS - Differential Global Navigation Satellite System
DGPS - Differential Global Positioning System
DH - Decision Height
DIAS - Differential GNSS Instrument Approach System
DME - Distance Measuring Equipment
DOP - Dilution of Precision
EFIS - Electronic Flight Instrumentation System
FAA - Federal Aviation Administration
FAF - Final Approach Fix
FAR - Federal Aviation Regulation
FAS - Final Approach Segment
FCC - Federal Communications Commission
FMEA - Failure Modes and Effects Analysis
FMS - Flight Management System
FSDO - Flight Standards District Office
FTE - Flight Technical Error
GPI - Ground Point of Intercept
GPIWP - Glidepath Intercept Waypoint
GPS - Global Positioning System
IAS - Intermediate Approach Segment
ICAO - International Civil Aviation Organization
IFR - Instrument Flight Rules
IFWP - Intermediate Fix Waypoint
ILS - Instrument Landing System
IMAWP - Initial Missed Approach Waypoint
IODE - Issue of Data Ephemeris
LDA - Localizer Type Directional Aid
LOC - Localizer
LORAN - Long Range Navigation
MAS - Missed Approach Segment
MASPS - Minimum Aviation System Performance Standards
MEL - Minimum Equipment List
MLS - Microwave Landing System
MMEL - Master Minimum Equipment List
MOA - Memorandum of Agreement
MRB - Maintenance Review Board
NDB - Non Directional Beacon
NOTAM - Notice to Airmen

OMM - Operations and Maintenance Manual
PRN - Pseudo Random Noise Code
RNAV - Area Navigation
ROC - Required Obstacle Clearance
RPI - Runway Point of Intercept
RTCA DGNSS MASPS - RTCA Inc. Document Number RTCA/DO-217, Minimum Aviation System Performance Standards DGNSS Instrument Approach System: Special Category I (SCAT-I), as revised, July 13,1994
RVR - Runway Visual Range
SA - Selective Availability
SCAT - Special Category
SDF - Simplified Directional Facility
SFAR - Special Federal Aviation Regulation
STC - Supplemental Type Certificate
SV - Space Vehicle
TC - Type Certificate
TCH - Threshold Crossing Height
TCWP - Threshold Crossing Waypoint
TERPS - FAA Order 8260.3
TSE - Total System Error
TSO - Technical Standard Order
VHF - Very High Frequency
VOR - Very High Frequency Omnidirectional Range
WGS - World Geodetic System

CHAPTER 2. DGPS GROUND FACILITIES

2-1. SPECIAL PRIVATE USE DGPS GROUND FACILITIES

For the purposes of this order, a special private use DGPS ground facility is a navigation aid that is installed, owned, operated, and maintained by a non-federally owned entity to support private use Special Instrument Approach Procedures. A special private use DGPS ground facility includes a DGPS reference station, ground-based monitor, data link, and appropriate transmitting equipment. These facilities and the associated Special Instrument Approach Procedures are not available for general public use. Special private use DGPS ground facilities shall be approved on a case-by-case basis in accordance with this order.

a. These U.S. facilities are subject to the provisions of the Federal Aviation Act of 1958 as well as Federal Communications Commission Rules Parts 2 and 87. Special Instrument Approach Procedures predicated on these facilities ARE NOT FAR Part 97 public use procedures. Special authorization shall be obtained and special restrictions shall apply to the use of these facilities and procedures.

b. DGPS ground facilities outside the United States are evaluated and approved, in accordance with this order, by the Flight Standards Service (AFS). The Instrument Approach Procedures that are based on these facilities are developed and approved in accordance with this order and existing AFS guidelines.

CHAPTER 3. DGPS SPECIAL CATEGORY I SYSTEMS

3-1. DGPS SPECIAL CATEGORY I SYSTEMS

For the purposes of this order, DGPS Category I systems are defined as instrument approach systems which use DGPS information for lateral flight guidance and DGPS derived geometric heights for vertical flight guidance. If the criteria in this order are met, DGPS Category I instrument approaches can be based on TERPS or ICAO PANS-OPS ILS obstacle clearance criteria, as appropriate. These systems do not include equipment which use barometrically derived information for vertical guidance during the Final Approach Segment (FAS) of an instrument approach.

3-2. BACKGROUND

Industry is very interested in developing a DGPS Category I instrument approach capability. RTCA Task Force 1 strongly recommends that DGPS capability be initially implemented through the use of special privately owned facilities. The Task Force also recommends that the necessary instrument flight procedures be developed through the Special Instrument Approach Procedure process.

a. The FAA has determined that special privately owned DGPS ground facilities in the United States shall be administered through the FAR Part 171 process. Sponsors should be informed that these facilities might not, in the future, be converted to public facilities.

b. The FAA has also determined that all Instrument Approach Procedures based on these facilities shall be developed as Special Instrument Approach Procedures and, as such, ARE NOT considered to be FAR Part 97 public procedures. Special authorization, equipment, and/or training is required before any operator is approved to conduct these DGPS Special Instrument Approach Procedures.

c. RTCA has developed Minimum Aviation System Performance Standards (MASPS) for DGNSS Instrument Approach Systems: Special Category I (SCAT-1). These MASPS (herein referred to as the RTCA DGNSS MASPS), and this order provide criteria for approval of special private use DGPS, Category I Instrument Approach Procedures.

d. FAA Technical Standard Order TSO-C129, Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS), dated December 10, 1992, provides minimum airborne performance standards for approval of IFR use of GPS for oceanic, domestic enroute, terminal, and instrument approach operations. GPS equipment meeting FAA TSO-C129 instrument approach requirements and installed in accordance with AC 20-138 and AC 20-130A can be used to fly Area Navigation (RNAV) procedures developed in accordance with Chapter 15 of TERPS or to fly GPS Instrument Approach Procedures developed in accordance with FAA Order 8260.38, dated December 14, 1993. Under certain constraints, these systems may also be used to fly any instrument approach that is based on

Very High Frequency Omnirange Station (VOR), VOR/Distance Measuring Equipment (DME), Non Directional Beacon (NDB), and NDB/DME criteria in TERPS or ICAO PANS-OPS.

e. When differential corrections are used to counteract GPS inaccuracy including the effects of Selective Availability (SA), GPS avionics can provide accuracy and integrity that is suitable for IFR approach operations with operating minima to as low as Decision Height (DH) 200 and Runway Visual Range (RVR) 1800. DGPS equipment, when used in conjunction with FAA TSO-C129 avionics (unless designated Class D in accordance with the RTCA DGNSS MASPS), can provide a level of service which will permit an aircraft to use DGPS to fly approaches based on ILS, MLS, LOC, LDA, and SDF criteria as specified in Chapter 10 of this Order.

f. Instrument Approach Procedure design, data base design, and airborne system design for all DGPS Category I precision approaches shall define the vertical path relative to a GEOMETRIC GLIDE PATH based on GPS vertical positioning (analogous to an electronic ILS Glide Slope).

g. It should be noted that, due to current flight navigation computer and display limitations, many aircraft currently calculate glide path information from barometric data instead of DGPS derived geometric heights. Since barometric information can, in certain environmental extremes, be less accurate than ILS glideslope information, this order does not address its use in conjunction with GPS. All DGPS Category I precision approach procedures shall be based on a glide path established by DGPS derived geometric heights, as defined in the RTCA DGNSS MASPS.

h. It is also critical to understand that the process of computing the nominal Center of navigation path, based on the waypoints which establish the FAS of an instrument approach, is distinct from the process of creating offsets/biases for specific airplane configurations to achieve a particular wheel crossing height. The Instrument Approach Procedure design shall be based on the straight line segment between the Glidepath Intercept Waypoint (GPIWP) and the Threshold Crossing Waypoint (TCWP).

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.

b. Industry Coordination. Airway Facilities' Management Consulting Staff, AAF-20 and AFS-400 will work any necessary coordination with industry before approval of any new type of U.S. DGPS ground installation or U.S. DGPS Special Instrument Approach Procedure is granted. AFS-400 will work any necessary coordination with industry for all DGPS ground facilities outside the United States.

c. National Policy Guidance. The Associate Administrator for Airway Facilities shall develop national guidance and direction for field approval of DGPS ground installations in the United States. AFS-400 shall develop national guidance and direction for field approval of DGPS ground installations outside the United States. Aircraft Certification's Aircraft Engineering Division, AIR-100 and the Certification Directorates will develop national guidance and direction for approval of DGPS airborne installations. AFS-400 shall develop national guidance and direction for approval of DGPS Category I instrument approaches and approval of operators to conduct these operations. This includes the Instrument Approach Procedure design standards, authority for operators to conduct DGPS operations, and the special private use DGPS ground installations to be used.

AFS-400 shall also develop national guidance and direction for the types and classifications of DGPS ground facilities that operators can use for DGPS operations.

d. Approved Facility List. To facilitate initial implementation of DGPS Category I approaches, AFS-400 shall establish and maintain a national list of the airports and runways, Special Instrument Approach Procedures, aircraft/avionics configurations, and operators approved for DGPS instrument approach operations. For DGPS ground facilities in the United States, the regional Airway Facilities Divisions shall forward information regarding DGPS Category I facility establishment applications to AFS-400 through the regional Flight

Procedures Branch. For facilities outside the United States, the Principal Avionics Inspector for the air carrier or the Flight Standards District Office (FSDO) assigned the FAR Part 91 operator shall forward a ground facility and operations evaluation report, with any recommended limitations and special provisions, to AFS-400 for concurrence, through the regional Flight Standards Division. Each DGPS ground installation approved for use by U.S. operators (or foreign flag operations in the United States) shall be specified in the AFS-400 nationally approved list. The regional Flight Procedure Branches shall forward a copy of all completed DGPS Special Category I Instrument Approach Procedures to AFS-400, for concurrence.

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.

f. Instrument Flight Procedures Implementation. The regional Flight Procedures Branch is responsible for the flight procedures formulation process for Special Instrument Approach Procedures specified in FAA Order 8260.19. The Flight Procedures Branch will also assist the assigned Flight Standards inspector in informing the operator of the data necessary to perform obstruction clearance studies and formulate Instrument Approach Procedures.

g. Flight Inspection. The Office of Aviation System Standards (AVN), shall ensure that flight inspection of DGPS ground radiated signals and DGPS Instrument Approach Procedures are accomplished in accordance with the U.S. Flight Inspection Manual, OA P 8200.1, and current AVN directives and orders.

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.

(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 8 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 5. APPROVAL OF GROUND INSTALLATIONS IN THE UNITED STATES

5-1. ESTABLISHMENT OF GROUND INSTALLATIONS FOR DGPS SPECIAL

CATEGORY I INSTRUMENT APPROACH OPERATIONS IN THE UNITED STATES

a. General. When properly authorized by the FAA, special private use ground installations (facilities) can be established for civil special private use DGPS instrument approach operations. A special private use DGPS ground installation includes the DGPS reference station, ground-based monitor and data link. Approval of the DGPS ground installation includes the siting, radio transmission frequency, physical installation and its performance, commissioning, and inspection and maintenance requirements.

b. Special Private Use DGPS Ground Facility Design, Installation, and Evaluation Criteria. The characteristics specified in the RTCA DGNSS MASPS or equivalent characteristics, shall be used for ground system design, installation, and evaluation. The accuracy, continuity of function, and integrity of function requirements for the special private use DGPS ground system are established by the RTCA DGNSS MASPS. All deviations from the RTCA DGNSS MASPS, except as specified by this order, shall be jointly approved by AFS-400, AIR-100, and Airway Facilities' Office of Spectrum Policy and Management, ASR-1.

c. Establishment of Special Private Use DGPS Ground Facility Design Suitability. To establish an installation, the applicant shall demonstrate that the DGPS ground facility is suitable for the intended operation. An acceptable set of interim requirements for Local Area DGPS facilities are specified in the RTCA DGNSS MASPS or equivalent criteria. To obtain approval, the applicant shall show that the DGPS ground station functions in accordance with the RTCA DGNSS MASPS or equivalent criteria, and this order. The following is a summary of the design criteria:

(1) Accuracy. The applicant shall demonstrate through analysis and flight testing that the DGPS ground installation provides the level of accuracy necessary for safe operations. Demonstrating the accuracy specified in the RTCA DGNSS MASPS for special private use DGPS ground installations is an acceptable means of satisfying this requirement.

(2) Continuity of Function/Reliability. The applicant shall provide sufficient data to establish that the operational reliability of the system meets that the RTCA DGNSS MASPS ground installation Continuity of Function (reliability) criteria, or equivalent.

(3) Integrity of Function. The applicant shall provide a system safety assessment, based on a fault tree and Failure Modes and Effects Analysis (FMEA), to show that the integrity of the ground installation meets the RTCA DGNSS MASPS or equivalent criteria.

(4) Use of Very High Frequency (VHF) Frequencies for Data Transmissions. DGPS data links used in the United States to support IFR flight operations shall use frequencies that are allocated for aeronautical radionavigation purposes. Subject to approval

by ASR-1, use of VHF communication frequencies to transmit DGPS data is limited to research and development, data collection, and operational proof of concept testing.

(5) Data Link Characteristics and DGPS Data Transmission. The data link characteristics specified in the RTCA DGNSS MASPS paragraph 2.4 shall be used. Subject to approval by ASR-1, the unassigned 50 khz VOR channels in the frequency spectrum from 112.0 Mhz to 118.0 Mhz may be used to transmit data link information for special private use DGPS ground installations compliant with the revised MASPS VHF datalink standard (Appendix F, as revised, July 13, 1994). The requirements of the MASPS notwithstanding, other portions of the frequency spectrum that are allocated for aeronautical radionavigation purposes, such as portions of the L Band, may be used to transmit DGPS data link information if acceptable performance can be demonstrated.

(6) Frequency Protection and Federal Communications Commission (FCC) Licensing. The applicant shall pre-coordinate with the responsible regional Airway Facilities Division to obtain a properly engineered frequency assignment for the DGPS ground installation. The applicant shall also obtain any required FCC radio station license to operate on that frequency and, if required, FCC type acceptance of the equipment used.

(7) Facility Identification. The ground installation shall provide a means for the aircraft to positively identify the station being used. The station identification shall be the same as the four letter ICAO identifier of the airport that is geographically closest to the ground facility location.

d. Operations and Maintenance Program for Special Private Use DGPS Ground Facilities. The applicant shall present an acceptable operations and maintenance program, documented in an OMM (See Appendix 1), for the special private use DGPS ground facility. The operational, quality assurance, maintenance, and return to service procedures shall be acceptable to the responsible regional Airway Facilities Division.

e. Flight Inspection of Special Private Use DGPS Ground Facilities and Instrument Approach Procedures. Flight inspection of DGPS ground facilities is required and shall be performed by AVN. A copy of the flight inspection report shall be forwarded to the responsible regional Airway Facilities Division Manager. The following flight inspection criteria shall be used for special private use DGPS ground installations and DGPS Special Instrument Approach Procedures:

(1) General U.S. Flight Inspection Requirements. AVN shall ensure that flight inspection of DGPS ground radiated signals and all DGPS Instrument Approach Procedures are consistent with the RTCA DGNSS MASPS and accomplished in accordance with the U.S. Flight Inspection Manual, OA P 8200.1, and current AVN directives and orders.

(a) Commissioning Requirements. A commissioning flight inspection shall be conducted on a special private use DGPS installation before its IFR approval is issued.

1. Flight Inspection of DGPS Ground Radiated Signals. Commissioning flight inspection may be flown in user aircraft if AVN determines that the necessary ground facility parameters can be properly evaluated.

2. DGPS Instrument Flight Procedures. Flight inspection of instrument flight procedures, in accordance with U.S. Flight Inspection Manual, OA P 8200.1, Section 214.3, shall be performed by AVN flight inspection personnel. Coordination with appropriate FAA organizations will be accomplished when operational constraints, imposed through special authorization, require the use of the appropriate user aircraft.

(b) Periodicity Requirements. Periodicity schedules shall be established by AVN and inspections shall be performed in accordance with the U.S. Flight Inspection Manual, OA P 8200.1, and current AVN directives and orders.

(c) Funding Policy. Pending the issuance of formal establishment criteria, funding for flight inspection of special private use facilities in the United States shall be in accordance with standard practices for reimbursable agreements.

f. DGPS Ground Facility Classification. Each DGPS ground facility used for instrument approaches shall have an approved FAA classification. The classifications assigned to these facilities are equivalent to those assigned to ILS/MLS in accordance with FAA Orders 6750.24 and 8400.8 (as amended). The classification of any DGPS ground facility shall be established by AFS-400. DGPS facilities which meet the requirements of this order can be classified as at least a I/T/1 facility and may be used for DGPS Category I instrument approaches.

g. Application to Establish a Special Private Use DGPS Ground Facility. The DGPS ground facility applicant shall forward, to the Non-Federal Coordinator in the responsible regional Airway Facilities Division, a FAA Form 7460, Notice of Proposed Construction or Alteration, and an application for a non-federal facility (see FAA Order 6700.20A, Appendix 6). The following additional information shall be submitted with the application: a description of the facility; evidence that the ground equipment meets the performance requirements specified in the RTCA DGNSS MASPS or equivalent criteria; an installation plan; a proposed procedure for facility operation; a copy of the FCC application; the training program for all required personnel; the proposed commissioning criteria; the proposed periodic inspection and maintenance program; and a description of any required test equipment and calibration procedures. The application should also specify the persons responsible for operating and maintaining the installation.

h. Special Private Use DGPS Ground Facilities. During this initial implementation phase, each request to establish a special private use DGPS ground facility shall be evaluated on a case-by-case basis in accordance with national guidance and direction provided by this order. Approval of a DGPS facility shall be based on a finding that the facility meets the requirements of the RTCA DGNSS MASPS or equivalent criteria, and the criteria in this order, for the intended operation. The facility performance, as determined by flight tests, shall meet the RTCA DGNSS MASPS or equivalent criteria. In addition, the following requirements shall be met to establish a DGPS ground facility: 1. installation of the equipment shall be

accomplished in accordance with accepted, sound engineering principles; 2. the applicant shall agree to operate and maintain the facility in accordance with the OMM established in accordance with FAA Order 6700.20A; 3. the applicant shall agree to obtain FAA permission prior to withdrawing the facility from service; 4. as required by the FAA, the applicant shall also agree to provide periodic reports and allow FAA inspection of the facility and its operations; 5. the sponsor shall provide FAA approved test equipment and calibration procedures; and 6. the maintenance personnel shall, as a minimum, possess a FCC General Radio Telephone license, provide evidence of "FAA-approved concepts training" on the equipment to be maintained, and possess verification letters from the Airway Facilities Sector of jurisdiction.

i. Special Private Use DGPS Ground Facility Evaluation Process. The regional Airway Facilities Division manager is the focal point for the establishment program for DGPS ground facilities in the United States. The Airway Facilities Division and other regional divisions are responsible for the actions specified in this order and FAA Order 6700.20A, paragraph 13. Requests to establish DGPS ground facilities in the United States shall be processed in accordance with Chapter 2 of FAA Order 6700.20A using the national technical guidance and direction in the RTCA DGNSS MASPS or equivalent criteria, and this order. The requirements in Chapters 3 and 5 of FAA Order 6700.20A, and the national policy guidance and direction specified in this order shall be used to evaluate DGPS ground facilities.

(1) The DGPS ground facility applicant shall conduct an analysis of the 24 hour continuous time-history Dilution of Precision (DOP) characteristics (with 24 GPS satellites operating) for both the ground reference station and monitor. This information shall be made available for the analysis identified in Chapter 7 of this order. This analysis shall be done parametrically for mask angles ranging from O degrees to 15 degrees (1 degree increments), taking into consideration the ground station monitor mask angle and site-specific terrain blocking.

(2) Following a satisfactory ground evaluation and flight inspection, the Airway Facilities Sector shall forward commissioning data to the regional Airway Facilities Division.

5-2. NATIONAL POLICY GUIDANCE FOR DGPS GROUND FACILITIES IN THE UNITED STATES

The Associate Administrator for Airway Facilities shall develop national guidance and direction for establishment of DGPS ground installations in the United States. The radio spectrum requirements shall be developed and the frequency assignments shall be made by ASR-1. AFS-400 shall develop national guidance and direction for the types and classifications of U.S. DGPS ground facilities that can be used to conduct various
DGPS instrument approach operations.

CHAPTER 6. APPROVAL OF GROUND INSTALLATIONS AND DGPS SPECIAL CATEGORY I OPERATIONS OUTSIDE THE UNITED STATES

6-1. ESTABLISHMENT OF GROUND INSTALLATIONS AND APPROVAL TO CONDUCT DGPS SPECIAL CATEGORY I INSTRUMENT APPROACHES OUTSIDE THE UNITED STATES

a. General. Special private use DGPS ground installations (facilities) at locations outside the United States can be approved for use in civil DGPS instrument approach operations by FAR Part 91, 121, 125, and 135 operators when properly authorized by the controlling State's civil aviation authority and approved by the FAA.

(1) A special private use DGPS ground installation includes the DGPS reference station, ground-based monitor, data link, and appropriate transmitting equipment. Approval of the DGPS ground installation includes the siting, radio transmission frequency, physical installation and its performance, commissioning, and inspection and maintenance requirements.

(2) Each DGPS ground installation used for aviation purposes shall have a sponsor which operates under FAR Part 91, 121, 125, or 135. Approval to establish and use a special private use DGPS ground installation is only issued to persons operating under these rules.

b. Special Private Use DGPS Ground Facility Design, Installation, and Evaluation Criteria. The characteristics specified in the RTCA DGNSS MASPS or equivalent characteristics, shall be used for ground system design, installation, and evaluation. The accuracy, continuity of function, and integrity of function requirements for the special private use DGPS ground system are established by the RTCA DGNSS MASPS. All deviations from the RTCA DGNSS MASPS, except as specified in this order, shall be approved by AFS-400 and AIR-100.

c. Establishment of Special Private Use DGPS Ground Facility Design Suitability. To establish an installation, the applicant shall demonstrate that the DGPS ground facility is suitable for the intended operation. An acceptable set of interim requirements for Local Area DGPS facilities are specified in the RTCA DGNSS MASPS or equivalent criteria. To obtain approval, the applicant shall show that the DGPS ground station functions in accordance with the RTCA DGNSS MASPS or equivalent criteria, and this order. The following is a summary of the design criteria:

(1) Accuracy. The applicant shall demonstrate through analysis and flight testing that the DGPS ground installation provides the level of accuracy necessary for safe operations. Demonstrating the accuracy specified in the RTCA DGNSS MASPS for special private use DGPS ground installations is an acceptable means of satisfying this requirement.

(2) Continuity of Function/Reliability. The applicant shall provide sufficient data to establish that the operational reliability of the system meets the RTCA DGNSS MASPS ground installation Continuity of Function (reliability) criteria, or equivalent.

(3) Integrity of Function. The applicant shall provide a system safety assessment, based on a fault tree and FMEA, to show that the integrity of the ground installation meets the RTCA DGNSS MASPS or equivalent criteria.

(4) Data Link Characteristics and DGPS Data Transmission. The data link characteristics specified in the RTCA DGNSS MASPS paragraph 2.4 shall be used. The requirements of the RTCA DGNSS MASPS, as revised, July 13, 1994, notwithstanding, other portions of the frequency spectrum, such as portions of the L Band, may be used to transmit DGPS data link information if acceptable performance can be demonstrated.

(5) Frequency Protection and Licensing. For DGPS ground facilities outside the United States, authorization to use the required aeronautical radio frequencies shall be obtained from the appropriate authority. The applicant shall obtain the necessary frequency protection and licensing approvals from the appropriate telecommunications authority within that sovereign state.

(6) Facility Identification. The ground installation shall provide a means for the aircraft to positively identify the station being used. The station identification shall be the same as the four letter ICAO identifier of the airport that is geographically closest to the ground facility location.

d. Operations and Maintenance Program for Special Private Use DGPS Ground Facilities. The applicant shall present an acceptable operations and maintenance program, documented in an OMM, for the special private use DGPS ground installation outside the United States. The operations and maintenance program shall be evaluated by the Principal Avionics Inspector for the air carrier or the FSDO assigned the FAR Part 91 operator, for acceptability. Selected minimum contents of the OMM are provided in Appendix 1 of this order.

e. Flight Inspection of Special Private Use DGPS Ground Facilities and Instrument Approach Procedures. Flight inspection of DGPS ground facilities, by either AVN or the applicant, is required. The following flight inspection criteria shall be used for special private use DGPS ground installations and DGPS Special Instrument Approach Procedures:

(1) Flight Inspection of Facilities Outside the United States. The flight inspection requirements for DGPS ground facilities outside the United States will, to the maximum extent possible, be equivalent to those in the U.S. Standard Flight Inspection Manual, OA P 8200.1, and current AVN directives and orders. The applicant is responsible for providing the proper resources to accomplish required flight inspection tasks.

(2) Commissioning Requirements. A commissioning flight inspection shall be conducted on a special private use DGPS installation before its IFR approval is issued.

(3) Periodicity Requirements. Periodicity schedules for DGPS ground facilities outside the United States will be established in the authorization for U.S. operators to use those facilities. These requirements will, to the maximum extent possible, be equivalent to those in the U.S. Flight Inspection Manual, OA P 8200.1, and current AVN directives and orders. The periodicity inspections shall also be accomplished in accordance with these criteria. The sponsor is responsible for providing the proper resources to accomplish required flight inspection tasks.

(4) Funding Policy. If AVN resources are used to flight inspect special private use foreign DGPS facilities and instrument flight procedures, funding for these activities shall be in accordance with standard practices for reimbursable agreements.

f. DGPS Ground Facility Classification. Each DGPS ground facility used for instrument approaches shall have an approved FAA classification. The classifications assigned to these facilities are equivalent to those assigned to ILS/MLS in accordance with FAA Orders 6750.24 and 8400.8 (as amended). The classification of any DGPS ground facility shall be established by AFS-400. DGPS facilities which meet the requirements of this order can be classified as at least a I/T/1 facility and may be used for DGPS Category I instrument approaches.

g. Application for Approval to Use a Special Private Use DGPS Ground Facility. Any special private use DGPS ground facility used by U.S. operators shall be evaluated by AFS. Authorization to operate and/or use a foreign special private use DGPS ground installation to support a DGPS Special Instrument Approach Procedure can only be granted to a “sponsor” operating under FAR Part 91, 121, 125, or 135. The sponsor shall submit a letter of application to obtain this approval. The application shall include: a description of the facility; evidence that the ground equipment meets the performance requirements specified in the RTCA DGNSS MASPS or equivalent criteria; an installation plan; a proposed procedure for facility operation; the training program for all required personnel; the proposed commissioning criteria; the proposed periodic inspection and maintenance program; and a description of any required test equipment and calibration procedures. The application should specify the persons responsible for operating and maintaining the installation. The application shall also include copies of any licenses and authorizations required by the appropriate telecommunications authority for that sovereign state.

h. Special Private Use DGPS Ground Facility Evaluation Process. AFS shall evaluate these installations in accordance with this order, the RTCA DGNSS MASPS or equivalent criteria, and current AFS directives and orders. Approval to use a special private use DGPS ground installation shall only be issued to persons operating under FAR Part 91, 121, 125, or 135. FAR Part 121, 125, and 135 applicants shall submit a letter of application to the CHDO. FAR Part 91 applicants shall submit a letter of application to the assigned FSDO. The CHDO or FSDO shall forward, upon receipt of the request, information regarding the application to AFS-400, through the regional Flight Standards Division. Evaluation of the DGPS ground facility shall be managed by the Principal Avionics Inspector for the air carrier or the FSDO assigned the FAR Part 91 operator. Although, if delegated by the responsible inspector, the actual on-site evaluation may be performed by another avionics specialist.

(1) The DGPS ground facility applicant shall conduct an analysis of the 24-hour continuous time-history DOP characteristics (with 24 GPS satellites operating) for both the ground reference station and monitor. This information shall be made available for the analysis identified in Chapter 7 of this order.

(2) Following a satisfactory ground facility evaluation and flight inspection, a ground facility and operations evaluation report, with any recommended limitations and special provisions, shall be forwarded to AFS-400, through the regional Flight Standards Division, for concurrence.

(3) The applicant shall agree to notify the FAA prior to withdrawing the facility from service. Also, the applicant shall agree to provide periodic reports and allow FAA inspection of the facility and its operations, when requested by the FAA

i. Approval to Use Special Private Use DGPS Ground Facilities Outside the United States. During this initial implementation phase, each request for approval to use a special private use DGPS ground facility shall be evaluated on a case-by-case basis in accordance with national guidance and direction provided by this order. Recommendations for approval shall be based on a finding that the facility and approach operation meet, for the intended operation, the requirements of the RTCA DGNSS MASPS or equivalent criteria, and the criteria in this order (including the applicable criteria specified in Chapter 8) or equivalent. The approval to use the private DGPS ground station with any necessary limitations, provisions, and procedures shall be specified in the operations specification or a Letter of Authorization issued to the sponsor, as appropriate. AFS-400 concurrence shall be obtained prior to issuing any approvals to conduct instrument approach operations using special private use DGPS ground installations outside the United States in conjunction with the foreign countries Civil Aviation organization.

6-2. NATIONAL POLICY GUIDANCE FOR DGPS GROUND FACILITIES OUTSIDE THE UNITED STATES

AFS-400, with assistance from AIR-100, shall develop national guidance and direction for approval of DGPS ground installations outside the United States. AFS-400 shall also develop national guidance and direction for the types and classifications of DGPS ground facilities outside the United States that can be used to conduct various DGPS instrument approach operations.

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 the 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 meets the criteria of this order.

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

(1) General DGPS Category I Criteria. Unless otherwise specified in this order, all DGPS Category I installations shall meet the criteria specified in the RTCA DGNSS MASPS or equivalent criteria.

(2) DGPS System Availability. 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.

(3) Interface With Other Aircraft Systems. The interface with other airborne equipment shall be designed such that normal or abnormal operation of DGPS equipment shall not adversely affect the operation of other equipment. Except as specifically permitted by this order or the RTCA DGNSS MASPS, normal or abnormal operation of other airborne equipment shall not adversely affect the operation of DGPS equipment. The DGPS system shall be compatible with the installed displays, flight directors, and autopilots. The interface with all other aircraft systems, such as Flight Data Recorders or Ground Proximity Warning

Systems, should be equivalent to that provided for existing ILS instrument approach operations.

(4) Limitations of RTCA DGNSS MASPS Class D Equipment. Compliance with the RTCA DGNSS MASPS Class D equipment does not necessarily provide basic RNAV capability to navigate the aircraft to the Intermediate Fix Waypoint (IFWP) or to the Initial Missed Approach Waypoint (IMAWP). The TERPS criteria, charting specifications, and air traffic requirements being developed for future implementation of DGPS approaches will require the aircraft to navigate using unaugmented GPS to the initial fix waypoint and continue to the intermediate approach waypoint (if specified) through to a missed approach holding waypoint. Aircraft that do not provide this capability will not be compatible with the planned National Airspace System. In order for an aircraft to be approved to conduct DGNSS approaches, these basic RNAV functions shall be provided by either the RTCA DGNSS MASPS airborne equipment and/or other navigation equipment on the airplane.

b. Cockpit Navigation Displays. The cockpit navigation displays used for DGPS operations shall meet the following special criteria:

(1) Lateral Situation Displays. DGPS lateral situation displays should meet criteria in the RTCA DGNSS MASPS or equivalent criteria. If an Electronic Flight Information System (EFIS) map display is used for DGPS Category I operations, it shall be used with a lateral deviation display that meets the requirements of the RTCA DGNSS MASPS.

(2) Vertical Situation Displays. DGPS Category I vertical situation displays should meet criteria in the RTCA DGNSS MASPS or equivalent criteria.

(3) Display of the Navigation Source. The source (VOR, DME, DGPS, Flight Management System (FMS), etc.) of the primary navigation information shall be continuously and unambiguously displayed to the pilot. The position of a properly identified rotary switch is acceptable.

(4) If suitable manual flight raw data Flight Technical Error (FTE) cannot be demonstrated, installations using a flight director or an autopilot may be approved if suitable FTE can be demonstrated with this configuration.

c. Annunciation and Alerting. Flight crew annunciations and alerts shall be provided and shall be consistent with the overall flight deck crew alerting philosophy for the specific airplane type. The annunciation and alerts for vertical modes should be provided separately from those used for lateral modes.

(1) Automatic Selection of GPS and DGPS Sources. Automatic switching between DGPS and GPS navigation sources is permitted when the DGPS equipment is not operating in the “approach mode”. Automatic DGPS and GPS navigation source switching is prohibited once the approach mode is activated. Automatic switching between DGPS and GPS sources in enroute and terminal area operations shall be annunciated only by illuminating the appropriate navigation source light, or an equivalent method.

(2) DGPS Approach Mode Annunciation. For DGPS Category I installations, a means shall be provided to indicate to the flight crew that the DGPS system is operating and meets all requirements including integrity, accuracy, station selection, and waypoint selection necessary for the intended instrument approach. This annunciation is intended to be independent of the flight guidance mode annunciation.

(a) Approach Mode Activation. There shall be a capability for the pilot to manually select the DGPS approach mode for DGPS Category I instrument approaches. In addition, automatic activation of the DGPS approach mode may be used for DGPS Category I instrument approaches, if a suitable alerting message plus a distinct mode annunciation (or equivalent alerting scheme) is provided. The annunciation of DGPS approach mode selection (either automatic or manual) shall be compatible with the selected navigation source information, or result in a separate alert/message. The DGPS approach mode selection process may also be used to select the desired navigation source (i.e., selecting the DGPS Category I approach mode can also select DGPS as the primary navigation source).

(b) DGPS Selection. Engaging the DGPS approach mode shall cause the following to occur: 1. the lateral and vertical guidance displays shall revert to the approved scale sensitivities for the approach selected, 2. the DGPS approach mode annunciation shall be continuously displayed within the pilots primary field of view, and 3. the waypoint transition alert at the TCWP shall be automatically disabled.

(c) GPS Selection. Engaging the GPS approach mode, if provided, shall cause the following to occur: 1. the lateral guidance display shall revert to the approved nonprecision approach scale sensitivity, and 2. the GPS approach mode annunciation shall be continuously displayed within the pilots primary field of view. It is desirable for engagement of the GPS mode to cause the GPS navigation source to be selected. This facilitates reversion to GPS navigation following a DGPS failure or loss of signal. For the purposes of this order, DGPS equipment is not required to provide a GPS mode of operation.

(4) Missed Approach Selection. A means shall be provided to facilitate the selection of missed approach guidance. If GPS, RNAV, or FMS is used to provide missed approach guidance, a means to readily sequence to the next waypoint is also required to facilitate transition to the Missed Approach Segment (MAS). A maximum of 2 separate key strokes or pilot actions is acceptable to select the missed approach guidance provided that the entire sequence can be completed within 5 seconds under the workload typically associated with executing a missed approach.

d. Lateral and Vertical Path Definition and Alarm Limits. Acceptable methods of defining lateral and vertical paths for all DGPS equipment are specified in Chapter 10 of this order.

(1) Glidepath Adjustment. The DGPS avionics should provide an offset to compensate for the difference in location of the phase center of the antenna used to receive GPS satellite signals and the center of navigation of the aircraft. This offset should also

assure as a priority that the minimum acceptable wheel crossing clearance is at least 18 feet (95% confidence) with 25 feet preferred. The process of computing the nominal path based on the waypoints should be distinct from the process of creating offsets/biases for specific aircraft configurations.

(2) Total System Error (TSE) Containment Warning Adjustments. The DGPS avionics shall account for the physical dimensions of the aircraft in which it is installed when computing the TSE containment warning. The aircraft semi-wing span should be used in computations for the horizontal TSE containment warning. The vertical dimension of the aircraft, allowing for antenna position and offset, should be used in computations for the vertical TSE containment warning.

e. Waypoint Modification. Modification by the pilot of any data identified in Chapter 11 of this order and any other waypoint identified as a “high precision” waypoint shall not be possible. The system design, data base standards, and operating procedures shall specify which information pilots or operators can add, delete, or modify.

f. Instrument Approach Data. All DGPS Category I instrument approaches shall be called up from a data base contained within the avionics. The flight paths constructed from these data shall meet the levels of integrity specified in the RTCA DGNSS MASPS. DGPS instrument approach waypoints that are manually defined by the pilot are not permitted. The data base used for DGPS instrument approaches shall include the requirements of Chapter 11 of this order.

g. Approach Path Integrity Check. The airborne equipment shall verify the integrity of the glidepath between the GPIWP and TCWP prior to engaging the DGPS Category I approach mode. An acceptable method of verifying the integrity of the waypoints is to use the coordinates of the GPIWP and TCWP to compute the three dimensional coordinates of the final approach path integrity check point. The results of this computation should be compared with the final approach integrity check point coordinates from the data base associated with the glidepath. The mathematical comparisons should agree within 0.1 arc seconds for the latitude and longitude coordinates and 1.0 foot for altitude. Failure of any of these comparisons should result in the display of the vertical and horizontal flags, and removal of the glidepath deviation and cross track deviation information.

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 identification 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 of 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 data base, 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 station “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.

i. Steep Angle Airworthiness Approval Criteria. The criteria in this order can be used to approve installations for DGPS instrument approach operations with glide path angles of 4.0 degrees or less. For approach angles of more than 4.0 degrees, the airplane should meet the requirements of FAA AC 25-7, Criteria for Approval of Steep Approach to Landing, in addition to any applicable criteria of this order. The AFM or AFM Supplement should state any instrument approach glide path angle restrictions.

j. Analysis, Tests, and Demonstrations. Except as otherwise described in this order, analysis, tests, and demonstrations should be in accordance with applicable criteria of the RTCA DGNSS MASPS, AC 20-138, and AC 20-138A, as appropriate.

(1) System Safety Assessment. The applicant shall provide a system safety assessment, based on a fault tree and FMEA, to show that the ground installation, data link, and airborne installation meet the apportioned levels of integrity as specified in the RTCA DGNSS MASPS, Appendix D or equivalent criteria.

(2) Airborne Equipment Software. Any DGPS airborne equipment software shall be approved as part of the type design during TC or STC process. The RTCA DGNSS MASPS integrity requirements are based on the assumption that obstacle clearance is established by the use of the 1.0×10^{-7} containment surfaces. As a result, a failure which places the aircraft outside the dimensions of the boundary is considered to be a Severe Major event and, in accordance with RTCA DO-178B, the software which is associated with navigational integrity should be developed to Level B.

(3) Airborne Equipment Environmental Qualification. The applicant shall provide an assessment to determine if the airborne equipment environmental qualification is appropriate for the aircraft installation.

(4) Systems Dependent on the Uplink of Waypoints. Airborne installations that are dependent on the uplink of waypoints as a means of meeting the integrity requirement of the RTCA DGNSS MASPS are not assured interoperatility with other differential DGNSS installations. In addition, those systems will not support public use operations using either local area or wide area DGNSS. For this reason, it is recommended that the airborne database achieve the necessary integrity without reliance on uplinking of waypoints.

(5) Acceptance. Results of any simulations or flight demonstrations of the failure conditions noted above should be consistent with results of any related failure analysis submitted.

k. Airborne System Maintenance. The Instructions for Continued Airworthiness for the airborne system shall be developed during the TC or STC process. These instructions should include those elements required by FAR Parts 23, 25, 27, and 29, as applicable. Also, the Instructions for Continued Airworthiness may be referenced in the operator’s maintenance manual for the DGPS airborne system.

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 properly 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 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 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 Operators. 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.

CHAPTER 9. AERONAUTICAL INFORMATION

9-1. AERONAUTICAL INFORMATION

Notices to Airmen (NOTAM's) are not provided for Special Instrument Approach Procedures. NOTAMs are provided by the National Flight Data Center regarding outages of the GPS constellation by individual Space Vehicle (SV) Number and Pseudo Random Noise (PRN) Number.

NOTE: Chapter 8 of this order requires that a procedure shall be established for the flight crew (and dispatcher, if applicable) to determine, prior to departure and inflight, that any required DGPS approaches will be available at the destination airport.

CHAPTER 10. INTERIM DESIGN CRITERIA

10-1. INTERIM STANDARD, DGPS SPECIAL CATEGORY I INSTRUMENT APPROACH PROCEDURE DESIGN CRITERIA

Until appropriate criteria is established in TERPS and ICAO PANS-OPS, as applicable, the following interim standard criteria shall be utilized to develop DGPS Special Category I Instrument Approach Procedures:

a. Instrument Flight Procedure Formulation. The formulation and issuance of DGPS Special Category I Instrument Approach Procedures shall be accomplished in accordance with the following criteria:

(1) Procedure Formulation In the United States. AVN is responsible for formulating procedures for all DGPS Special Instrument Approach Procedures that are based on facilities in the United States.

(2) Procedure Formulation Outside the United States. The formulation of DGPS Instrument Flight Procedures for facilities outside the United States shall be accomplished in accordance with FAA Order 8260.31 (as amended) and the applicant's operations specifications or Letter of Authorization, as appropriate.

(3) Procedure Identification. All DGPS Special Category I Instrument Approach Procedures will be identified with the appropriate runway number (e.g., DGPS CAT I RWY 24).

(4) Coordinate Systems. All DGPS Special Category I Instrument Approach Procedures in the United States shall use WGS-84 earth reference coordinates. Procedures outside the United States which comply with this Order shall also use WGS-84 earth reference stations.

(5) Electronic Standards. The procedure design criteria shall assume that the DGPS ground equipment and avionics meet the RTCA DGNSS MASPS or equivalent criteria.

(6) Vertical Guidance Sources. DGPS Special Category I Instrument Approach Procedure design shall assume that the glide path guidance is based on GEOMETRIC HEIGHTS derived from DGPS information. It shall also be assumed that this guidance is acceptable for DH200 and RVR1800 instrument approach operations.

(7) Interim DGPS Steep Angle Criteria. Steep Angle criteria are applied when airplanes use a glide path angle of more than 3.0 degrees. For the purposes of this order, Steep Angle approaches for fixed wing aircraft shall use a descent angle of 6.0 degrees or less, and adequate threshold crossing clearance shall be verified for the aircraft type using that approach procedure. Until appropriate criteria are established in TERPS or ICAO PANS-OPS, the criteria in FAA Order 8260.36 shall be utilized to develop Steep Angle DGPS Special Instrument Approach Procedures.

(8) Interim DGPS Helicopter Criteria. For helicopters, the maximum glide path angle is 9.0 degrees. Until appropriate criteria are established in TERPS or ICAO PANS-OPS, the criteria in FAA Order 8260.37 shall be utilized to develop DGPS instrument approaches to heliports. Helicopter instrument approach operations to runways should initially use the instrument approach design criteria for airplanes specified in this chapter.

b. Special Instrument Approach Procedure Policy. All DGPS Special Category I approaches based on special private use facilities shall be developed as Special Instrument Approach Procedures. The DGPS Category I concept is based on an “ILS-like” procedure where the lateral and vertical guidance is provided from DGPS derived geographic positions and geometric heights, respectively.

(1) Use of TERPS or ICAO PANS-OPS Design Criteria. DGPS Special Category I Instrument Approach Procedures shall be initially based on TERPS or ICAO PANS-OPS ILS obstacle clearance criteria. The lowest height for IFR flight shall be expressed as a DH minimum.

(a) U.S. Glide Paths Equal To or Less Than 3.0 Degrees. DGPS Special Category I Instrument Approach Procedures for U.S. installations shall be designed in accordance with the criteria for ILS precision approaches contained in Chapter 9 of TERPS or ICAO PANS-OPS. The obstacle clearance areas, the Required Obstacle Clearance (ROC), and the missed approach criteria shall apply as described in Chapter 9 of TERPS.

(b) U.S. Glide Paths Greater Than 3.0 Degrees. FAA Order 8260.36 shall be used to develop fixed wing aircraft DGPS Special Category I procedures which have glide paths exceeding 3.0 degrees.

(c) DGPS Ground Facilities Outside the United States. DGPS approach procedures for installations outside the United States shall be based on TERPS or ICAO PANS-OPS ILS criteria, as appropriate. The operating minima for DGPS Special Category I approach procedures shall be based on ILS criteria in TERPS or ICAO PANS-OPS, as appropriate.

(d) Instrument Approach Procedures at Heliports. DGPS Special Category I Instrument Approach Procedures to heliports shall be designed in accordance with FAA Order 8260.37.

(e) Operating Minima. The operating minima for DGPS Special Category I Instrument Approach Procedures shall be based on ILS criteria in TERPS, FAA Orders 8260.36 and 8260.37, or ICAO PANS-OPS, as appropriate.

(2) Preferred Siting Criteria for DGPS Stand-Alone Procedures. The following provisions establish the preferred siting criteria for all DGPS Special Category I Instrument Approach Procedures that are not co-located with an existing ILS or MLS approach. Procedure design should assume that the DGPS lateral guidance will emulate the operation of

a localizer (azimuth) antenna located at a standard traditional site on a 9,000 foot runway (10,000 feet localizer-to-threshold distance). The alignment of any offset approach course shall intercept the extended runway centerline, on the glide path, at a point 1100 to 1200 feet toward the threshold from the Decision Altitude (Height) (DA(H)) point. The preferred glide path angle is 3.0 degrees with a course width of ±0.7 degrees; the preferred Threshold Crossing Height (TCH) is 55 feet and the preferred Ground Point of Intercept (GPI) is 1049 feet past the landing threshold. Other values can be used if operational advantages can be gained. In this case, the most critical civil aircraft likely to use that approach shall be considered in making this decision.

(3) Siting Criteria for Precision Approach Overlays. For DGPS Category I approaches which overlay existing ILS or MLS approaches, the DGPS approach shall use the same glide path angle, TCH, and GPI as the ILS or MLS approach unless operational advantage can be gained by using a different glide path angle. The most critical civil aircraft likely to use that approach shall be considered in making this determination.

c. Required Geodetic Data. The following geodetic data are required to be supplied with a request to establish a DGPS Category I instrument approach. All geodetic data shall be specified as WGS-84 coordinates.

(1) The surveyed location of the runway approach threshold at centerline, the departure end of the runway at centerline, and the phase center of the DGPS ground antenna shall be specified to an absolute accuracy of at least 6.0 feet horizontally and vertically.

(2) The positions of the runway ends at centerline and the phase center of the ground station GPS antenna listed in (1) above, in WGS-84 coordinates, shall be specified to a relative accuracy of 0.1 feet laterally and vertically.

d. Approach Path Description. The approach path consists of an intermediate approach and a FAS. These segments are defined by three waypoints: the IFWP, the GPIWP, and the TCWP. A GPS MAS may also be used and is defined using an IMAWP. See figure 11-1, DGPS Approach Segments and Special Waypoints.

(1) The Intermediate Approach Segment (IAS). The IAS begins at the IFWP, which is a two-dimensional waypoint, and extends to the point at which the barometric altitude specified for the IAS intersects the glidepath.

(2) The Glidepath. The glidepath is defined by two precision, three-dimensional waypoints: the GPIWP and the TCWP. The glidepath is formed by a line, extending infinitely in each direction, through these two points.

(3) The Final Approach Segment. The FAS extends from the point at which the barometric altitude specified for the IAS intersects the glidepath to the DA(H) point on the glidepath. The glidepath should meet the requirements of FAA Order 8260.34, TCH requirements, and TERPS or ICAO PANS-OPS, as appropriate.

(4) A Final Approach Fix (FAF) should be established coincident with the GPIWP unless operationally advantageous to locate it closer to the runway.

e. Computation of Approach Segments and Approach Path Waypoints. The approach segments and approach path waypoints used in DGPS Category I instrument approaches should be computed in accordance with the criteria in this order. Unless specified otherwise in this paragraph, the approach path waypoint coordinates shall be computed with a relative accuracy of at least one foot and a resolution of 0.01 arc seconds horizontally, and an accuracy and resolution of 0.1 foot vertically. Unless otherwise specified, the coordinates shall be provided in the relative coordinate system used to establish the TCWP and the location of the phase center of the DGPS ground system antenna.

(1) Runway Centerline Bearing. As a reference for computing the GPIWP, the surveyed runway approach threshold and departure end points, at centerline, will be used to compute the True Bearing of the runway centerline to a resolution of 0.001 degrees.

(2) TCH Determination. The glidepath shall provide adequate wheel crossing clearance at the threshold for the intended aircraft types using the DGPS approach. The TCH requirements of FAA Order 8260.34, Glide Slope TCH requirements, and the requirements of this order shall be used to establish the TCH. For DGPS approaches which overlay an ILS or MLS approach, the Runway TCWP is located at the ILS TCH.

(3) Computing the TCWP. The TCWP shall be located above the runway threshold and the runway centerline at a height equal to the TCH for the procedure. The TCWP coordinates shall be specified in WGS-84 references for all three dimensions. The coordinates of the TCWP shall be specified to 0.01 arc seconds and 0.1 feet vertically.

(4) Computing the Glidepath. The glide path will normally overlay the extended centerline and will be computed in relation to the Approach Surface Baseline (ASB) in accordance with Chapter 9 of TERPS or ICAO PANS-OPS. The glide path is defined by a line through the TCWP, extending infinitely in each direction. If the glide path is laterally offset from the centerline, the glidepath angle will be computed relative to a horizontal plane tangent to the threshold and containing the ASB. For procedure design purposes, the intersection of this line and the ASB is the GPI, and the intersection with the runway centerline is the Runway Point of Intercept (RPI). The maximum and minimum angles, without special approval, for DGPS FAS's which overlay existing approaches are 3.25 and 2.75 degrees, respectively. For stand-alone DGPS Category I approaches, the use of angles other than 3.0 degrees requires special approval.

(5) Computing the FAS and GPIWP. The FAS is a line segment defined by the "three dimensional" GPWIP and the TCWP. The coordinates of the GPIWP shall be specified to 0.01 arc seconds and 0.1 feet vertically, in WGS-84 computed relative to the runway threshold.

(6) Final Approach Integrity Checkpoint. In addition to the high precision waypoints defining the final approach path, a high precision point located midway between the GPIWP and TCWPP and collinear with the waypoints will be supplied. The coordinates of the Final

Approach Integrity Checkpoint shall be specified to 0.01 arc seconds laterally and 0.1 feet vertically in WGS-84. The data on this checkpoint is provided for integrity checking by the airborne equipment, and is not a waypoint for the approach procedure.

(7) Computing the IAS and IFWP. The length of the IAS shall be established in accordance with TERPS or ICAO PANS-OPS. The centerline of the IAS is formed by a line through the IFWP and the GPIWP at the barometric altitude assigned for the IAS, and extends from the IFWP to the glideslope intercept point. The IFWP shall be laterally aligned with the final approach. The IFWP is a two dimensional waypoint and shall be computed in the relative reference coordinate system to a resolution of 0.01 arc seconds, and shall be specified in WGS-84 earth referenced coordinates to a resolution of 0.01 arc minutes.

f. MAS and IMAWP. Standard criteria in Chapter 9 of TERPS, FAA Orders 8260.36 and 8260.37, or ICAO PANS-OPS, as appropriate, shall be used to establish the MAS of DGPS Special Instrument Approach Procedures. The IMAWP is an optional two dimensional waypoint. It shall be computed in the relative reference coordinate system to a resolution of 0.01 arc seconds, and shall be specified in WGS-84 earth referenced coordinates to a resolution of 0.01 arc minutes. If an IMAWP is used, it shall lie along the final approach course extended.

g. Waypoint Name Word Length. The following guidelines are provided for word lengths of waypoints used in the design of DGPS Category I instrument approaches. These guidelines are provided to facilitate procedure development and evolution of DGPS instrument approaches.

(1) Five-Character. “Five-character” identifiers should be used for “frequent use” waypoints serving air/ground communication or charting (e.g., “NOBBY” intersection, RW25L, etc.). Five-Character identifiers should be used for DGPS Instrument Approach Procedure waypoints.

h. Approval. Approval of GPS/DGPS Instrument Approach Procedures shall be in accordance with this order, FAA Order 8260.19 coordination requirements for “Special Instrument Approach Procedures”, and FAA Order 8400.10 Vol 4, Ch 2. The DGPS Category I Instrument Approach Procedure should be documented on FAA Form 8260-7.

CHAPTER 11. AIRBORNE DATA BASE

11-1. AIRBORNE DATA BASE

The DGPS data used for instrument approaches shall be verified using a procedure acceptable to the cognizant ACO and shall be included in the airborne data base. In addition, the following requirements apply:

a. High Precision Waypoints. The high precision waypoints which define the glidepath, i.e., the GPIWP and TCWP, for each special instrument approach shall be stored in the data base with the resolution specified in Chapter 10 of this order.

b. Standard-Precision Waypoints. Two standard-precision waypoints may be developed as part of the procedure. These two-dimensional waypoints will be in WGS-84 coordinates specified to a resolution of 0.01 arc minutes.

(1) The IFWP shall be located at the beginning of the intermediate segment. The intermediate segment extends to the GPIWP. The IFWP may be used as an approach intercept waypoint.

(2) The IMAWP is located along the final approach course extended. This point can serve as the clearance limit or the point from which terminal or enroute navigation can be continued.

c. High Precision Waypoint Verification. The applicant shall provide a means of meeting the requirements for integrity of waypoint data defined in paragraph 2.1.3.2.2 of the RTCA DGNSS MASPS. An acceptable means of verification is the comparison of the final approach integrity check point with the midpoint computed by the airborne system. If this method is used, the resolution of the final approach integrity check point coordinates shall be as specified in Chapter 10 of this Order.

APPENDIX 1. OPERATIONS AND MAINTENANCE MANUAL (OMM) FOR DGPS GROUND FACILITIES OUTSIDE THE UNITED STATES

1. PURPOSE. This describes the minimum contents of the Operations and Maintenance Manual (OMM) for DGPS ground facilities outside the United States.

2. BACKGROUND. An acceptable operations and maintenance program, documented in an OMM, shall be provided for the special private use DGPS ground facility installed outside the United States.

3. MANUAL CONTENTS. The OMM shall include the following as a minimum:

NOTE: Other sources for documenting the following items may be incorporated by reference if they are readily available and are acceptable to the responsible Flight Standards inspector.

a. Theory and Principles of Operation. The manual shall present a concise overview of system operation, including hardware interfaces, component functions, monitoring and maintenance philosophy.

b. Technical Performance Parameters. The manual shall provide a complete list of all technical performance parameters for each system function and/or components. Each of the parameters listed shall show a nominal value and the acceptable range that has been established by the manufacturer and accepted during commissioning. In addition, those performance parameters that are crucial to system performance shall be identified as “Key Performance Parameters”.

c. Certification Requirements. The manual shall identify all system performance parameters that are to be routinely evaluated to insure proper operation of the ground station. It shall also state the intervals for system evaluation and facility certification, which in any case shall NOT EXCEED 90 DAYS.

d. Facility Operation. The manual shall provide procedures for the satisfactory operation of the facility. These operating procedures shall include necessary guidelines for normal and abnormal operations.

e. Periodic Maintenance Requirements. The manual shall list all required periodic maintenance activities and their scheduled intervals. Each periodic maintenance activity shall describe the procedure for performing that maintenance task.

f. Maintenance Procedures. The manual shall provide a detailed description (i.e., procedures) of all foreseeable maintenance tasks, including all the periodic maintenance activities identified in the Periodic Maintenance Requirements paragraph above. A listing of all necessary test equipment and associated calibration requirements for each, shall be provided in the manual. Also, the accept/reject criteria shall be provided for each procedure.

g. Personnel and Facilities. The manual shall identify contract maintenance facilities if maintenance is to be performed off-site. The manual shall also list the authorized, qualified, certificated, and/or licensed personnel to be used in the maintenance and Return to Service of the DGPS ground facility. Training and certificates and/or authorizations held should be included for each authorized individual.

h. Return to Service. The manual shall provide procedures for returning the facility to service. These procedures shall include quality assurance and inspection tasks associated with accepting new equipment, as well as returning repaired equipment to service.

i. Records. All activities relating to the DGPS ground installation shall be recorded. The manual shall provide the procedures and describe the documents to be used for recording all activities, including all site visits, all periodic and corrective maintenance, all equipment failures, all observed technical performance parameters, and all facility certifications. Such records will comprise the legal written record of facility operation and shall be maintained on site for a minimum of two years. The records shall be maintained for longer periods if required by other regulations or laws of the foreign country.

j. Documentation Control. To ensure currency and availability, the manual shall specify the procedures for controlling all documents, specifications, technical data (including software), and other essential information used in the operation of the DGPS ground facility.

APPENDIX 2. OPERATOR'S MAINTENANCE MANUAL FOR THE DGPS AIRBORNE SYSTEM

1. PURPOSE. This provides selected minimum criteria that shall be included in the operator's maintenance manual for the DGPS airborne system.

2. BACKGROUND. An acceptable maintenance program, documented in the operator's maintenance manual, shall be provided for the DGPS airborne system. Reference to the manufacturer's Instructions for Continued Airworthiness may be made in the operator's manual, where appropriate.

3. MANUAL CONTENTS. The operator's maintenance manual shall include the following as a minimum:

NOTE: Other sources for documenting a portion of the following items may be used if acceptable to the responsible Flight Standards inspector.

a. Program Scope. The manual shall state the classifications of maintenance (e.g., A, B, and C) including the persons authorized to perform it, and the inspections, repairs, bench and ramp checks, and overhaul activities to be performed.

b. Performance of Maintenance. The manual shall provide a list of the maintenance that will be performed under contract, as well as the maintenance to be performed by the operator.

c. Personnel and Facilities. The manual shall describe the qualified and certificated personnel, and the maintenance facilities to be used in the maintenance of the DGPS airborne system.

d. Service Difficulties. The manual shall outline a method(s) to assess unusual service difficulties and operational problems. Quick identification and resolution of difficulties is particularly important during the period of initial introduction of the GPS\DGPS system.

e. Periodic Inspection. The manual shall list the components to be inspected and the inspections to be performed at each periodic inspection, as appropriate (a reference to the manufacturer's Instructions for Continued Airworthiness may be used).

f. Bench Checks. The manual shall provide the bench check procedures to be used (a reference to the manufacturer's Instructions for Continued Airworthiness may be used).

g. Overhaul. The manual shall provide the overhaul procedures to be used (a reference to the manufacturer's Instructions for Continued Airworthiness may be used).

h. Ramp Check. The manual shall specify the procedures, type of test equipment, calibration of test equipment, and frequency of ramp check inspections to be used.

i. Maintenance Documentation. The manual shall include the following information:

(1) Procedures to insure that all required documentation is available and current. This includes all manuals, specifications, technical data (including software), and other essential information used in the maintenance of the airborne DGPS system.

(2) Personnel responsible for controlling the required maintenance documentation.

(3) A sample of all maintenance and inspection forms used in maintenance of the DGPS airborne system, accompanied by the procedures for completing the forms.

j. Records. The manual shall outline the methods for recording failures, and the procedures used to assure that repairs, periodic inspections, and required maintenance are accomplished as required. All maintenance records shall be kept for a minimum of two years. The records shall be kept for longer periods if required by other regulations.

k. Maintenance Performance. The manual shall include a statement that all maintenance shall be performed in accordance with the manual.

l. Reporting Requirements. The manual shall include the following reporting requirements:

(1) Procedures to immediately report significant difficulties to the applicable aircraft manufacturer, avionics manufacturer, and FAA, as appropriate and as required by the applicable FAR.

(2) Procedures to furnish the CHDO or assigned FSDO with a copy of all alterations, including technical data or reference thereto. This includes all accomplishment of service bulletins, service letters, etc.

APPENDIX 3. AUTHORIZATION TO USE DGPS SPECIAL CATEGORY I INSTRUMENT APPROACH PROCEDURES

1. PURPOSE. This provides a sample Letter of Authorization for FAR Part 91 operators to conduct DGPS Special Category I Instrument Approach Procedures.

2. SAMPLE LETTER. The following is a sample Letter of Authorization for FAR Part 91 operators to conduct DGPS Special Category I Instrument Approach Procedures:

LETTER OF AUTHORIZATION PROVISIONS

1. The DGPS airborne equipment shall be approved in accordance with the specifications of FAA Order 8400.XXXX and other criteria established for the implementation of DGPS Special Instrument Approach Procedures.

2. An appropriately qualified instrument rated pilot, familiar with the DGPS Special Instrument Approach Procedure being flown, shall serve as the pilot-in-command during the conduct of that instrument approach.

3. Prior to beginning the FAS of the DGPS Special Instrument Approach Procedure, the pilot-in-command shall assure that:

a. The appropriate instrument procedure is used and the proper approach clearance, if required, has been received.

b. An approved differential correction source is being used when beginning the FAS.

4. The DGPS instrument approach shall be discontinued if the DGPS system or the airborne avionics required for the approach being flown fail or become inoperative.

5. The specified DGPS Special Instrument Approach Procedures are authorized at the following airports and no other DGPS Instrument Approach Procedures shall be flown at any location under IFR weather conditions. FAA Form 8260-7 for the authorized procedures shall, at all times, be attached to this Letter of Authorization.

(Airport) **(Special Instrument Approach Procedure)**
Attachment

APPENDIX 4. TECHNICAL REQUIREMENTS

1. TECHNICAL REQUIREMENTS FOR THE DGPS INSTRUMENT APPROACH SYSTEM

a. This order and the RTCA, Inc. Document Number RTCA/DO-217, Minimum Aviation System Performance Standards DGNSS Instrument Approach System: Special Category I (SCAT-I), as revised, July 13, 1994, HEREIN AFTER REFERRED TO AS THE RTCA DGNSS MASPS, Sections 1, 2, and 3, establish the technical requirements for the design, installation, and evaluation of the DGPS with the following changes:

NOTE: A Copy of the RTCA DGNSS MASPS can be obtained from:

RTCA Incorporated
1140 Connecticut Avenue, Northwest, Suite 1020
Washington, DC 20036-4001, USA
Telephone: (202) 833-9339
Facsimile: (202) 883-9434

(1) Change 1.2.2.4 by replacing "There is no requirement for a downlinking capability for the DIAS application." with: "There is no requirement for a downlinking capability for the DIAS application, however, if the capability is available, use of it for DIAS applications shall be prohibited by design."

(2) Change 2.1.6 by replacing the second paragraph with: "In addition to satisfying the nominal update period noted above, SCAT-I data links shall be operated in such a manner that the probability of the longest possible interval between received differential correction updates (Type 1 message in Normative Appendix A) in the typical local radio frequency environment exceeding 15 seconds during an approach is less than $6x10^{-6.}$

(3) Delete entire 2.1.7 and replace with: "**DGPS Operational Service Volume** In general, the differential correction signal is an omni-directional signal-in-space. The DGPS ground facility must provide the minimum usable differential correction signal (as specified in the RTCA DGNSS MASPS) and will be verified within the following maneuvering area about the glidepath: laterally, beginning at 450 feet each side of the Threshold Crossing Waypoint (TCWP) out to plus or minus 10 degrees either side of the glidepath at 20 nautical miles; and vertically, beginning at the runway threshold and a point 20 feet above the TCWP out to plus or minus ½ of the glidepath angle at 20 nautical miles. In accordance with the RTCA DGNSS MASPS, the DGPS ground facility operational service volume is required down to a height of 75 feet above the runway threshold."

(4) Table 2.2.2-1b:

Change: "2377' (+2 deg.)", "1418", and "Based on ILS, using a 9000' runway plus 1000' localizer clearance"
To: "2477 (+2 deg.)", "1413", and "* Full-Scale Deflection = (10,000 ft.** + Distance to TCWP) x .035", respectively, and
Add: "** Based on ILS, using 9000' runway plus 1000' localizer clearance".

(5) Modify 2.2.2.1.2 by adding the following at the end of the fifth sentence: "The translation from the GNSS antenna to another location shall include pitch/roll lever arm factors of the aircraft on final approach."

(6) Information regarding 2.2.2.2.1: This paragraph requires a GNSS status indicator for all classes of equipment. Class D equipment may meet this requirement by displaying the navigation flags (vertical and horizontal) with the guidance information out of view until the equipment is receiving and applying corrections from the ground station associated with the selected approach. Paragraph 2.2.2.2.1 also requires a DIAS Approach Mode Indication for all classes of equipment. Since Class D equipment has only one mode, this indication is not required, however, if the navigation information is on a shared display, the source of the navigation information being displayed must be indicated to the pilot. There should be no contradictory source information indicated to the pilot.

(7) Delete entire 2.2.2.8 and replace with: "The equipment shall provide a means of selecting a precision approach procedure. A means shall be provided to activate the selected approach. See Section 1.0, Appendix H, and FAA TSO-C129 for a discussion of the transition into and out of DIAS Approach Mode, including necessary waypoints."

(8) Delete entire 2.2.2.9 and replace with: "The equipment must have a means of displaying the names of all waypoints of the approach and a means to indicate the current "TO" waypoint. The system is not required to display the latitude and longitude of these points. The system must not display the altitude of the GPIWP or TCWP to avoid possible confusion between barometric and geometric altitudes."

(9) Information regarding 2.2.2.12: This paragraph references paragraph 2.2.2.11 for the resolution requirements for the display of flight plan/navigation data. Instead of the requirements specified in 2.2.2.11, the latitude and longitude should be displayed to a minimum resolution of .01 arc minutes and the altitudes (if required) to 10 feet.

(10) Change 2.2.2.14 by replacing the last sentence of the first paragraph with: "The system may provide digital outputs in any industry standard output format (e.g., ARINC 429)."

(11) Modify 2.2.3.1.1 by adding the following:

"1. The airborne GPS equipment should be shown to meet accuracy requirements when subjected to a radiated signal with continuous wave (CW) modulation at a frequency of

1.57542 Ghz (L1 frequency) and an isotropic radiated field strength of 20 mv/meter measured at the exterior case of the GPS receiver. The radiated susceptibility test procedures of RTCA/DO-160C, Section 20, should be followed when conducting this test. This test should be conducted with simulated satellite and DGPS signal inputs and should not result in the loss of track of any satellite used for navigation or loss of the DGPS correction signal. The duration of the test must be sufficient to determine if tracking has been lost (20 seconds should normally be long enough, depending on the coasting features used by the particular GPS equipment).

NOTE: This test is intended to verify adequate shielding of the GPS receiver itself, not protection from strong on-frequency interference received through the antenna.

2. Intermodulation effects are possible between multiple channel SATCOM installations and GPS. GPS equipment should not be certified in aircraft with multiple channel SATCOM equipment unless the SATCOM equipment has been demonstrated not to interfere with the reception of GPS.

3. Harmonic interference (12^{th} and 13^{th} harmonic) from VHF transmissions on 121.150, 121.175, 121.200, 131.250, 131.275, and 131.300 Mhz has been observed to adversely affect reception of the GPS signal. Low pass or notch filters (with an insertion loss of 2 Db or less or the aircraft VHF COM radio must be re-certified) installed at the output of the VHF transmitter to attenuate the undesired harmonic signal, or modification of the VHF transmitter to improve internal harmonic attenuation, may be required. Shorted stubs, of appropriate lengths, could also possibly provide effective filtering and antenna matching."

(12) Modify 2.2.5, subparagraph e. to add the following:

"The pass/fail criteria for the direct effects of lightning are:

1. Following the application of the lightning currents, the antenna must be capable of maintaining pressure integrity of the aircraft on which it is installed;

2. The antenna must not fail in a way that would damage the aircraft structure to which it is mounted; and

3. The antenna need not be functional following the tests."

(13) Modify 2.5.1 by adding a new subparagraph as follows: "i. <u>GPS Constellation</u> In order to accurately simulate the GPS Constellation, a Selective Availability Model shall be integrated into the tests."

(14) Table 2.5-1

Change: The reference "3.3.3.5" (associated with the "Requirement Paragraph" of "2.1.7")
To: "3.3.3.2";

Change: References “3.3.3.3” (associated with the “Requirement Paragraphs” of “2.2.1.4”, “2.2.1.5”, and “2.2.1.6”)
To: “3.3.3.1”;

Change: Reference “3.3.3.5” (associated with the “Requirement Paragraph” of “2.2.3.2.4”)
To: “3.3.3.1”;

Change: “Integrity alarm tx’d within 4 secs. (latency)” (associated with the “Requirement Paragraph” of “2.3.2.5”)
To: “Integrity alarm tx’d within 3 secs. (latency)”; and

Change: “3.3.3.5” (associated with the “Requirement Paragraph” of “2.3.3.3.1”)
To: “3.3.3.2”.

(15) Applicants should note that flight path points identified as waypoints in Table 2.5-3, Table 2.5-4, Table 2.5-5, and Table 2.5-6 in the RTCA DGNSS MASPS are not waypoints but are flight path test points. The simulated aircraft should fly the path defined by the test points. However, the waypoints defining the FAS in all airborne equipment bench tests are Waypoint 2 and Waypoint 4 in paragraph 2.5.3.5 of the RTCA DGNSS MASPS. The points identified as Waypoint 1 and Waypoint 3 in paragraph 2.5.3.7 are flight path test points and not waypoints.

(a) For the purpose of the simulation test, the following shall be assumed:

1. The vertical distance between the aircraft center of navigation and the bottom of the landing gear shall be assumed to be 20 feet.

2. The lateral distance between the aircraft center of navigation and the wingtip shall be assumed to be 110 feet.

3. The vertical distance between the aircraft center of navigation and the top of the empennage shall be assumed to be 30 feet.

(b) In lieu of the requirements of Table 2.5-3, Figure 2.5-2, Table 2.5-4, Figure 2.5-3, Figure 2.5-4, Table 2.5-5, Figure 2.5-5, Figure 2.5-6, and Table 2.5-6 the following tables and associated figures shall be used:

Table 2.5-3
Horizontal Boundary Test Waypoints

HAT	Leg #	Initial Test Point	95% Performance Boundary	Containment Boundary	Full Scale Deflection Test Point	Final Test Point
1500	1	39.49989250 N 74.67756870 W 1594.0 ft.	39.49862012 N 74.67844222 W 1593.9 ft.	39.49628128 N 74.68004779 W 1593.9ft.	39.49669815 N 74.67976162 W 1593.9 ft.	39.49627643 N 74.68005112 W 1593.9 ft.
1500	2	39.49989250 N 74.67756870 W 1594.0 ft.	39.50116494 N 74.67669511 W 1593.9 ft.	39.50350373 N 74.67508931 W 1593.9 ft.	39.50308687 N 74.67537554 W 1593.9 ft.	39.50350858 N 74.67508599 W 1593.9 ft.
1250	3	39.49375380 N 74.66263990 W 1338.2 ft.	39.49268252 N 74.66337526 W 1338.1 ft.	39.49071206 N 74.66472784 W 1338.2 ft.	39.49096412 N 74.66455482 W 1338.2 ft.	39.49070721 N 74.66473117 W 1338.2 ft.
1250	4	39.49375380 N 74.66263990 W 1338.2 ft.	39.49482505 N 74.66190447 W 1338.1 ft.	39.49679548 N 74.66055173 W 1338.2 ft.	39.49654342 N 74.66072477 W 1338.2 ft.	39.49680033 N 74.66054840 W 1338.2 ft.
1000	5	39.48761300 N 74.64771330 W 1083.5 ft	39.48674528 N 74.64830891 W 1083.5 ft.	39.48514320 N 74.64940854 W 1083.5 ft.	39.48522803 N 74.64935032 W 1083.5 ft.	39.48513835 N 74.64941187 W 1083.5 ft.
1000	6	39.48761300 N 74.64771330 W 1083.5 ft	39.48848066 N 74.64711773 W 1083.5 ft.	39.49008271 N 74.64601799 W 1083.5 ft.	39.48999789 N 74.64607623 W 1083.5 ft.	39.49008756 N 74.64601467 W 1083.5 ft.
750	7	39.48147010 N 74.63278900 W 830.0 ft.	39.48080355 N 74.63324652 W 829.9 ft.	39.47956501 N 74.63409656 W 829.9 ft.	39.47948988 N 74.63414812 W 829.9 ft.	N/A (see note)
750	8	39.48147010 N 74.63278900 W 830.0 ft.	39.48213661 N 74.63233157 W 829.9 ft.	39.48337513 N 74.63148147 W 829.9 ft.	39.48345027 N 74.63142990 W 829.9 ft.	N/A
500	9	39.47532510 N 74.61786700 W 577.5 ft.	39.47485976 N 74.61818641 W 577.4 ft.	39.47399204 N 74.61878189 W 577.4 ft.	39.47374724 N 74.61894989 W 577.4 ft.	N/A
500	10	39.47532510 N 74.61786700 W 577.5 ft.	39.47579048 N 74.61754766 W 577.4 ft.	39.47665819 N 74.61695214 W 577.4 ft.	39.47690299 N 74.61678413 W 577.4 ft.	N/A
400	11	39.47286660 N 74.61189890 W 476.8 ft.	39.47248360 N 74.61216167 W 476.7 ft.	39.47176131 N 74.61265734 W 476.7 ft.	39.47169344 N 74.61270392 W 476.7 ft.	N/A
400	12	39.47286660 N 74.61189890 W 476.8 ft.	39.47324951 N 74.61163605 W 476.7 ft.	39.47397180 N 74.61114036 W 476.7 ft.	39.47403966 N 74.61109378 W 476.7 ft.	N/A
300	13	39.47040770 N 74.60593110 W 376.2 ft.	39.47010469 N 74.60613897 W 376.2 ft.	39.46953025 N 74.60653317 W 376.2 ft.	39.46915456 N 74.60679097 W 376.2 ft.	N/A
300	14	39.47040770 N 74.60593110 W 376.2 ft.	39.47071064 N 74.60572314 W 376.2 ft.	39.47128508 N 74.60532893 W 376.2 ft.	39.47166076 N 74.60507111 W 376.2 ft.	N/A

Table 2.5-3 (cont.)
Horizontal Boundary Test Waypoints

250	15	39.46917810 N 74.60294730 W 326.0 ft.	39.46889208 N 74.60314355 W 326.0 ft.	39.46835400 N 74.60351280 W 326.0 ft.	39.46800497 N 74.60375230 W 326.0 ft.	N/A
250	16	39.46917810 N 74.60294730 W 362.0 ft.	39.46946410 N 74.60275102 W 326.0 ft.	39.47000218 N 74.60238176 W 326.0 ft.	39.47035121 N 74.60214224 W 326.0 ft.	N/A
200	17	39.46794840 N 74.59996360 W 275.9 ft.	39.46768182 N 74.60014657 W 275.9 ft.	39.46718009 N 74.60049086 W 275.9 ft.	39.46685772 N 74.60071207 W 275.9 ft.	N/A
200	18	39.46794840 N 74.59996360 W 275.9 ft.	39.46821506 N 74.59978065 W 275.9 ft.	39.46871678 N 74.59943635 W 275.9 ft.	39.46903915 N 74.59921513 W 275.9 ft.	N/A
100	19	39.46548890 N 74.59399650 W 175.7 ft.	39.46530709 N 74.59412127 W 175.7 ft.	39.46496291 N 74.59435744 W 175.7 ft.	39.46456056 N 74.59463353 W 175.7 ft.	N/A
100	20	39.46548890 N 74.59399650 W 175.7 ft.	39.46567067 N 74.59387179 W 175.7 ft.	39.46601485 N 74.59363561 W 175.7 ft.	39.46641720 N 74.59335951 W 175.7 ft.	N/A
50	21	39.46425900 N 74.59101310 W 125.7 ft.	39.46413536 N 74.59109794 W 125.7 ft.	39.46392691 N 74.59124098 W 125.7 ft.	39.46341064 N 74.59159523 W 125.7 ft.	N/A
50	22	39.46425900 N 74.59101310 W 125.7 ft.	39.46438259 N 74.59092830 W 125.7 ft.	39.46459104 N 74.59078526 W 125.7 ft.	39.46510732 N 74.59043100 W 125.7 ft.	N/A
0	23	39.46302900 N 74.58802980 W 75.7 ft.	39.46296355 N 74.58807471 W 75.7 ft.	39.46280600 N 74.58818282 W 75.7 ft.	39.46226064 N 74.58855703 W 75.7 ft.	N/A
0	24	39.46302900 N 74.58802980 W 75.7 ft.	39.46309444 N 74.58798490 W 75.7 ft.	39.46325199 N 74.58787680 W 75.7 ft.	39.46379735 N 74.58750258 W 75.7 ft.	N/A

Note: Use the “Full Scale Deflection Test Point” as the “Final Test Point” for all flight legs below the 1000’ HAT test cases. The reason is because the full scale deflection is outside the outer tunnel below the 1000’ HAT test case.

Figure 2.5-2
Horizontal Boundary Test

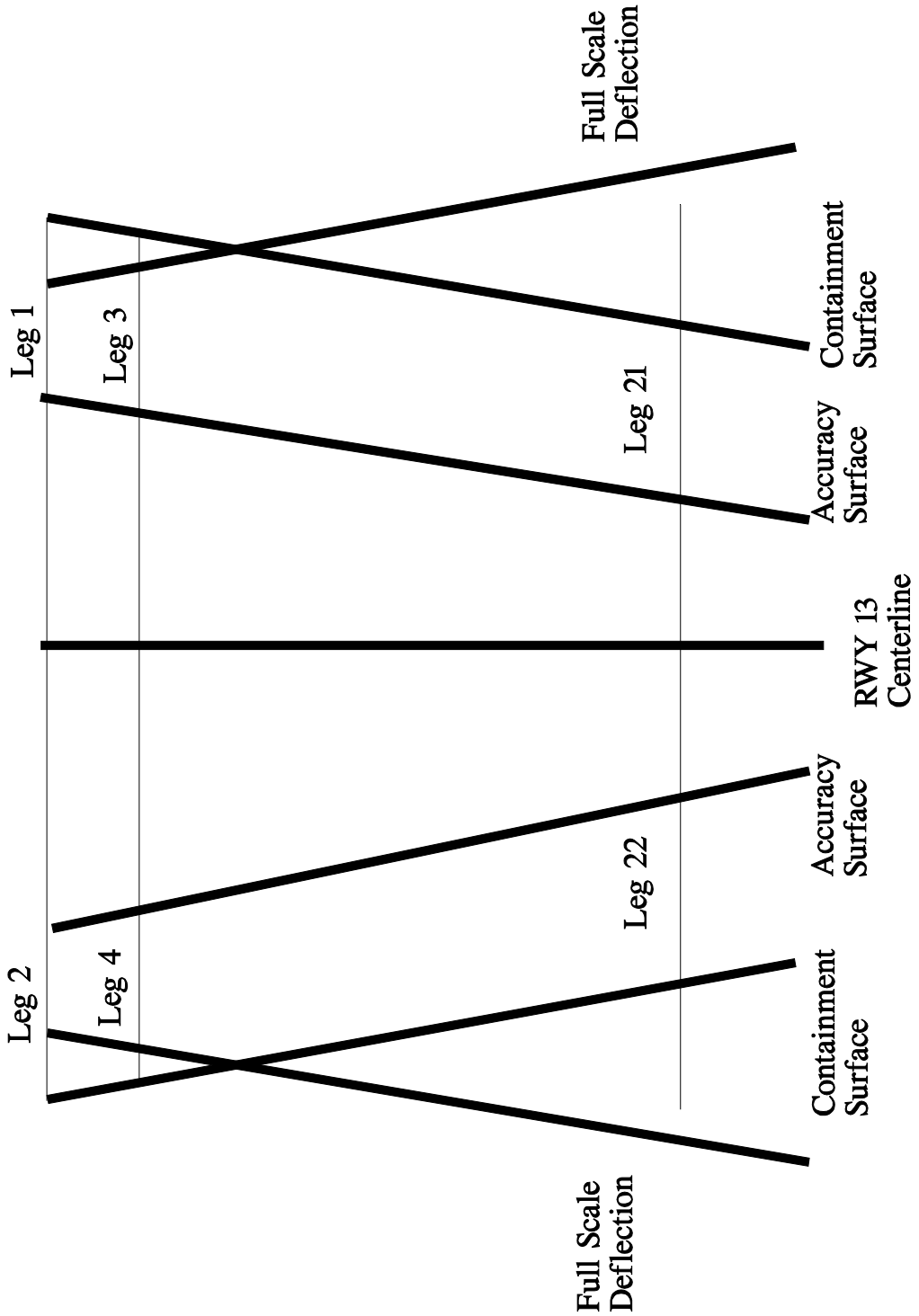

Table 2.5-4
Vertical Path Deviation Test Waypoints

Leg #	HAT	Initial Test Point	Full Scale Deflection Test Point
1	1500	39.50075199 N 74.67965453 W 1628.8 ft.	39.49989253 N 74.67756868 W 1243.9 ft.
2	1250	39.49446838 N 74.66437398 W 1367.2 ft.	39.49375379 N 74.66263987 W 1047.1 ft.
3	1000	39.48818514 N 74.64910169 W 1106.7 ft.	39.48761297 N 74.64771333 W 850.5 ft.
4	750	39.48189983 N 74.63383173 W 847.4 ft.	39.48147008 N 74.63278905 W 654.9 ft.
5	500	39.47561244 N 74.61856409 W 589.1 ft.	39.47532512 N 74.61786703 W 460.4 ft.
6	400	39.47309494 N 74.61245291 W 486.0 ft.	39.47286656 N 74.61189886 W 383.7 ft.
7	300	39.47057957 N 74.60634807 W 383.2 ft.	39.47040766 N 74.60593106 W 306.2 ft.
8	250	39.46932053 N 74.60329281 W 331.8 ft.	39.46917809 N 74.60294729 W 268.0 ft.
9	200	39.46806386 N 74.60024360 W 280.6 ft.	39.46794844 N 74.59996361 W 228.9 ft.
10	100	39.46554536 N 74.59413354 W 178.0 ft.	39.46548888 N 74.59399653 W 152.7 ft.

Figure 2.5-3
Vertical Full Scale Deflection

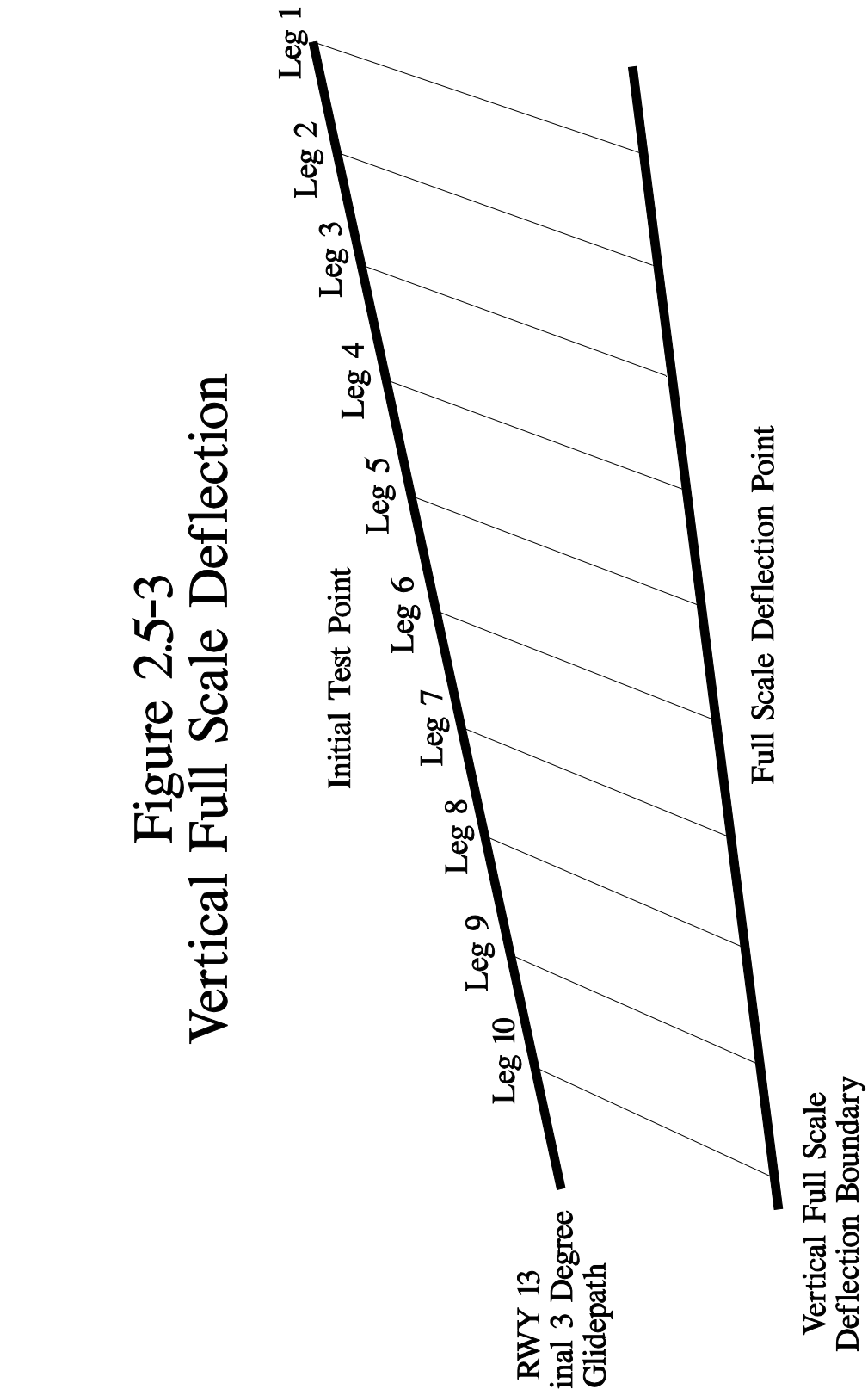

Table 2.5-5

Flight Legs for 95% Vertical Accuracy Test

Leg #	HAT	Initial Test Point	95% Performance Boundary	Final Test point
1	1500	39.50030999 N 74.67858180 W 1610.8 ft.	39.49989253 N 74.67756868 W 1423.9 ft.	39.49989253 N 74.67756868 W 1421.9 ft
2	1250	39.49410495 N 74.66349202 W 1352.4 ft.	39.49375379 N 74.66263987 W 1195.1 ft.	39.49375379 N 74.66263987 W 1193.1 ft.
3	1000	39.48789538 N 74.64839857 W 1094.9 ft.	39.48761297 N 74.64771333 W 968.5 ft.	39.48761297 N 74.64771333 W 965.5 ft.
4	750	39.48168864 N 74.63331933 W 838.8 ft.	39.48147008 N 74.63278905 W 740.9 ft.	39.48147008 N 74.63278905 W 738.9 ft.
5	500	39.47547738 N 74.61823641 W 583.6 ft.	39.47532512 N 74.61786703 W 515.4 ft.	39.47532512 N 74.61786703 W 513.4 ft.
6	400	39.47299180 N 74.61220270 W 481.8 ft.	39.47286656 N 74.61189886 W 425.7 ft.	39.47286656 N 74.61189886 W 423.7 ft.
7	300	39.47050589 N 74.60616935 W 380.2 ft.	39.47040766 N 74.60593106 W 336.2 ft.	39.47040766 N 74.60593106 W 334.2 ft.
8	250	39.46926650 N 74.60316175 W 329.6 ft.	39.46917809 N 74.60294729 W 290.0 ft.	39.46917809 N 74.60294729 W 288.0 ft.
9	200	39.46802702 N 74.60015424 W 279.1 ft.	39.46794844 N 74.59996361 W 243.9 ft.	39.46794844 N 74.59996361 W 241.9 ft.
10	100	39.46552572 N 74.59408588 W 177.2 ft.	39.46548888 N 74.59399653 W 160.7 ft.	39.46548888 N 74.59399653 W 158.7 ft.

Figure 2.5-5
95% Vertical Accuracy Surface

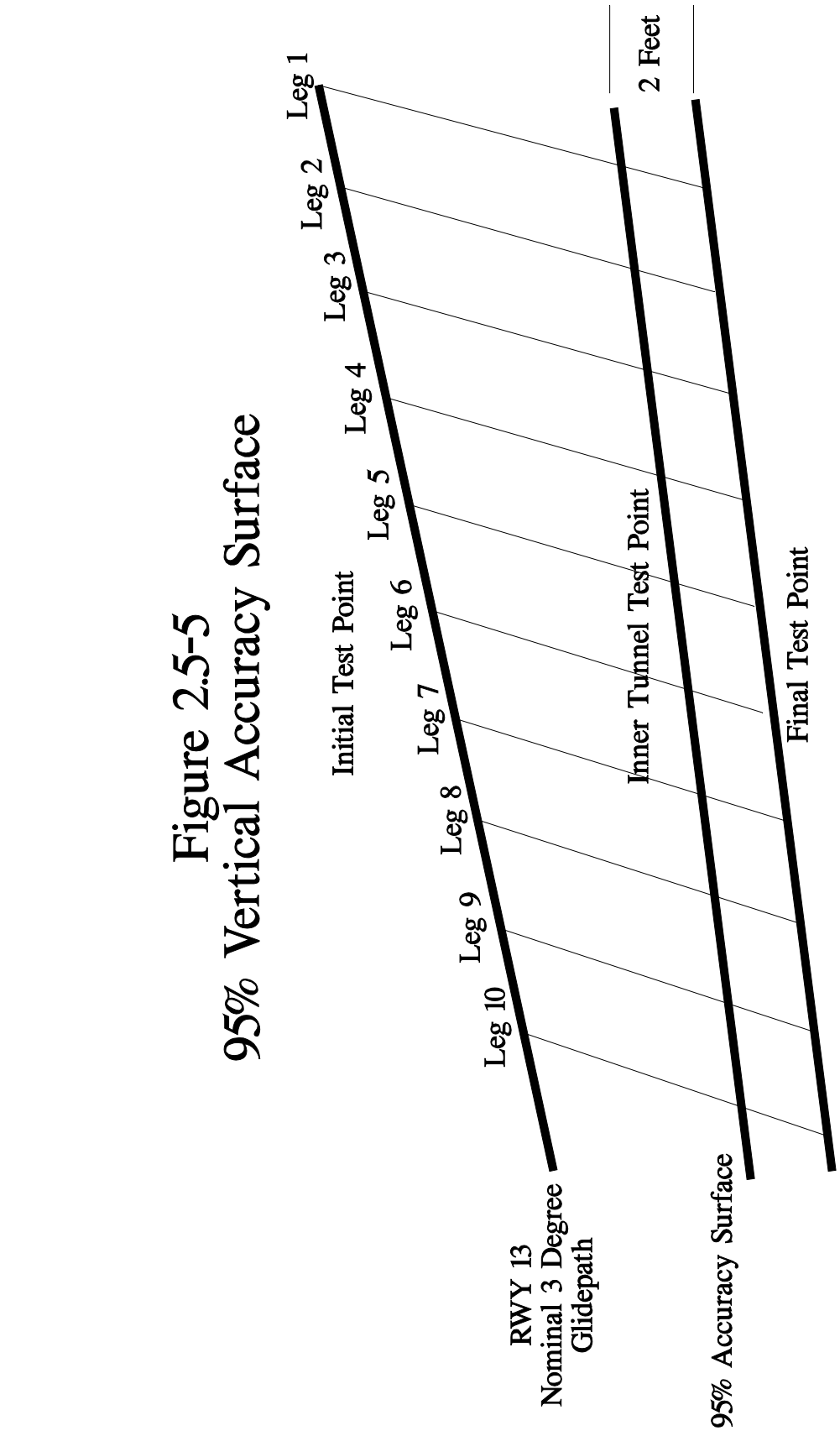

Figure 2.5-6
Vertical Containment Surface

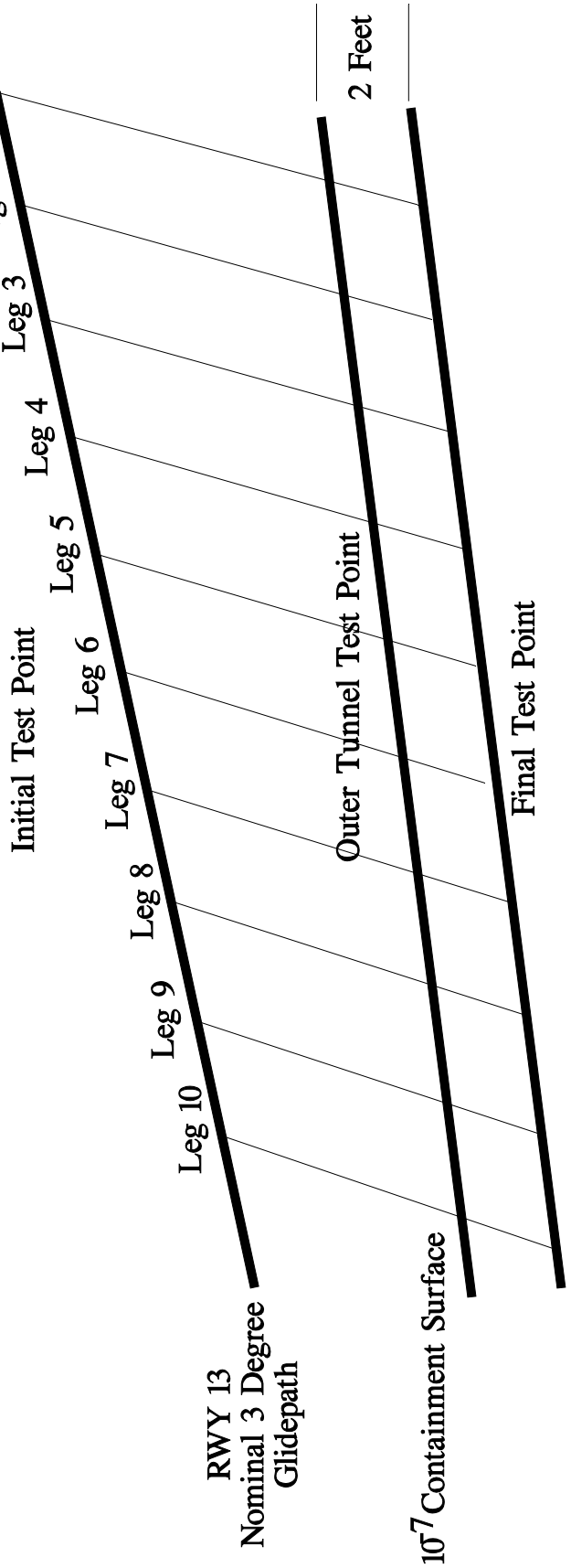

Table 2.5-6

Flight Legs for Vertical Containment Surface

Leg #	HAT	Initial Test Point	Containment Boundary	Final Test Point
1	1500	39.50107121 N 74.68042929 W 1641.8 ft.	39.49989253 N 74.67756868 W 1113.9 ft.	39.49989253 N 74.67756868 W 1111.9 ft.
2	1250	39.49474586 N 74.66504736 W 1378.5 ft.	39.49375379 N 74.66263987 W 934.1 ft.	39.49375379 N 74.66263987 W 932.1 ft.
3	1000	39.48841843 N 74.64966777 W 1116.2 ft.	39.48761297 N 74.67713330 W 755.5 ft.	39.48761297 N 74.67713330 W 753.5 ft.
4	750	39.48208892 N 74.63429052 W 855.1 ft.	39.48147008 N 74.63278905 W 577.9 ft.	39.48147008 N 74.63278905 W 575.9 ft.
5	500	39.47575733 N 74.61891560 W 595.0 ft.	39.47532512 N 74.61786703 W 401.4 ft.	39.47532512 N 74.61786703 W 399.4 ft.
6	400	39.47322264 N 74.61276271 W 491.2 ft.	39.47286656 N 74.61189886 W 331.7 ft.	39.47286656 N 74.61189886 W 329.7 ft.
7	300	39.47069008 N 74.60661615 W 387.7 ft.	39.47040766 N 74.60593106 W 261.2 ft.	39.47040766 N 74.60593106 W 259.2 ft.
8	250	39.46943104 N 74.60356089 W 336.3 ft.	39.46917809 N 74.60294729 W 223.0 ft.	39.46917809 N 74.60294729 W 221.0 ft.
9	200	39.46816946 N 74.60049976 W 284.9 ft.	39.46794844 N 74.59996361 W 185.9 ft.	39.46794844 N 74.59996361 W 183.9 ft.
10	100	39.46559939 N 74.59426459 W 180.2 ft.	39.46548888 N 74.59399653 W 130.7 ft.	39.46548888 N 74.59399653 W 128.7 ft.

(16) Paragraph 2.5.3.1

Replace paragraph b with the following text:

"Now allow the simulated aircraft to fly from the 'Initial Test Point' to the 'Final Test Point', as defined in Table 2.5-3. If no 'Final Test Point' is defined, use the 'Full Scale Deflection Test Point' as the final test point. Verify, at the '95% Performance Boundary', the 'Containment Boundary', and the 'Full Scale Deflection Test Point', that the correct signals are available from the avionics. See Table 2.5-1 for the pass/fail criteria. Also verify that the caution signals for the inner tunnel are only available below 900' HAT. Finally, verify that an audible alarm is available for the containment surface alarm.

Repeat the simulated aircraft flights for the cases 2 and 3 in Table 2.5-2a."

(17) Paragraph 2.5.3.3

Replace "HAT" with "height above sea level".

(18) Paragraph 2.5.3.3

Change:

"Waypoint 1: 39.5505970 N, 74.8007637 W, alt = 3744.7 ft.

Waypoint 2: 39.4995791 N, 74.6767572 W, alt = 1583.9 ft.

Waypoint 1 corresponds to 11 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 2 corresponds to the FAF (4.5 nmi out) of the same runway."

To:

"Waypoint 0: 39.5424222 N, 74.7811980 W, alt = 3398.21 ft.

Waypoint 1: 39.4998935 N, 74.6775687 W, alt = 1593.98 ft.

Waypoint 0 corresponds to 10 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 1 corresponds to the FAF (4.5 nmi out) of the same runway.";

Change: "Allow the simulated aircraft to fly the route defined by the Waypoints 1 and 2."

To: "Allow the simulated aircraft to fly the route defined by Waypoints 0 and 1."; and

Change: "Again allow the simulated aircraft to fly the route defined by Waypoints 1 and 2."

To: "Again allow the simulated aircraft to fly the route defined by Waypoints 0 and 1.".

Change: "These waypoints, in latitude, longitude, and HAT, define the path..."

To: "These waypoints, in latitude, longitude, and height above sea level, define the path..."

Replace the last two paragraphs with:

"Allow the simulated aircraft to fly from the 'Initial Test Point' to the 'Final Test Point', as defined in Table 2.5-5. Verify, for each leg, that a caution signal is available, below 900' HAT, from the avionics whenever the plane is at or near the 'Inner Tunnel Test Point'. Also verify that after the DIAS Approach Mode is deselected, the caution is not continued.

Repeat this test for cases 2 and 3 in Table 2.5-2a."

(19) Paragraph 2.5.3.4

Change:

"Waypoint 1: 39.5505970 N, 74.8007637 W, alt = 3744.7 ft.

Waypoint 2: 39.4995791 N, 74.6767572 W, alt = 1583.9 ft.

Waypoint 3: 39.4678069 N, 74.5961437 W, alt = 275.7 ft.

Waypoint 1 corresponds to 11 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 2 corresponds to the FAF (4.5 nmi out) of the same runway. Waypoint 3 corresponds to the DA(H) (0.4520 nmi out) of the same runway."

To:

"Waypoint 0: 39.5424222 N, 74.7811980 W, alt = 3398.21 ft.

Waypoint 1: 39.4998935 N, 74.6775687 W, alt = 1593.98 ft.

Waypoint 9: 39.4679484 N, 74.5999636 W, alt = 275.89 ft.

Waypoint 0 corresponds to 10 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 1 corresponds to the FAF (4.5 nmi out) of the same runway. Waypoint 9 corresponds to the DA(H) (0.4710 nmi out) of the same runway.";

Replace first sentence in first paragraph of subparagraph a. with: "Allow the simulated aircraft to fly from Waypoint 1 to Waypoint 9.";

Replace second sentence in first paragraph of subparagraph b. with: "Allow the simulated aircraft to fly from Waypoint 0 to Waypoint 1, defined earlier in this section.";

Modify subparagraph b. by adding the following at the end of the first paragraph: "Please note that this test uses a VDOP of 5.0. If the manufacturer uses a different VDOP threshold, a different constellation must be tested.";

Replace the second paragraph under subparagraph b. with the following:

"Configure the GNSS simulator with the satellite data contained in Table 2.5-2a, case 1, and Table 2.5-2b. Also configure the GNSS simulator to fly from the 'Initial Test Point" to the 'Final Test Point', as defined in Table 2.5-6. A figure showing each leg is shown in Figure 2.5-6. Verify that as the simulated aircraft 'flies' at or near the 'Containment Boundary', that an audible warning is issued within one second. Verify that the DIAS Approach Mode Indicator is

off, the glide slope flag signal is on, and vertical guidance is not available. Also verify that the horizontal deviation signal is still displayed, as under normal conditions."

Replace second sentence in third paragraph of subparagraph c. with: "Again have the simulated aircraft fly Waypoints 0 and 1.";

Replace first sentence in fifth paragraph of subparagraph c. with: "Set the simulated aircraft at Waypoint 0, with a ground speed equal to zero.";

Replace second sentence in sixth paragraph of subparagraph c. with: "Allow the simulated aircraft fly the Waypoints 0 and 1 defined earlier in this subsection.";

Modify subparagraph c. by adding the following at the end of the

sixth paragraph: "Please note that this test uses a HDOP of 5.0. If the manufacturer uses a different HDOP threshold, a different constellation must be tested."; and

Replace second sentence in seventh paragraph of subparagraph c. with: "Have the simulated aircraft fly Waypoints 0 and 1 defined earlier in this subsection.".

(20) Paragraph 2.5.3.5

Change:

"Waypoint 2: GPIWP: 39.4995791 N, 74.6767572 W, alt = 1583.9 ft.
Waypoint 4: TCWP: 39.4640765 N, 74.5905679 W, alt = 125.9 ft.
TCH: 50.2 ft. (Waypoint 4 not shown in Figure 2.5-4)

Waypoint 2 corresponds to the FAF (4.5 nmi out) from the threshold of runway 13 at Atlantic City International Airport (ACY).

Situate the simulated aircraft at Waypoint 2."

To:

"Waypoint 1: GPIWP: 39.4998935 N, 74.6775687 W, alt = 1593.98 ft.

Waypoint 11: TCWP: 39.4642590 N, 74.5910131 W, alt = 125.70 ft.
TCH = 50 ft.

Waypoint 1 corresponds to the FAF (4.5 nmi out) from the threshold of runway 13 at Atlantic City International Airport (ACY).

Situate the simulated aircraft at Waypoint 1.".

(21) Paragraph 2.5.3.6

Replace third sentence of subparagraph 1) with: "Place the simulated aircraft at Waypoint 0 as defined in Figure 2.5-4." and

Replace third sentence of subparagraph 2) with: "Place the simulated aircraft at Waypoint 0 as defined in Figure 2.5-4."

(22) Paragraph 2.5.3.7

Change:

"Waypoint 1: 39.5505970 N, 74.8007637 W, alt = 3744.7 ft.

Waypoint 3: 39.4678069 N, 74.5961437 W, alt = 275.7 ft.

Waypoint 1 corresponds to 11 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 3 corresponds to the DA(H) (0.4520 nmi out) of the same runway."

To:

"Waypoint 0: 39.5424222 N, 74.7811980 W, alt = 3398.21 ft.

Waypoint 9: 39.4679484 N, 74.5999636 W, alt = 275.89 ft.

Waypoint 0 corresponds to 10 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 9 corresponds to the DA(H) (0.4710 nmi out) of the same runway."

(23) Paragraph 2.5.4.1

Modify by adding the following after the initial listing of the "6 conditions" (i.e., before: "Repeat this test for cases 5 and 6 in Table 2.5-2a.: "Verify that the receiver has completed acquisition, and is providing position solutions within 5 minutes.";

Change the groundspeed of 110 knots to 118 knots by replacing the second sentence in fourth paragraph with: "Configure the GNSS simulator to the satellite data in Tables 2.5-2a, case 1 and 2.5-2b with the groundspeed equal to 118 knots."; and

Change:

"Waypoint 1: 39.5505970 N, 74.8007637 W, alt = 3744.7 ft.

Waypoint 3: 39.4678069 N, 74.5961437 W, alt = 275.7 ft.

Waypoint 1 corresponds to 11 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 3 corresponds to the DA(H) (0.4520 nmi out)."

To:

"Waypoint 0: 39.5424222 N, 74.7811980 W, alt = 3398.21 ft.

Waypoint 9: 39.4679484 N, 74.5999636 W, alt = 275.89 ft.

Waypoint 0 corresponds to 10 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY) and Waypoint 9 corresponds to the DA(H) (0.4710 nmi out)."

(24) Paragraph 2.5.4.2

Replace the fourth paragraph (i.e., the paragraph following "...5 seconds and 10 seconds.") with: "Repeat this test for cases 2 and 3 in Table 2.5-2 a." and

Change:

"Waypoint 1: 39.5505970 N, 74.8007637 W, alt = 3744.7 ft.

Waypoint 2: 39.4995791 N, 74.6767572 W, alt = 1583.9 ft.

Waypoint 3: 39.4678069 N, 74.5961437 W, alt = 275.7 ft.

Waypoint 1 corresponds to 11 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY), Waypoint 2 corresponds to the FAF (4.5 nmi out) of the same runway, and Waypoint 3 corresponds to the DA(H) (0.4520 nmi out) of the same runway. A figure showing this 'flight' is pictured in Figure 2.5-4.

When the aircraft reaches Waypoint 2, remove PRN #2, PRN #13, PRN #15, or PRN #27 from the navigation solution. PRN #12 must remain in the navigation solution. Verify that 6 seconds after the simulated aircraft reaches Waypoint 2 that the DIAS Approach Mode Indicator is off."

To:

"Waypoint 0: 39.5424222 N, 74.7811980 W, alt = 3398.21 ft.

Waypoint 1: 39.4998935 N, 74.6775687 W, alt = 1593.98 ft.

Waypoint 9: 39.4679484 N, 74.5999636 W, alt = 275.89 ft.

Waypoint 0 corresponds to 10 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY), Waypoint 1 corresponds to the FAF (4.5 nmi out) of the same runway, and Waypoint 9 corresponds to the DA(H) (0.4710 nmi out) of the same runway. A figure showing this 'flight' is pictured in Figure 2.5-4.

When the aircraft reaches Waypoint 1, remove PRN #2, PRN #13, PRN #15, or PRN #27 from the navigation solution. PRN #12 must remain in the navigation solution. Verify that 6 seconds after the simulated aircraft reaches Waypoint 1 that the DIAS Approach Mode Indicator is off."

(25) Delete entire 2.5.4.3 (including any references to 2.5.4.3 made throughout the RTCA DGNSS MASPS).

(26) Paragraph 2.5.4.4

Change:

"Waypoint 1: 39.5505970 N, 74.8007637 W, alt = 3744.7 ft.

Waypoint 2: 39.4995791 N, 74.6767572 W, alt = 1583.9 ft.

Waypoint 1 corresponds to 11 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY), Waypoint 2 corresponds to the FAF (4.5 nmi out) of the same runway."

To:

"Waypoint 0: 39.5424222 N, 74.7811980 W, alt = 3398.21 ft.

Waypoint 1: 39.4998935 N, 74.6775687 W, alt = 1593.98 ft.

Waypoint 0 corresponds to 10 nmi out (along centerline) from the threshold of runway 13 at Atlantic City International Airport (ACY), Waypoint 1 corresponds to the FAF (4.5 nmi out) of the same runway."

(27) Paragraph 2.5.5.2

Change subparagraph (a) by replacing "Table 2.3-1" with: "Table 2.2-1" and

Replace "Repeat this test for cases 5 and 6 in Table 2.5-2 a." with: "Repeat this test for cases 2 and 3 in Table 2.5-2 a."

(28) Change 2.5.5.4 by replacing "ephemeris" in subparagraph 1) with: "IODE".

(29) Paragraph 2.5.5.7

Modify subparagraph a. by adding the following at the end of the paragraph: "Also verify that this system availability advisory is automatically logged by the system for later retrieval.";

Modify subparagraph b. by adding the following after the sixth sentence in the first paragraph: "Also verify that this system availability advisory is automatically logged by the system for later retrieval."; and

Modify subparagraph c. by adding the following at the end of the paragraph: "Also verify that this integrity monitoring function maintenance alert is automatically logged by the system for later retrieval."

(30) Modify Appendix A by adding the following in the paragraph A.1 section: "All data fields shall be transmitted in the order specified with the least significant bit of each field transmitted first."

(31) Replace "Table A-1", Appendix A with:

Table A-1: Acceleration Error and Indications

Acceleration Error Boundary	Indication
000	0.000 m/s/s≤ Acceleration Error Bound ≤ 0.002 m/s/s
001	0.002 m/s/s < Acceleration Error Bound ≤ 0.004 m/s/s
010	0.004 m/s/s < Acceleration Error Bound ≤ 0.006 m/s/s
011	0.006 m/s/s < Acceleration Error Bound ≤ 0.008 m/s/s
100	0.008 m/s/s < Acceleration Error Bound ≤ 0.014 m/s/s
101	0.014 m/s/s < Acceleration Error Bound ≤ 0.021 m/s/s
110	Acceleration Error Bound > 0.021 m/s/s
111	Station not working: Do Not Use

(32) Modify Appendix H by deleting paragraph 4. which references a non-existent paragraph in FAA TSO-C129.

b. Advisory Circular 20-138, Airworthiness Criteria of Global Positioning System (GPS) Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System, May 25, 1994 and AC 20-130A, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, are referred to throughout this Order. These AC's supersede the guidance contained in FAA Notice 8110.47 and FAA Notice 8110.48. AC 20-138 has been issued, and the final draft of AC 20-130A is currently being used as interim guidance until AC 20-130A is formally issued.