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Introduction

Occasionally there are technical innovations in aviation that propel the industry forward at accelerated rates. Past examples of such quantum leaps are the invention of the aileron, the variable pitch prop and the jet engine. Today's quantum leap is Global Positioning System (GPS). Never before has there been a navigation aid available capable of providing pilots with such precise navigation information in all phases of flight.

However, GPS receivers require more pilot attention than traditional VOR or ADF receivers, particularly during the approach phase. They are essentially navigation management computers, with many features, modes and controls. Before flying a stand-alone approach in instrument conditions, a pilot must be completely familiar with GPS fundamentals, system operation and the approach procedure to be flown.

Commercial and corporate operators are required to have approved training programs to qualify for GPS stand-alone approach approval.

General aviation pilots are not required to undergo an approved training program nor is there any special licence endorsement to qualify them to conduct GPS stand-alone approaches. Nevertheless, general aviation pilots are cautioned about the level of complexity of GPS approach systems. It is strongly recommended that pilots take advantage of GPS receiver stimulation modes, commercially available training and every opportunity to fly practice approaches in visual conditions. Pilots are also encouraged to develop and adopt standard GPS operating procedures for enroute, approach and missed approach phases of flight.

General Aviation pilots flying aircraft equipped with GPS receivers can anticipate being asked to demonstrate their ability to operate the receiver during Flight Tests in all phases of flight, including GPS stand-alone or overlay approaches.

1

ORGANIZING THE TRAINING

Although GPS receivers are complex computers capable of many functions, this instructors guide is designed for teaching the student only those functions necessary to enable him/her to depart from point A, navigate to point B, hold at point B, carry out an approach, overshoot and go to the alternate under Instrument Flight Rules (IFR). The guide is designed for GPS receivers that have been certified for IFR operations in accordance with Technical Standard Order (TSO) C-129. However, instructors may find it useful for instructing students on other non TSO C-129 certified GPS receivers.

Instructors will find that a combination of classroom instruction and hands on training will work best in teaching students how to operate a GPS receiver. It is recommended that an introductory flight with the instructor demonstrating the receiver and its capabilities will help give the student an appreciation for the level of skill required to operate the receiver efficiently and safely. The use of a GPS simulator or the actual receiver in simulation or "take-home mode" is highly recommended. Time spent in the classroom will pay dividends in the air.

Try hard not to overwhelm the student with facts and figures about the GPS system in general. Teach them the basics and instill the desire to learn more about the system on their own. It is assumed that once the student is proficient in conducting the basic operations, he/she will have a thirst to learn the other functions of the receiver as opposed to just using the receiver as a "Direct-to box".

Throughout the training it should be stressed that only approaches retrieved from the database are approved for Instrument Flight Rules (IFR) flight. Instructors shall discourage students from inventing their own approaches and shall not demonstrate how to create or fly a user invented approach at any time.

2

PREFLIGHT PREPARATION

Objective

To facilitate the student learning:

- the background knowledge necessary to operate the GPS receiver in all phases of flight

- the interface between GPS and other cockpit instruments

Motivation

A good overall knowledge of GPS will pique the interest of students and enhance their learning experience. A secondary aim is to motivate the student to learn more about the system on their own.

How the GPS integrates with other cockpit instruments is critical to the safe and efficient operation of the aircraft.

Essential Background Knowledge

Explain the general principles of GPS operation:

an overview of the system, including the number of satellites, a general description of the orbits and area of coverage,

an overview of the general principles of how the receiver determines its position,

an overview of Receiver Autonomous Integrity Monitoring (RAIM),

an insight into other applications,

an overview of similar systems that have been put into service by other nations

Explain the advantages of GPS, including its accuracy

Explain the limitations and possible errors of the system, including database errors and interference from VHF emissions

Explain the basic components of a GPS installation:

sensor/navigation computer,

database,

antenna

Explain the function of the various modes of the GPS receiver

Explain how the GPS interfaces with the CDI/RMI/HSI, if equipped

Explain how the GPS interfaces with the Autopilot/Flight Director, if equipped

Explain how the GPS interfaces with other flight management systems, if equipped

Explain the terms and conditions of the approval to use GPS in Canada

Advice to **Instructors**

Most manufacturer “Pilot Guides” contain the essential background knowledge and system configuration information to satisfy the requirement of this task.

Remember that students do not have to master all the navigational and other functions of the GPS receiver in order to operate it competently. Ensure they have a thorough knowledge of the functions required to use the receiver for flight in IMC conditions and encourage them to learn the other functions as need or desire dictate.

Use a receiver simulator or the simulation mode of the receiver to demonstrate the various modes and functions of the receiver prior to starting instruction in the aircraft if possible.

Use the aircraft itself on battery power or GPU, if simulator not available.

Review the Aircraft Flight Manual or Flight Manual Supplement describing the receiver installation and emphasizing any restrictions

Take the student to the aircraft and point out the various components of the installation including the receiver, the antenna and, if equipped, the various annunicators, the CDI, RMI, or HSI and the autopilot/flight director.

Use the attached AIP Special Aviation Notices to explain the terms and conditions of the approval to use GPS in Canada.

Instruction and Student Practice

Demonstrate how to turn the GPS receiver on and the general functions of each of the modes, then allow ample time for the student to experiment with the receiver before beginning the actual operational instruction.

Completion Standards

The student shall be able to:

- describe the Global Positioning System in general terms

- describe the major components of the GPS installation and any restrictions contained in the Aircraft Flight Manual or Flight Manual Supplement

- describe the phases of flight for which the equipment is approved

- describe the terms and conditions of the approval to use the equipment in Canada

3

DEPARTURE

Objective

To facilitate the student learning:

- to initialize the GPS receiver

- to create a flight plan in the GPS from the point of departure to the destination

- to take-off and fly the aircraft to the first waypoint enroute

Motivation

Preparation for departure is the foundation of a safe and effective flight. Pilots must be able to initialize and verify the functioning of the GPS receiver and accurately program it while ensuring that the essential duties of operating the aircraft are conducted safely.

Essential Background Knowledge

Explain how to turn the GPS receiver on

Explain how to operate the GPS receiver controls

Explain how to complete the receiver initialization with pilot inputs, if required

Explain the function of the flight plan (FPL) mode of the GPS receiver

Explain how to create a flight plan in the GPS

Explain how to confirm whether RAIM will be available for the approach at destination

Explain how to modify the flight plan by deleting or inserting waypoints

Explain how to create user-defined waypoints

Explain how to add a SID to the flight plan (not all receivers have this capability)

Explain airspace advisories and alerts

Explain the importance flying the aircraft at all times and of not fixating on the GPS operation

Advice to Instructors

As this phase tends to be time consuming, the more time spent in the classroom learning the programming functions of the receiver the better.

Ensure that students don't get so involved in learning to use the GPS receiver that they forget to fly the aircraft. This applies to all phases of the flight.

Using this system, especially in the early stages of the learning curve, tends to draw pilot attention into the cockpit, be careful, and remember to keep a close eye out for other aircraft.

Ensure that students cross check GPS positions with other navigational equipment. Databases have been known to be wrong. Moreover, there is a regulatory requirement to verify the coordinates of database generated waypoints against flight information publications when conducting GPS stand-alone approaches.

Air Instruction and Student Practice

Have the student operate the GPS receiver as much as possible. The student will be slow at first and will make mistakes, resist speeding up the process by jumping in to help. Allow the student to make mistakes and the time to figure out where he/she went wrong, within reason.

Emphasize the need to be accurate when information, especially waypoint coordinates, are entered into the receiver. As input errors are the largest single source of system errors, have the student double check all information as it is entered.

Completion Standards

The student shall be able to:

- turn on and operate the GPS receiver

- monitor and verify the receiver self test and initialization

- verify the data displayed on the receiver self test page is the same as the data being displayed on the aircraft instruments interfaced with the receiver, if applicable

- verify the external annunicators illuminate as designed, if any

- verify the database is up to date

- complete the receiver initialisation with pilot inputs, if required

- create a flight plan in the GPS receiver

- modify the flight plan, including inserting and deleting waypoints

- create user- defined waypoints

- if the receiver is capable, retrieve airport information from the database

- add a SID to the flight plan, if the point of departure has one

- take-off and fly the SID or ATC clearance to intercept the track to the fast waypoint enroute

- maintain track to the first waypoint enroute within 1/2 scale deflection of the track bar

- maintain assigned altitudes within 100 feet

- understand the function of the message page and to take appropriate action

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ENROUTE PROCEDURES

Objective

To facilitate the student learning:

- to navigate from the point of departure to the destination using GPS

Motivation

The introduction of GPS has revolutionized how pilots navigate enroute. It is essential that pilots acquire and maintain a high standard of operating skill for this phase of flight.

Essential Background Knowledge

Explain the functions of the navigation (NAV) mode of the GPS receiver

Explain the moving map display screen symbology, if applicable

Explain the track bar sensitivity parameters in NAV mode

Explain the "Direct TO" (DTO) function of the GPS

Explain how retrieve information about the nearest suitable airport to the route of flight

Explain how to add Standard Terminal Arrival Routes (STAR) to the flight plan

Advice to Instructors

Take care not to become so involved in demonstrating the functions and explaining the features of the GPS that your lookout is compromised, especially immediately after take off, in the climb, during the transition to the approach and during the missed approach.

If there are no airports near the training area with a STAR, instructors should get the student to input a flight plan to an airport with a STAR even though that airport is beyond the range of the aircraft. Once programmed, the student can then modify the flight plan to tit the aircraft capability.

Sometime during the exercise give the student an emergency which requires him/her to divert to the nearest suitable airport. Be alert to ensure the student takes care of the emergency and then programs the GPS. Do not allow the student to be so concerned with programming the GPS that aircraft safety becomes a secondary consideration

Air Instruction and Student Practice

The student should fly the aircraft to several waypoints enroute so that he/she can practice normal enroute navigation techniques including determining fuel flows, making position reports and calculating ETAs. At least three legs of 10 to 15 minutes should be enough for this practice.

Ensure the student practices going direct to a waypoint and adding a STAR to the flight plan.

Completion Standards

The student shall be able to:

- navigate from the point of departure to destination using GPS for guidance
- describe the track bar sensitivity parameters in NAV mode
- intercept a track to a waypoint
- maintain track within 1/2 deflection of the track bar
- maintain assigned altitudes within 100 feet
- delete or add waypoints to the flight plan
- create user-defined waypoints
- program and fly “Direct TO” (DTO) a waypoint
- divert to the nearest suitable airport in the event of an emergency
- retrieve airport information from the GPS database
- add a STAR to the flight plan

5

HOLDING PROCEDURES

Objective

To facilitate the student learning:

- to program a hold in the GPS receiver, if capable

- to execute holding procedures using GPS

Motivation

The ability to execute a hold is essential for all pilots operating under IFR.

Essential Background Knowledge

Explain the various types of holds the student may encounter when flying IFR

Explain how to add a hold to the flight plan, if capable

Advice to Instructors

Either give the student a simulated hold clearance or ask ATC to issue one.

Ensure the student is able to input and execute an enroute, NDB, VOR and a DME hold.

If the hold entry is executed on autopilot, question the student to ensure that he/she has correctly anticipated the aircraft track.

Air Instruction and Student Practice

Ensure the student practices a least one of each type of hold, if practicable.

The direction of entry should be varied so that the student can practice the recommended hold entry procedures found in the Instrument Procedures Manual.

Completion Standards

The student shall be able to:

- add a hold to the flight plan in flight

- activate a hold

- execute a holding procedure using GPS

- take prompt corrective action if the aircraft does not perform as anticipated during an autopilot hold entry

6

APPROACH PROCEDURES

Objective

To facilitate the student learning:

- to retrieve and arm an approach procedure from the GPS database

- to execute an approach using GPS

Motivation

Within 20 years all IFR terminal navigation will likely be conducted using GPS as the primary navigation aid. Pilots wishing to fly in this environment will have to have a thorough understanding of the system, its limitations and use.

Essential Background Knowledge

Explain how to transition from the enroute procedures to the approach procedures using GPS for guidance

Explain that approaches must be retrieved from a current database and cannot be created by the pilot inputting waypoints

Explain how to add approaches to the flight plan

Explain how to arm approaches

Explain how to change or delete an approach once added to the flight plan

Explain the various sensitivity parameters of the track bar during approaches and how to confirm that they have changed at the appropriate time

Explain the Technical Standard Order (TSO) C-129 requirement for a Receiver Autonomous Integrity Monitoring (RAIM) check

Explain how to do a RAIM check

Explain what to do if the system fails the RAIM check

Explain the cockpit indications, if any, and what to do if GPS integrity is loss during the approach, before and after the Final Approach Waypoint (FAWP)

Explain how to verify approach waypoints

Explain how to conduct GPS approaches

Advice to Instructors

The transition from enroute procedures to GPS approaches should be conducted exactly the same as for traditional navigation aids. Instructors should emphasize the importance. of planning the approach in a methodical and deliberate manner so that the pilot can anticipate and react smoothly to ATC instructions.

Review the AIP Special Aviation Notice dated February 1, 1996 (IFR Conditional Approval of GPS Operations) with the student to ensure he/she understands the certification conditions respecting GPS approaches under IFR and the requirements of TSO C-129.

The accuracy of GPS depends on valid waypoint coordinates. The fact that GPS is used as the source of guidance for approaches makes the validity of coordinates even more important. Almost every pilot who has used area navigation systems can recall database errors. This obviously cannot be tolerated with approach waypoints, so the deliberate verification of waypoints in accordance with direction provided in the GPS Supplement to the Aircraft Flight Manual is essential. At the very least, one waypoint should be verified against the coordinates for the waypoint in a published flight information publication and other waypoints verified by bearing and distance from the confirmed waypoint.

Air Instruction and Student Practice

The student should practice GPS stand alone and overlay approaches until he/she can demonstrate to the instructor that he/she can do the approaches safely and effectively.

Completion Standards

The student shall be able to:

- transition from enroute procedures to terminal procedures including pre-landing and approach checks, briefings, management of approach aids and adherence to ATC clearance

- add approaches to the flight plan from the GPS database

- change or delete an approach that has been added to the flight plan

- arm approaches

- describe the various sensitivity parameters of the track bar during approaches

- conduct a RAIM check

- understand the certification conditions imposed by TSO C-129 respecting GPS approaches, the operational limitations imposed by the Flight Manual Supplement and the terms and conditions of the Canadian approval to fly GPS approaches (see the AIP attachments)

- verify approach waypoints against an independent source

- select and verify cockpit navigation sources

- select and verify the Automatic Flight Control guidance source switches if equipped

- establish the aircraft on the required track

- maintain the track within 1/2 deflection of the track bar

- maintain published or cleared vertical navigation minima within 75 feet

- identify waypoint passage

-execute approaches to minima using GPS for guidance

7

MISSED APPROACH PROCEDURES

Objective

To facilitate the student learning:

- to retrieve and arm the missed approach procedure from the GPS database

- to execute the missed approach using the GPS

Motivation

Pilots flying under IFR must be prepared to execute a missed approach on all approaches.

Essential Background Knowledge

Explain how activate a missed approach

Explain how to execute a missed approach

Advice to Instructors

The missed approach should be practiced frequently to ensure the student can do it efficiently and safely. The transition from the landing configuration to the go around, the completion of after take off aircraft checks, conducting frequency shifts for radio calls and activating the missed approach all draw pilot attention into the cockpit during this critical regime of flight. Extreme care must be taken to ensure a proper lookout is maintained for other traffic.

Air Instruction and Student Practice

The student should execute a missed approach on every practice approach. It is assumed that the student knows how to land the aircraft.

Completion Standards

The student shall be able to:

- activate the missed approach

- execute the missed approach procedure including after takeoff checklist, management of navigation aids and adherence to ATC clearance

- establish the aircraft on the missed approach track

- maintain the track within 1/2 deflection of the track bar

- maintain published or cleared vertical navigation minima within 100 feet

- identify waypoint passage

-execute missed approaches using GPS for guidance

8

ALTERNATE

Objective

To facilitate the student learning:

- to add the routing to an alternate to the flight plan either in flight or prior to departure

- to execute a diversion to an alternate using GPS

Motivation

Pilots must always be prepared to proceed to an alternate when operating an aircraft under IFR.

Essential Background Knowledge

Explain how to add the alternate routing to the flight plan either on the ground prior to departure or in flight

Explain how to change flight plans to get to the alternate, for those receivers that will not permit an alternate to be added to the flight plan

Explain that conventional NAVAIDS must be available for a diversion to an alternate should the GPS fail or signals be lost

Advice to Instructors

Impress upon the student that they must be prepared to divert to an alternate at any time, irrespective of the weather.

Air Instruction and Student Practice

Ensure the student practices setting course to an alternate at least once during training.

Completion Standards

The student shall be able to:

- add the routing to an alternate to the flight plan either in flight or prior to departure

- to execute a diversion to an alternate using GPS for guidance

9

SYSTEM MALFUNCTIONS

Objective

To facilitate the student learning:

- to recognize a system malfunction

- to take appropriate action in the event of a system malfunction

Motivation

It is extremely important that pilots who are operating database dependent navigation equipment be aware that they must be vigilant and monitor the information and guidance that is being provided by their aircraft's navigation systems. Anomalies have been detected which are a result of software problems or a result of the way procedures and information has been encoded into the database of some GPS equipment. These anomalies may be transparent to the user until such time as the aircraft departs from its expected route or path of flight. It is essential that pilots confirm the equipment is going to respond as expected, by comparing the database information with the hard copy procedure in the Canada Air Pilot and other flight information publications. The requirement to make this comparison is specified in the GPS avionics Flight Manual Supplement.

Essential Background Knowledge

Explain how to verify database waypoints. The verification method used is at the discretion of the instructor provided it is effective. An acceptable method is to compare the database coordinates of a waypoint with the coordinates of the waypoint that are published in a flight information publication and then verify other waypoints by bearing and distance from the verified waypoint. Separate waypoint verifications should be carried out for enroute and terminal procedures.

Review the RAIM check and the appropriate actions.

Review the appropriate action for the illumination of a "GPS Integrity" light.

Explain the appropriate action for a GPS receiver power failure.

Advice to Instructors

GPS system performance is such that it may lead students to develop a false sense of security. Ensure that students cross check the system with conventional navigation aids and occasionally give them a system failure to ensure they can smoothly transition to traditional navigation methods.

The student must diligently monitor the performance of their equipment and verify the accuracy of each selected waypoint using current approved hard copy data prior to using their equipment for IFR navigation. If there are any discrepancies between the information in the database and the published hard copy, then the student must ensure they follow the hard copy procedure.

Air Instruction and Student Practice

Some systems have malfunction reports embedded in their databases, if so, have the student retrieve a report and record the information provided.

Completion Standards

The student shall be able to:

- recognize a system malfunction

- take the appropriate action in the event of a system malfunction

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POST FLIGHT PROCEDURES

Objective

To facilitate the student learning:

- post flight “GPS Problem Report” preparation and handling

Motivation

As GPS is new technology, it is important that pilots using the system report any difficulties or anomalies so that others can benefit and corrective action can be taken.

Essential Background Knowledge

Review AIP Aviation Notice dated July 18, 1996, attached

Advice to Instructors

Students should be encouraged to take an active part in reporting system difficulties and anomalies. Reviewing the AIP notice and the “GPS Problem Report” form and having the student fill out a report form for a loss of signal integrity during an approach should achieve the aim.

Review the completed form for completeness and accuracy.

Completion Standards

The student shall be able to:

- complete post flight “GPS Problem Report” form and know where to send it

Transport Canada Transport Canada
Aviation Aviation

JULY 20, 1995

AVIATION NOTICE

GLOBAL POSITIONING SYSTEM (GPS) OPERATIONS IN INSTRUMENT METEOROLOGICAL CONDITIONS USING GPS RECEIVERS NOT MEETING TSO C129

A Special Aviation Notice issued on February 2. 1995. entitled IFR Conditional Approval of Global Postioning System GPS) Operations governs the IFR use of GPS. This document specifics that pilots must use GPS receivers approved under Technical Standard Order (TSO) C129. Standards in TSO C129 ensure that GPS is safe to use. The Transportation Safety Board has reported that some pilots are using receivers which do not meet TSO C129 for guidance in Instrument Meteorological Conditions (IMC). in some cases to fly non-precision approaches.

GPS provides very acurate guidance. but the basic GPS satellite constellation does not warn users promptly if the system is providing faulty signals. Satellite hardware or software problems have produced position errors of 80 NM in the past. and this could occur any time. Errors are rare and this perhaps generates overconfidence and the tendency to use GPS improperly. Traditional aids, like VOR and ILS. have a monitoring system that can detect if the aid is out of tolerance, then take action to either switch to an alternate system or shut the aid down. If the aid is shut down. cockpit instrumentation provides a suitable warning to pilots. A Wide Area Augmentation System (WAAS), planned for the end of the 1990s. will continuously monitor GPS satellites and provide warnings to cockpit receivers within six seconds of a problem occurring. Until then, pilots must use receivers which meet TSO C129 for IFR operations. The TSO specfies a technique called Receiver Autonomous Integrity Monitoring (RAIM). RAIM works by calculating aircraft position using different sets of satellites. comparing positions and warning the pilot if there is a discrepancy.

Besides RAIM. non-precision approach operations call for a high level of confidence in way point coordmates. Consequently, pilots must extract approach way point from the TSO C129 receiver's dam base: pilot-entered way points cannot be used to fly an instrument approach. There have been many instances of improper data entry with RNAV systems. These were generally of little consequence because the aircraft were en route: approach way points are obviously more critical. Another requirement of TSO C129 is that course deviation indicator (CDI) sensitivity must be increasd to 0.3 NM full-scale deflection during an approach. This feature is provided to reduce flight technical error, to ensure the aircraft remains within the area protected from obstacles.

Of an even more serious safety concern is that some pilot are designing their own GPS non-precision approaches. This is a job for professionals. The standards applied by approach designers take into account the accuracy of the aid the ability of the pilot to track the guidance signals. and all the obstacles in the area surrounding the approach and missed approach flight paths. All of this is necessary to ensure appropriate terrain and obstacle clearance throughout the procedure.

It is illegal to use receivers which do not meet TSO C129 for guidance in IMC. It is also illegal to fly "homemade" or published approaches for which the way points have been manually entered by the pilot. Standards set out in TSO C129 and in the Special Aviation Notice, dated February 2, 1995, are clearly linked to safety. Pilots who fly in IMC using receivers which do not meet TSO C129 are not only operating illegally, they are operating unprofessionally by exposing themselves and their passengers to unacceptable risk.

Gilles Rodriques
Director General
Air Navigation System

Transport Canada Transport Canada
Aviation Aviation

FEBRUARY 1, 1996

SPECIAL AVIATION NOTICE

IFR CONDITIONAL APPROVAL OF GLOBAL POSITIONING SYSTEM (GPS) OPERATIONS

INTRODUCTION

On July 22 1993. the use of GPS for IFR operations was approved under the conditions described in a Special Aviation Notice. A revision was issued on February 2. 1995. Developments since that time relating to stand-alone non-precision approaches, require updating the approval document. This Special Aviation Notice replaces the one issued February 2. 1995. It specifies the conditions and limitations associated with the approval to use GPS for certain IFR operations in Canada and for Canadian. registered aircraft in North Atlantic Minimum Navigatmn Performance Specification (NAT MNPS) airspace.

The avionics requirements for IFR flight are described in Air Navigation Order. Series V, No. 22 - IFR Flight Instruments and Equipment Order. An exemption to this Order, allowing a GPS receiver to replace a VOR or ADF receiver. was issued as Aeronautical Information Circular 5/94.

At this point. GPS is considered a supplemental-means navigation system, meaning it is approved for use in conjunction with a sole means of navigation system. such as VOR. This approval allows GPS to be used most of the time as the source of guidance. with the understanding that pilots will back up GPS with sole-means systems in accordance with the terms of this approval.

OCEANIC. DOMESTIC EN ROUTE AND TERMINAL OPERATIONS

GPS may be used for IFR flight guidance for oceanic, domestic en route and terminal operations if the following provisions and limitations are met:

(a) The GPS navigation equipment must be approved in accordance with the requirements specified in Technical Standard Order (TSO C-129) (Class A1, A2, B1, B2, C1 or C2), installed and approved in accordance with the appropriate sections of the Airworthiness Manual. and operated in accordance with the approved flight manual or flight manual supplement.

(b) Aircraft using GPS equipment under IFR must be equipped with another approved and operational means of navigation. Should GPS navigation capability be lost, this equipment must allow navigation along the planned mute or suitable alternate route. Monitoring of the traditional navigation equipment is necessary when there are insufficient satellites in view for Receiver Autonomous Integrity Monitoring (RAIM) to operate.

(c) For flight plan purposes other than for operations described in (d), the suffix “R” must be used to indicate RNAV capability.

(d) For Canadian-registered aircraft in NAT MNPS airspace, a GPS installation with TSO C-129 authorization in Class Al, A2 B1, B2, Cl or C2 may be used to replace one of the other approved means of long-range navigation (INS, IRS or OMEGA). For flight within Canadian Minimum Navigation Performance Specifications (CMNPS) airspace or Required Navigation Performance Capability (RNPC) airspace, GPS may serve as the long-range navigation system. CMNPS and RNPC airspace are depicted in RAC 12.2.1, Figure 12.1.

NON-PRECISION APPROACH

GPS non-precision approaches will be introduced in two ages. In the tint stage, 147 existing VOR, VOR/DME. NDB and NDB/DME approaches, listed in the Canada dir Pilot. can be flown using GPS guidance. These "overlay” approaches will provide pilots with operational experience flying GPS approaches while monitoring traditional NAVAIDs. Overlay approaches will use the existing approach plate and name.

In the second stage. “stand-alone” approaches are being published. These are new GPS approaches that do not overlay traditional approaches. They are provided for runways which currently have no approach, runways served by circling approaches or runways which have straight-in approaches where the use of GPS will significantly reduce minima. New approach plates. with GPS in the name, are being provided for sand-alone approaches.

GPS relies on approach way points stored in a receiver data base. Incorrect way point coordinates compromise safety. Coordinates are checked during the data base creation process. from the runway survey through to updating the receiverís data base. Errors should be but. but are possible. Pilots must therefore verify way point coordinates in accordance with direction provided in the GPS Supplement to the Aircraft Flight Manual. The data base integrity problem is being addressed by a number of standards bodies. Efforts are aimed at developing a system that will check data automatically from its creation to us use by pilots. The next generation of receivers will warn pilots if there is a problem.

GPS may be used for IFR flight guidance during a non-precision instrument approach if the provisions and limitations in (a), (b) and(c) below are met.

(a) General Provisions

(i) The GPS avionics must meet TSO C-129 (Class Al, B1. B3. C1. C3) requirements or equivalent criteria, must be installed and approved in accordance with the appropriate sections of the Airworthiness Manual, and operated in accordance with the flight manual or flight manual supplement. The avionics data base must be current and must contain the non-precision approaches to be flown. All asssociated data bases and charted GPS instrument approach procedures used must contain coordinates relative to the World Geodetic System 1984 (WGS 54).

(ii) An approach using GPS shall not be flown unless in is reltrieved from the avionics data base. The GPS avionics must store the location of all way points required to define the approach and present them in the order depicted on the published non-precision instrument approach procedure chart.

(b) GPS Overlay Approaches

(i) The appropriate ground NAVAID(s) (e.g., VOR, NDB. DME) which define the published approach being flown must be operaring, and the avionics required to fly that approach must be operating and monitored by the flight crew.

(ii) The approach must be requested and approved by its published name. (e.g.. ìNDB RWY 24î. ìVOR RWY 24î).

(iii) Approach way point coordinates must be verified in accordance with direction provided in the GPS Supplement to the Aircraft Flight Manual.

NOTE: Assuming the underlying NAVAID(s) and related avionics continue to function, the pilot must revert to traditional means of navigation if there is a discrepancy between GPS and the traditional NAVAID(s).

(c) GPS Stand-alone Approaches

(i) RAIM must be available at the final approach fix to provide integrity for the navigation guidance used during the approach.

(ii) Any required alternate aerodrome must have an approved instrument approach procedure, other than GPS. which is anticipated to be operational at the estimated arrival time. The avionics Iî fly that approach most be installed and operational. The avionics required to receive the traditional NAVAID(s) that may be used to fly from the deparment to the destination and to any required alternate aerodrome most also be installed and operational.

(iii) The published approach must be identified and requested as a GPS approach (e.g., ìGPS RWY 24î).

(iv) Approach way point coordinates must be verified in accordance with direction provided in the GPS Supplement to the Aircraft Flight Manual.

NOTE: Air Carrier and commercial operators conducting GPS IFR operations shall meet the appropriate provisions of their Operating Certificates and Operations Specifications. An Air Carrier Advisory Circular has been published with more derailed information and guidance concerning training requirements and approval procedures.

Ron Jackson
Assistant Deputy Minister
Aviation

FEBRUARY 1, 1996

SPECIAL AVIATION NOTICE

IFR APPROVAL OF GLOBAL POSITIONING SYSTEM (GPS) AS A PRIMARY-MEANS NAVIGATION SYSTEM IN OCEANIC AND REMOTE AIRSPACE

GENERAL

This Special Aviation Notice sets out the general provisions for the operational approval to use GPS as a primary-means navigation system in oceanic and remote areas including North Atlantic Minimum Navgation Performance Specification (NAT MNPS) airspace.

A primary-means navigation system is a navigation system approved for a given operation or phase of flight that must meet accuracy and integrity requirements. but need not meet full availability and continuity of service requirements. Safety is achieved by limiting flights to specific time periods and through procedural restrictions. It should be noted that there is no requirement to have a sole-means navigation system on board to support a primary-means system.

Primary-means navigation systems, under the right GPS constellation conditions, may be used as the only,- required means of satisfying the necessary levels of accuracy. integrity and availability for a partcular area, route, procedure or operation.

EXISTING SUPPLEMENT-MEANS APPROVAL

The Special Aviation Notice. dated February 1. 1996. titled “IFR Conditional Approval of GPS Operations“. specifies the conditions and limitations associated with the supplemental-means approval to USC GPS for certain IFR operations in Canada and for Canadian registered aircraft in NAT MNPS airspace. Under the supplemental-means IFR approval. a GPS installation with Technical Standard Order (TSO) C-179 authorization in Class A1, A2. B1, B2, Cl or C2 may be used to replace one of the two approved means of long-range navigation required (INS. IRS or OMEGA) in MNPS airspace.

PRIMARY-MEANS APPROVAL

Primary-means GPS sensors meet requirements beyond those in TSO C-129 for Receiver Autonomous lntegrity Monitoring (RAIM) This increases the availability of integrity to the point where two primary-means GPS receivers can be used as the only required means oflong-range navigation.

The use of primary-means equipment requires that flights be planned for times when GPS signals will support operations. This preflight planning is achieved through the use of a RAIM prediction program. and certain dispatch conditions apply. The failure of a primary-means navigation system may require reversion to a non-normal means of navigation (e.g.. dead reckoning).

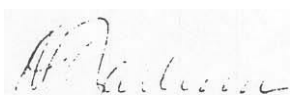
The approval to use GPS as a primary-means navigation system in MNPS airspace requires equipment, installation and operational approvals, which will be based on the following documents:

(a) RTCA/DO-208, *Minimum Operational Performance Standards for Airborne Supplemental Navigation Equipment,*

(b) TSO C-129 (Class Al, A2. B1, B2, C1, or C2), *Airborne Supplemental/Navigation Equipment Using the Global Positioning System;* and

(c) FAA Document No. 8110.57, *GPS as a Primary Means of Navigation for Oceanic/Remote Operations.*

Operation seeking approval to use GPS as a primary-means navigation system in MNPS airspace can do so by means of an application to the appropriate Regional Air Carrier Office.



Ron Jackson
Assistant Deputy Minister
Aviation

Transport Canada Transport Canada
Aviation Aviation

July 18, 1996

AVIATION NOTICE

GPS PROBLEM REPORT

To assist Transport Canada Aviation in assessing the extent to which air navigation is affected by GPS outages or performance degradation caused by electromagnetic interference or other factors, pilots are encouraged to report incidents of abnormal operation to the Satellite Navigation Program Office. Examples of abnormal operation Include: large position errors. loss of lock. loss of coverage or satellites in view, degraded signal-to-noise or figure of merit indications.

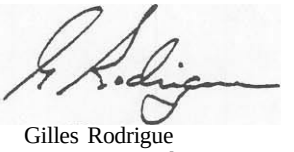
Crews experiencing any of these problems are requested 10 complete the reproducible form on the reverse side. and return it to:

Transport Canada (AANDN)
Satellite Navigation Program Office
Attn: Andrew Graham
Ottawa ON K1A 0N8

Telephone: (613) 941-7135(collect calls accepted)

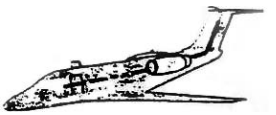
Facsimile: (613) 990-9655

Internet: grahama@tc.gc.ca



Gilles Rodrigue
Director General
Air Navigation System

GPS Problem Report Form



Prepared by: _____ Date _____

(Please print.)

Telephone _____

Aircraft Registration: _____

Aircraft Type: _____

GPS Receiver: ❑ Hand-held ❑ Panel Mount ❑ FMS Sensor

GPS Receiver Make/Model: _____

Installation approved for: ❑ IFR Approach ❑ IFR En Route ❑ VFR

GPS Antenna Location: _____

Date of Occurrence: _____ Altitude: _____

Tie of Occurrence: _____

Location of Occurrence:
(Latitude/Longitude. or
Nearest City or Landmark) _____

_____

What problem did the receiver indicate? _____

_____

_____

For how long? _____

Did any operator action help? _____

_____

_____

Possible causes (VHF radio transmission, television/radio transmitter antennas, buildings, etc.):

_____

_____

Comments or other observations: _____

_____

_____

_____
