



## CIVIL AVIATION ADVISORY PUBLICATION

### CAAP 1

(01 January 2013)

### GLOBAL POSITIONING SYSTEMS (GPS)

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#### *USE OF GLOBAL POSITIONING SYSTEMS (GPS) BY YEMEN REGISTERED AIRCRAFT*

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#### 1 PURPOSE

This Civil Aviation Advisory Publication (CAAP) provides guidance material for the use of Global Positioning Systems (GPS) for operators of Yemen registered civil aircraft. It also identifies the types of equipment that the Civil Aviation and Met. Authority (CAMA) has determined to be acceptable and contains guidelines for operators using GPS equipment as the primary means for navigation and non precision approaches (NPA).

#### 2 STATUS OF THIS CAAP

This is the first issue of CAAP GPS dated 01 January 2013. It will remain current until withdrawn or superseded.

#### 3 APPLICABILITY

This guidance material applies to all Yemen operators for operations either in or outside Yemen territorial airspace, however it must be noted that beyond Yemen FIR, operators must comply with ICAO Annex 2 and other State's regulations when operating within their airspace.



#### 4 CONTENTS

Para Title	page
1 PURPOSE.....	1
2 STATUS OF THIS CAAP .....	1
3 APPLICABILITY .....	1
4 CONTENTS .....	2
5 REFERENCES .....	2
6 OPERATIONAL APPROVAL .....	3
7 DESCRIPTION OF TERMS USED .....	3
7.1 Primary Means Navigation Systems .....	3
7.2 Sole Means Navigation Systems .....	4
7.3 Receiver Autonomous Integrity Monitoring (RAIM).....	4
8 OPERATIONAL REQUIREMENTS.....	4
9 EQUIPMENT.....	5
9.1 General. ....	5
9.2 Classes of equipment specified in TSO-C129 .....	5
9.3 Instrumentation. ....	6
9.4 Future Enhancement.....	6
10 REQUIREMENTS FOR GPS BASED NON PRECISION APPROACHES .....	6
10.1 Approval.....	6
10.2 General. ....	6
10.3 Specific.....	7
11 TRAINING .....	7
11.1 General. ....	7
11.2 Flying School Courses.....	7
11.3 Training Syllabus.....	8

#### 5 REFERENCES

This CAAP should be read in conjunction with CAAP 2 on B-RNAV operations in European airspace (see also CAAP 2 Appendix 1) and CAAP 3 in respect to RNP 5 requirements. Copies of these documents can be obtained through your CAMA regional office. The following publications were used as reference material.

- (a) ICAO
  - (i) Doc 267-AN/159, Guidelines For The Introduction And Operational Use of Global Navigation Satellite System (GNSS).
- (b) Federal Aviation Administration (FAA)

- (i) Technical Standard Order TSO-C129 – Airborne Supplemental Navigation Equipment Using The Global Positioning System (GPS)
- (ii) AC 20-138 - Airworthiness Approval of Global Positioning System (GPS) Navigation Equipment for use as a VFR and IFR Supplemental Navigation System.
- (iii) AC 90-94 - Guidelines for Using Global Positioning Systems Equipment for IFR En Route and Terminal Operations and for Non Precision Instrument Approaches In U.S. National Airspace System.

## **6 OPERATIONAL APPROVAL**

The Yemen Civil Aviation and Met. Authority has approved the use of the Global Positioning System (GPS) as a primary-means IFR navigation aid for oceanic, domestic en route and terminal operations. GPS cannot be used as a sole means navigation system, or for precision instrument approaches, until further authorisation is issued. Certified GPS equipment is now available for the following purposes;

- (a) Position fixing, as required by CARs.
- (b) Use as a long range navigation system, in accordance with CARs, including operation on designated RNAV routes and NAT MNPS airspace.
- (c) Deriving distance information for enroute navigation, traffic information and ATC separation.
- (d) Enroute IFR descent below Lowest Safe Altitude (LSALT).
- (e) GPS non precision approaches.
- (f) Enroute IFR descent below LSALT/MSA - GPS Arrivals (helicopter only)
- (g) Application of RNAV based separation.

## **7 DESCRIPTION OF TERMS USED**

### **7.1 Primary Means Navigation Systems**

The International Civil Aviation Organisation (ICAO) specifies requirements for approved IFR navigation systems. The relevant parameters influencing the approval of radio navigation aids are accuracy, integrity, availability and continuity of service. Primary means navigation is defined as 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 appropriate procedural restrictions. There is no doubt that GPS achieves the accuracy required

for enroute, terminal and non-precision approach flight phases. GPS accuracy is better than 100 metres, 95 per cent of the time - well ahead of most ground based radio navigation systems. Integrity, or trust in the system, in this case is met by several methods, the most common being RAIM.

## **7.2 Sole Means Navigation Systems**

A sole-means navigation system meets all four navigation system performance requirements - accuracy, integrity, availability and continuity of service. ADF, VOR, DME, INS and OMEGA are the existing sole means navigation systems approved in Yemen although OMEGA became redundant on 30 September 1997. GPS will require augmentation to achieve sole-means approval, which could be in the form of wide area or local area augmentation or differential systems (WAAS or LAAS).

## **7.3 Receiver Autonomous Integrity Monitoring (RAIM).**

Receiver Autonomous Integrity Monitoring (RAIM) makes use of redundant information from the satellite constellation to provide a cross-check of the navigation solution. RAIM tracks a minimum of five satellites and calculates position solutions using various combinations of four satellites (GPS requires a minimum of four satellites to operate). Should any one solution vary by more than a specified amount, a failure is assumed and a warning notified to the user.

## **8 OPERATIONAL REQUIREMENTS**

The main operational requirements are:

- (a) Operating instructions for GPS navigation equipment must be carried on board the aircraft, and incorporated into company operations manuals.
- (b) GPS equipment must be operated in accordance with operating instructions, including any additional requirements specified in the approved aircraft flight manual or flight manual supplement.
- (c) In addition to GPS, aircraft must be equipped with serviceable radio navigation systems as specified in CARs or the aircraft's Minimum Equipment List.
- (d) GPS must not be used to satisfy any of the alternate requirements of CARs.
- (e) When within rated coverage of ground based navigation aids, pilots should monitor the ground based system, and maintain track as defined by the most accurate ground based radio navigation aid available. If there is a discrepancy between the GPS and the ground based system information, pilots should use the information provided by the ground based system. ATC shall be informed if RAIM is lost, or GPS accuracy is in doubt, in controlled airspace.

- (f) International ATC may require GPS equipped aircraft to establish on, and track with reference to, a particular VOR radial or NDB track for the application of separation.
- (g) GPS must not be used as a navigation reference for flight below the LSALT/MSA, except as specified for non precision approaches (NPA) in para 9.
- (h) Aircraft using GPS under IFR must be equipped with other approved and operational means of navigation.
- (i) Pilots of aircraft equipped with approved GPS systems should insert "Z" in field 10, and NAV/GPSRNAV in field 18 of the ICAO flight plan.
- (j) Operators are required to record GPS integrity data on a regular basis.
- (k) For Yemen registered aircraft operating in NAT MNPS airspace, a GPS installation to TSO C129 Classes A1, A2, B1, B2, C1 or C2 may be used to replace one of the other approved means of long range navigation (INS, IRS)
- (l) Operators should report all instances of interference to the CAMA, giving location, time, duration and a description of the event.

## 9 EQUIPMENT

### 9.1 General.

To use this primary means GPS approval, there are some requirements for both aircraft equipment and for pilot training. The equipment must have the US FAA TSO C129 approval and be installed in accordance with the manufacturer's instructions. Barometric aiding must also be installed and for international IFR operations, a data card subscription would be required. TSO C129 specifies minimum performance standards for approval GPS equipment.

### 9.2 Classes of equipment specified in TSO-C129

There are 3 classes of receiver specified in the TSO C129;

9.1.1 Class A equipment incorporates both the GPS sensor and navigational capability and incorporates RAIM.

- (a) Class A1 is approved for en route, terminal and NPA operations.
- (b) Class A2 is approved for en route and terminal operations only.

9.1.2 Class B equipment consists of a GPS sensor that provides data to an integrated navigation system and incorporates RAIM.

- (a) Class B1 and B3 is approved for en route, terminal and NPA operations.
- (b) Class B2 and B4 is approved for en route and terminal operations only.

9.1.3 Class C equipment consists of a GPS sensor that provides data to an integrated navigation system, which provides enhanced guidance to an autopilot or flight director to reduce flight technical error. It is approved for installation in Air Carrier aircraft (FAR 121) and C1 through C4 correspond to B1 through B4 in all other respects.

### **9.3 Instrumentation.**

On some aircraft, instruments may need to be relocated to ensure the GPS instrumentation is part of the instrument scan for IFR approaches. An assessment would be made by the CAMA Flight Operations Directorate.

### **9.4 Future Enhancement.**

Further enhancements of the GPS to achieve sole means approval will require the development of a new TSO. Pilots and operators therefore should be aware that current equipment may not be capable of being upgraded to the future standard.

## **10 REQUIREMENTS FOR GPS BASED NON PRECISION APPROACHES**

### **10.1 Approval.**

The use of GPS based navigation equipment as a supplemental air navigation system to fly any part of an instrument non precision approach is approved when the following general and specific requirements are met;

### **10.2 General.**

- (a) The GPS equipment must be approved by the CAMA Airworthiness Section as complying with FAA TSO-C129, classes A1, B1, B3, C1 or C3, and the instrument location, as well as training and operational procedures must be approved by the Flight Operations Section, and
- (b) Pilots must have received in training specified in para 11, and
- (c) The navigation data base must contain current information on the non precision approach to be flown, and
- (d) All approach plates and data bases must have position information in WGS 84 coordinates, and
- (e) The approach to be flown must be retrievable from the data base, which must have stored;

- (i) The location of all navigation aids required to define the approach, and
  - (ii) The location of all way points and intersections, and
  - (iii) Present the information in the order depicted on the published NPA chart.
- (f) If required, the nominated alternate aerodrome must have an approved non GPS instrument approach procedure expected to be available at the estimated time of arrival, and
- (g) The use of GPS equipment to fly NPA's is initially restricted to approaches based on VOR, VOR/DME, NDB, NDB/DME and RNAV let downs, and
- (h) The approach must be requested and approved by its published name (eg; NDB RWY 24 or GPS RWY 24).

### **10.3 Specific.**

For the approach used;

- (a) The operator must be authorised by the national authority in whose airspace the approach procedure is promulgated, and
- (b) The appropriate ground based navigation aid(s) must be serviceable, and
- (c) The appropriate navigation equipment, in addition to the GPS equipment, must be installed and operational in the aircraft.

## **11 TRAINING**

### **11.1 General.**

Unless exempted by CAMA, the pilot must have satisfactorily completed an approved course of GPS navigation training by a CAMA approved check and training organisation or Flying School. The training will be ground based and include both theory of GPS operation and practical operation of TSO approved GPS equipment. Each course will cover procedures specific to a type of aircraft equipment and general information. Pilots who have completed the course and who wish to use a different type of GPS aircraft equipment are responsible for ensuring they are familiar and competent with the operation of that equipment type.

### **11.2 Flying School Courses.**

Ground based courses, as described above, shall be developed by flying schools approved for instrument training, as part of the instrument rating course.

### 11.3 Training Syllabus.

The training syllabus for GPS use as primary means navigation shall cover the following;

- (a) GPS system components and principles of operation.
- (b) Navigation system performance requirements.
- (c) Authorisation and documentation.
- (d) GPS errors and limitations.
- (e) Human factors related to GPS.
- (f) GPS equipment checks.
- (g) GPS warnings, messages and pilot action.
- (h) Operational use.
- (i) Awareness of ICAO WGS 84 standard coordinates.