IFR GPS Ground Work

Version: 1.0

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Revision History

Version	Date	Changes
1.0	2003/12/14	Initial version

1. What does Satellite Ranging mean?

   Satellite ranging is the method by which GPS fixes position by the measurement of distance from several satellites. The time taken for the transmission of a satellite signal is used to determine the distance to the satellite.

2. How many satellites must the GPS measure from in order to determine two possible positions at which the receiver is located?

   3 satellites are required.

3. What does the GPS receiver do in order to reject the incorrect one of the two possible positions?

   One of the two positions identified via 3 satellites will be either not on the Earth or travelling at an impossible speed – the receiver rejects such a position. The GPS reference system is based on the WGS 84 co-ordinate system (based on Lat/Long).

4. What does the abbreviation "C/A" as relating to satellite codes stand for?

   Coarse/Acquisition.

   How does the GPS receiver use these codes to measure the distance from the satellite?

   The satellite and receiver generate the same pseudo random codes (C/A codes) repeating every 1 mS. The codes received from the satellite by the receiver are matched against its internally generated codes and thus the receiver can determine the elapsed time between transmission and reception. Since the speed of the signal is known (generally) the distance can be derived.

5. Timing is critical in GPS measurement. What does the GPS receiver do in order to overcome any time inaccuracies within its own timing mechanism?

   Measuring the distance from a fourth satellite then adding or subtracting time from each of the signals to determine a common point of intersection for the computed distances.

6. When considering satellite orbits, what is an "Ephemeris Error"?

   Ephemeris errors are errors due to errors in the satellite orbits, due to, for example gravitational influences.

7. Briefly describe each of the following errors as they relate to the GPS.

Ionosphere error – the satellite signal slows down as it passes through the Earth's ionosphere – can be compensated for by applying an average speed variation to the signals.

Water Vapour error – the satellite signal slows down as it passes through the atmosphere.

Multi-path error – the satellite signal may bounce around and reach the antenna by various paths.

Dilution of Precision – a variable error that depends on the position of the satellites relative to the receiver. (Vertical DOP, Horizontal DOP, Position DOP, Time DOP Geometric DOP). Can be reduced by selecting the best 4 satellites in view by the receiver.

Selective Availability – intentional degradation of the satellite timing signals to reduce accuracy of the GPS system (for civilian users).

8. What is differential GPS?

Differential GPS is the use of a ground based station that transmits satellite error correction signals. These corrections can be determined since the DGPS receiver is at a known location on the Earth. An example of a DGPS approach is the Norfolk Island SCAT approach.

9. Briefly describe Receiver Autonomous Integrity Monitoring (RAIM).

RAIM is the system by which the integrity of the satellite signals is monitored by the receiver and faulty signals are discarded. Requires the availability of 6 satellites (or 5 with barometric aiding).

10. How can "Barometric Aiding" assist RAIM?

Barometric aiding is the introduction of a virtual satellite overhead by supplying the receiver with a barometric pressure, that is, a known distance above the Earth.

11. What requirements must be met by a GPS receiver in order for it to be used to fly a GPS arrival?

- Must be a TSO 129 GPS receiver with RAIM operative.
- Must be panel mounted in accordance with AAAC 6-26.
- The GPS database must be current and approved by the GPS manufacturer and not capable of modification.
- The PIC must have completed a GPS theory course and demonstrated proficiency in the flying a GPS Arrival and have his/her logbook stamped.

- Recency – 1 each 90 days.

12. When flying a GPS Arrival, the conventional destination tracking aid (NDB or VOR) must be used for track guidance. True or false?

    True

13. If a track disparity occurs between GPS and the ground based navaid, the GPS arrival may be continued using the GPS data. True or false?

    False

14. Can a GPS Arrival be flown with a RAIM warning active?

    No.

    What procedure must be adopted should this RAIM warning activate?

    Track to the MAPt and conduct a Missed Approach.

15. If a destination is equipped with a 1000 MHz DME and DME Arrival procedure specified, then this shall have preference to a GPS Arrival in a suitably equipped aircraft. True or false?

    True