Royal Institute of Navigation
Science Technology Practice

AIRSPACE & SAFETY INITIATIVE

USING GPS IN AIRCRAFT for Visual Navigation

A syllabus for training

GANG

Instructor's guide

GASCo

The Syllabus

A. CLASSROOM TRAINING

B. IN THE AIRCRAFT

A. CLASSROOM TRAINING (THEORY)

1. General Operations

a. How does it work?

Description
The student should be trained in the general operation principles of GPS, notably the constellation of satellites, the part played by ground stations and "ownership" of the system (US DoD), Awareness of Selective Availability (even though presently disabled).

Critical points
System could be switched off or accuracy reduced, relative power and susceptibility to interference.

Expectation of Student's level of understanding
General appreciation of the basics of operation, including fallibility due to potential for interference of control by the DoD.

b. Altitude, positions in 3D

Description
Training in how the position is derived. Triangulation (or, more precisely, Trilateration). Necessity for a minimum of 3 satellites for 2D position and 4 for 3D plus reason for needing an additional satellite for clock correction and therefore accuracy; basic awareness of almanac.

Critical points
Minimum coverage.

Expectation of Student's level of understanding
Appreciation of minimum satellite coverage.

c. Accuracy

Description
Training on factors affecting accuracy: notably number of satellites, but also correlated with error factors (next item). Mention EGNOS enhancement.

Critical points
Dilution of Precision (DoP), fallibility of accuracy.

Expectation of Student's level of understanding
Awareness of DoP and importance to phases of flight.

d. Error Factors

Description
Following on from accuracy, factors that contribute to degradation of accuracy and/or ultimate loss of signal (e.g. multipath, ephemeris, atmospheric, clock, SA, as well as deliberate and accidental jamming etc). Explain RAIM in simple terms.

Critical points
Fallibility of GPS. Consequence of RAIM alerts

Expectation of Student's level of understanding
Appreciation of causes of errors, awareness of NOTAM'd jamming; appreciation that it would be a risk to use GPS as sole method of navigation, and that RAIM is no guarantee of infallibility.

e. Developments

Description
Awareness training of the extension of the established DoD system, numbers of satellites, Ground & satellite station enhancements (Differential GPS and WAAS); Awareness training of alternative systems such as GLONASS and Galileo and other augmentation systems.

Critical points
[Which system does the student's GPS use?]

Expectation of Student's level of understanding
Appreciation of continued change.

2. Familiarisation with an actual GPS

a. Powering the GPS

(1) - Batteries

Description
Familiarisation with the type and quantity of batteries used and how to install them. Expected battery life based on experience and manufacturers data (correlated against battery chemical type). Appreciation of effect of GPS setup on battery life (especially screen backlight). Need to carry spare batteries where practical.

Critical points
Readiness to avoid and deal with a battery failure.

Expectation of Student's level of understanding
Battery life and the fact that battery life varies depending on configuration of GPS and chemical makeup of battery. Need to carry spare batteries securely. Difficulty of changing batteries in the air.

(2) - Rechargeables

Description
Extension of above point to cover rechargeable batteries, and understanding of milliamp hours ratings and discharge characteristics.

Critical points
Many rechargeable batteries run out more quickly and more abruptly than disposable types.

Expectation of Student's level of understanding
Awareness of different characteristics.

(3) – External Power

Description
If GPS supports external power, how to connect the power, awareness of the effect on batteries when power connected (recharged or not depending on GPS make); awareness of different GPS indications when power connected/on batteries; effect of current in the power wire on the magnetic compass and also need for full and free checks with cable connected.

Critical points
Indications;Effect on compass; full and free control checks.

Expectation of Student's level of understanding
Student to be able to install the GPS safely in the aircraft.

b. Switching on the GPS

(1) – Power On

Description
Ability to turn on the GPS.

Critical points
Which button to press.

Expectation of Student's level of understanding
Able to switch on the GPS.

(2) – Start-up Sequence

Description
Awareness of the screens to expect, especially those with database currency; appreciation of the meaning of other start-up screens, such as base map currency, VFR warnings etc.

Critical points
Database Currency.

Expectation of Student's level of understanding
Ability to check database currency.

(3) – Autolocating and acquiring position

Description
Explanation of how the acquisition process works cross referencing to knowledge of the almanac (above), including relevant indications and messages on the GPS; appreciation of factors affecting location time (distance moved with GPS off; not used for some time etc); importance of crosschecking signal.

Critical points
Indications when the position is fixed; signal strength indicators.

Expectation of Student's level of understanding
Awareness of the position fixing state, especially when the position is fixed and reliable and when it is not; awareness of the factors affecting autolocation time.

(4) – Selecting an initialisation method

Description
Extension of the above point to include how position acquisition can be accelerated (depending on GPS type) typically by setting approximate position, or how autolocation can re-initialised.

Critical points
If GPS won't autolocate, signal strength may be a factor.

Expectation of Student's level of understanding
Awareness of control over the way the GPS fixes its position.

c. Operating Principles

(1) – Main Pages

Description
Familiarisation with the key pages of the GPS, how to loop through the main pages and also to access both context sensitive menus and main menu(s). Ability to quickly get back to the GPS "home" page (if supported by particular model).

Critical points
Key/button familiarity and ability to find way around GPS.

Expectation of Student's level of understanding
Fluency in fundamental selections of key pages and menus.

(2) –Satellite Status and Positions Pages

Description
Extension of the above point to ensure familiarity with the two key pages that display satellite status and fundamental raw position information.

Critical points
Satellite status.

Expectation of Student's level of understanding
Ability to rapidly view the satellite status page and confirm the GPS is generating a valid position.

(3) – HSI / CDI / Map Pages

Description
Extension of the above to ensure familiarity with various navigation pages including HSI/CDI and MAP pages (where supported), any range, declutter features, especially if automatically modified depending on phase of flight (eg, CDI sensitivity). Phraseology & abbreviation differences from traditional ones (CRS / heading / track)

Critical points
Key/button familiarity. Phraseology familiarity

Expectation of Student's level of understanding
Fluency in selection and interpretation of Navigation Pages.
Phraseology used.

(4) – Active Route Page

Description
Extension of the above in ensuring familiarity with the active route/"flight plan" (waypoint list). Ability to recognise whether or not a route is active; activate/deactivate routes and find route to activate from sub menus if a route isn't yet active.

Critical points
Key/button familiarity.

Expectation of Student's level of understanding
Fluency in understanding and manipulating and displaying Route.

d. Configuration Checks

(1) – Checking the Data Base Validity

Description
Extension of the observation in the start-up sequence to include possibility of error and implications of the database being invalid (e.g. double check controlled airspace boundaries etc); considerations for when to update etc. Knowledge about "locked" waypoints or similar (depending on GPS make).

Critical points
Importance of GPS database validity.
Importance of checking current chart & NOTAMs for notified airspace.

Expectation of Student's level of understanding
Appreciation that if the database is invalid then information must always be checked against a valid, current source.

(2) – Setting the Timezone

Description
Explanation of how to know which time zone the GPS is operating in and to set the timezone if desired.

Critical points
Which timezone the GPS is operating in.

Expectation of Student's level of understanding
Appreciation of how to know what time zone is in use and how to change it to the student's preferred setting (typically UTC or local).

(3) – Setting Measurement Units

Description
Explanation of how to recognise what units the GPS is operating in (ie, statute, metric, nautical etc) and set them if required.

Critical points
Which units are in operation.

Expectation of Student's level of understanding
Appreciation of how to check the units being used and set them to the student's preferred setting typically nautical miles distance and feet altitude, Celsius temperature.

(4) – Position Format and Map Datum

Description
Explanation of map datums and how and why positions vary between datums. Awareness of position formats, especially degrees and decimal minutes versus degrees minutes and seconds.

Critical points
Which units are in operation.

Expectation of Student's level of understanding
Appreciation of how to check the data being used and match them to the setting using other navigation charts etc used, typically WGS84 and degrees, decimal minutes.

(5) – Setting Battery Type

Description
Where supported, correlate with the battery discussion in 2a to explain how setting may affect GPS's management of battery performance and display.

Critical points
Awareness mis-setting may cause mis-management and mis-reporting of battery power.

Expectation of Student's level of understanding
Appreciation of correlation between this setting (if available) and battery type.

(6) – Contrast and Brightness

Description
Where supported, explanation of how to adjust contrast and brightness; correlate with effect on battery life (if known); awareness of how to adjust from switch on or "home" position if screen is inadvertently made unreadable; knowledge of any special night setting (or how to reduce brightness for night operation).

Critical points
Key/button familiarity.

Expectation of Student's level of understanding
Fluency in selection and setting of contrast and brightness if supported and any effect on battery life and how to deal with making the screen unreadable by accident.

(7) – Bleeper Settings

Description
Where supported, explanation of how to configure beeper volume; correlate with effect on battery life (if known).

Critical points
Key/button familiarity.

Expectation of Student's level of understanding
Fluency in selection of bleeper settings.

(8) – Display Mode

Description
Where supported (typically on systems with an option to operate in portrait or landscape mode), explanation of how to configure and recommendations to choose and become familiar with a single preferred mode (since layout and key "muscle memory" typically changes).

Critical points
Try to choose one mode and stick with it.

Expectation of Student's level of understanding
Fluency in mode selection and appreciation that switching modes may cause mistakes due to changes in screen layout and "muscle memory".

e. Exploring the Information in the Database

(1) – Preset Information

Description
Exploration of the data stored in the database; differentiation of what is in the aeronautical database and in any underlying base map - airports, navaids, towns, notified airspace boundaries, points of interest etc - also the geographical scope of each. Phraseology differences.

Critical points
What's in which database, geographical scope, vertical and horizontal airspace boundaries, implications for database currency.

Expectation of Student's level of understanding
Appreciation of the critical points.

(2) – Creating User-Defined Waypoints

Description
Exploration of the facilities to create user defined waypoints and how to create (and edit) them (typically latitude/longitude, distance & bearing to pre-existing waypoint, selecting from a pre-stored basemap feature (eg, town, POI), marking on a map; gross error checks.

Critical points
Different methods of creating and error checking user Defined Waypoints.

Expectation of Student's level of understanding
Appreciation of the critical points.

3. Using the GPS Unit's Simulator

a. Starting the Simulator

Description
Assuming supported, explanation of how to start the simulator and the indications that the GPS is in simulator mode.

Critical points
Existence of Simulator mode, how to start it and how it is indicated.

Expectation of Student's level of understanding
Ability to switch the simulator on and appreciation of how it is indicated.

b. Setting the Simulator Position

Description
Explanation that it is useful to be able to set the simulator's start position and how to do so. Setting a sample start position, probably the student's home airfield for use in the rest of this section.

Critical points
Setting the simulator position.

Expectation of Student's level of understanding
Recognition that it is useful to be able to set the simulator's start position and how to do so.

c. Using GOTO (Direct To)

Description
Explanation of how to use the GOTO (Direct To) function; build on this to use this feature to explain the remainder of this section, by setting a destination from the aviation database (by ICAO code) relative to the present simulator position.

Critical points
Setting a destination using GOTO (Direct To).

Expectation of Student's level of understanding
Understanding of how to select a destination waypoint using GOTO (Direct To) by ICAO code.

d. Simulator Speed

Description
Explanation of how to set and modify the simulator speed (may be more than one method depending on GPS model), including getting back to the navigation screen(s) if necessary; set it to follow the track set in step c at a sensible pace, most likely the typical IAS of the student's aircraft.

Critical points
Setting simulator speed.

Expectation of Student's level of understanding
Ability to set simulator speed using the methods available on the target GPS.

e. Airspace Warnings / Alarms

Description
Using the simulator to demonstrate how the GPS warns of airspace (if supported). Interpretation and how to get more information and to cancel. Include explanation of how to configure the warnings including lateral distance and vertical buffering. If applicable, discussion how standard US settings may be inappropriate for much "busier" European airspace. Use and setting of waypoint alarms if supported.

Critical points
Relative urgency and importance.

Expectation of Student's level of understanding
Ability to recognise and cancel airspace warnings and reconfigure to student’s tastes. Ability to get more descriptive information (if supported) such as radio frequencies.

f. Selecting Another Waypoint Using Another Method

Description
Expand on using GOTO (Direct To) to explain how to select a waypoint using another method (if supported) such as by town, "facility" or description rather than ICAO code - goal is to teach that most modern GPS systems support entry other than purely by ICAO codes.

Critical points
Waypoints can be selected other than by ICAO codes.

Expectation of Student's level of understanding
Understanding of how to select a destination waypoint using GOTO (Direct To) other than by ICAO code.

g. Map / Navigation settings

Description
Use the simulated flight to enable the student to explore the displayed screens, especially any map and navigation screens. Experiment with declutter settings, orientation and if available, look at menu based configuration settings. Subject to GPS type/data source, note any non-conventional displays (e.g. missing MATZ information, American style tower zones etc) and data NOT in database found on conventional charts; appreciation of key fields such as speed, distance, bearings, track made good, desired track, etc.

Critical points
Map configuration, any non-familiar zone displays etc; key data fields (especially differences between track definitions); items NOT in the database.

Expectation of Student's level of understanding
Familiarity with the moving map display and other navigation displays, and data fields overlaid on them; appreciation of items probably not in the database such as non-ICAO fields, glider winch launching etc.

h. Switching the Simulator Off

Description
Explain how to switch the simulator off; reinforcing indications as to when GPS is in simulator mode.

Critical points
Existence of Simulator mode, how to stop it and how it is indicated.

Expectation of Student's level of understanding
Ability to switch the simulator off and appreciation of how it is indicated.

B. IN THE AIRCRAFT (PRACTICAL)

4. GPS in the Aircraft

a. Positioning the GPS

(1) – Yoke Mount

Description

Demonstrate how to fit the GPS with the yoke mount (if supplied), so the yoke remains smooth and balanced. Explain issues such as cable routing, screw mount protrusion.

Critical points

Control must remain smooth and unencumbered.

Expectation of Student's level of understanding

Ability to install the Yoke and GPS without affecting control feel or creating cockpit hazards.

(2) – Dash Mount

Description

Demonstrate how to fit the GPS with the dash mount (if supplied). Explain the importance of ensuring it is secure and won't fall off, external view is not obscured and the compass is not affected; explain (relative to yoke mount) risk of glare and difficulty using in turbulence.

Critical points

Obstructed view, upset compass. Glare risk, ease of use in turbulence.

Expectation of Student's level of understanding

Ability to install the GPS on dash mount without creating a hazard and appreciation of relative strengths and weaknesses of yoke versus dash mount.

b. Installing the Antenna

Description

Discussion of the benefits of using an extension antenna (especially if yoke mounted). Demonstrate relative signal strength if possible using the signal strength display indication and use this to assist in whether or not an external antenna is required. Install if required taking care to route the cable not to create a hazard or obstruction to view and in a position to avoid it falling on the floor if it becomes unstuck.

Critical points

Signal strength vs obstruction/cable routing hazard.

Expectation of Student's level of understanding

Ability to identify if an antenna extension is required and how to install so it does not create a flight hazard.

c. Installing External Power

Description
Practical extension of 2a to install external power cable (if available) ensuring the compass is not affected and cable routing does not create a hazard.

Critical points
Risk of upsetting compass, Cable routing hazard.

Expectation of Student's level of understanding
Ability to install external power cable if available routing such that the compass is not affected and does not create a flight hazard.

d. Check the Installation

(1) – Full and Free Check

Description
Demonstrate the importance of a "full and free" check to ensure that any yoke and cables do not create a flight hazard.

Critical points
Importance of Full and Free Check.

Expectation of Student's level of understanding
Appreciation of the importance of a full and free check upon installation of the GPS (prior to starting the engine)

(2) – Contrast and Brightness

Description
Ensure the contrast and brightness is set relative to the installation (ie, to overcome glare but not be too bright, particularly for night operation)

Critical points
Importance of correct contrast / brightness setting

Expectation of Student's level of understanding
Appreciation of how to set contrast and brightness in the practical cockpit environment.

Note: Attaching any object into an aircraft requires great care, and nothing can be permanently fitted to an aircraft without the permission from the appropriate engineering authority.

e. Start-Up Procedures

(1) – Basic procedures

Description
Discuss and agree a point, to be added to the student's checklist, that they will normally turn the GPS on. This could be ahead of engine start or, more typically, when they would normally turn on the main aircraft avionics. Consider possible voltage spike on start-up if using aircraft power.

Critical points
Decide and stick to when the GPS is switched on the overall aircraft start up sequence.

Expectation of Student's level of understanding
Appreciation of need for consistency, add GPS switch on and start-up checks to overall checklist.

(2) – Check Database Validity

Description
Build upon the equivalent check in the theory section to ensure the database is valid and appreciation of the implications if it is not current.

Critical points
Importance of GPS validity

Expectation of Student's level of understanding
Appreciation that errors may occur, and, especially if the database is invalid, all airspace information must be checked against a valid, current source.

(3) – Check Power Supply

Description
Ensure that the power is as expected (battery/external mode indication, external power if applicable and battery life). Discuss whether a flight should be commenced on battery power if level is not full (or subject to experience below a certain level).

Critical points
Importance of check that power is as you expect it.

Expectation of Student's level of understanding
Appreciation of need for check of GPS power supply and decision making processes around it, especially whether to change batteries.

(4) – Check Satellite Status

Description
Review satellite status and associated factors such as DOP. Illustrate if possible (e.g. by temporarily removing antenna) the display if satellite signal is lost.

Critical points
Importance of need to check/confirm satellite status.

Expectation of Student's level of understanding
Appreciation that checking status is an important step in the checklist and the indicators of a poor signal and especially if the signal is lost

(5) – Check Indicated Position

Description
Confirm that the indicated position matches the aircraft's real position (this can be done visually on a map screen if available).

Critical points
Importance of need to check/confirm satellite position indication matches real position.

Expectation of Student's level of understanding
Appreciation that checking the position indication is an important step in the checklist.

5. Flight Planning & Flying a Route (Ground Exercise)

a. Check NOTAMs and Weather

Description
Reinforce that using GPS is part of conventional planning and that checking NOTAMS and weather should still be done as usual.

Critical points
Continued importance of standard planning parameters.

Expectation of Student's level of understanding
Appreciation that GPS does not remove the need for elements of conventional planning especially checking NOTAMS and weather.

b. Choosing Waypoints

Description
Explain factors in choosing GPS waypoints. This should be in keeping with the databases available in the GPS but importantly the alternative navigation method - for example if visual DR is being used, choosing a VOR may be less suitable than choosing a visual landmark (unless the VOR is associated with a visual landmark)

Critical points
Importance of Factors influencing choice of waypoints.

Expectation of Student's level of understanding
Appreciation that GPS should not be used as the sole means of navigation and therefore the waypoints should be ones which will "work" for the other/alternative mode of navigation.

c. Plan Flight

Description
Explain how flight planning should continue to be done in the conventional way for the type of flight envisaged including checking airspace boundaries, creation of flight log, applicable chart and wind calculations.

Critical points
Continued importance of standard planning parameters.

Expectation of Student's level of understanding
Appreciation that GPS should not be used as the sole means of navigation and therefore conventional flight planning should still be carried out.

d. Enter Route into the GPS

Description
Practical exercise in entering the route into the GPS using the selected waypoints. The information shown in the GPS route can be used to check data in the flight log. Gross error check.

Critical points
Comparison error check.

Expectation of Student's level of understanding
Ability to enter a route and appreciation of the importance of the error check against the flight log.

e. Saving the Route in the GPS

Description
If applicable (subject to GPS) the route should be saved to demonstrate how routes can be saved and retrieved.

Critical points
Most GPS can support multiple routes.

Expectation of Student's level of understanding
Appreciation of how routes are stored and retrieved.

f. Activating the Route

Description
Explain how the route entered (and/or saved) is activated and what distinguishes an active route from a non-active route. (A common mistake is creating or selecting a route and not activating it).

Critical points
Importance of activating a route.

Expectation of Student's level of understanding
Appreciation that a route must be active to be used in flight and how to activate it if it is not already activated.

g. Configuring the Active Route Information

Description
If supported, explain how to configure different fields or columns on the page that displays the active route. Highlight areas for potential confusion such as the desired track is NOT the same as the heading on the flight log (due to wind effect) and the distances may be cumulative for the trip rather than for each leg. Also note which fields are "live" and may count up or down in flight.

Critical points
Configurability and reasons for confusion.

Expectation of Student's level of understanding
Appreciation of configurability of the Active route pages and common causes of error of interpretation.

h. Configuring the Map / Navigation Pages

Description
Build on the theoretical exercise 3g to explore the displayed screens, especially any map and navigation screens. Experiment with declutter settings, orientation and if available, look at menu based configuration settings. Subject to GPS type/data source, note any non-conventional displays (e.g. missing MATZ information, American style tower zones etc); appreciation of key fields such as speed, distance, bearings, track made good, desired track, etc.

Critical points
Map configuration, any non-familiar zone displays etc; key data fields (especially differences between track definitions).

Expectation of Student's level of understanding
Familiarity with the moving map display and other navigation displays, and data fields overlaid on them.

6. First Flight (Flown with Instructor / Safety Pilot)

a. Prepare the Flight

Description
Prepare for a flight as in 5 above.

b. Switch On

Description
Switch on the GPS as planned in the checklist in 4 above.

c. Functional Checks

Description
Switch on the GPS as planned in the checklist in 4 above.

d. Fly Headings, not the GPS Line

Description
Demonstrate the importance of flying headings planned in the flight log, not trying to "fly the line" on the GPS (which encourages reduction in lookout). Encourage the GPS to be brought sensibly into the instrument checks during the normal visual (or IF) scan pattern rather than become the primary instrument! With experience the GPS can be used to estimate any differences in the wind from forecast.

Critical points
"Fly the Heading, not the Line."

Expectation of Student's level of understanding
Appreciation that the GPS can be used easily in parallel with the alternative navigation method but if used as the primary method may lead to dangerous reduction in lookout.

e. Appreciation of Navigation Displays

Description
Encourage the use of the various navigation displays available including map, CDI/HSI if available and demonstrate the effect of steering off course on various displays and digital display fields.

Critical points
Appreciation of displays.

Expectation of Student's level of understanding
Appreciation of displays.

f. Include GPS in regular checks

Description
Encourage the incorporation into regular checks such as FREDA checks - looking for coverage, power.

Critical points
The GPS is not infallible - check for coverage and power.

Expectation of Student's level of understanding
Appreciation that the GPS should be checked like any other instrument

g. GPS at the Waypoint

Description
Encourage the incorporation of GPS in checks carried out at waypoints (e.g. HAT checks); check track and groundspeed prior to and coming away from the waypoint match that expected in the flight log. Ensure sufficient lookout, especially around the waypoint.

Critical points
Compare GPS with expected track and speed.

Expectation of Student's level of understanding
Carries out post turn confidence checks of heading and ETAs.

7. Subsequent Flights

a. In-Flight Cross-Checks

Description
Encourage the growth of experience by cross checking, not only with conventional nav aids and ground features, especially to get a growing feel for how actual conditions match those forecast.

b. Track Corrections Using GPS

Description
Encourage development of experience in comparing GPS display fields.

(1) – Bracketing the Track and the Actual "Winds Aloft"

Description
Demonstrate how the traditional "bracketing the track" can be solved digitally. Align track made good with desired track; if already on the desired track it will be followed exactly and the bearing to the next waypoint will equal the desired track. Note the actual heading to adjust for any differences between actual and forecast winds aloft.

Critical points
How to "bracket the track" and adjust for actual winds aloft.

Expectation of Student's level of understanding
Appreciation of how the desired track, track made good and bearing can easily help "bracket the track" and adjust for actual conditions.

(2) – Paralleling Track

Description
Demonstrate how the track can be paralleled by aligning track made good with desired track. The desired track can be paralleled at a specific distance by use of the cross track error field if available to determine the distance from the desired track. The bearing will then rise or fall as the waypoint is approached. It is good practice to treat tracks between conventional navigation aids as a line feature and fly to the right.

Critical points
How to parallel track - treating GPS tracks between conventional waypoints as a line feature.

Expectation of Student's level of understanding
Appreciation of the desired track, track made good, bearing and cross track information (if available); appreciation of a GPS track between conventional waypoints as a line feature.

(3) – Regaining Track

Description
Demonstrate how the track can be regained at the next waypoint using the bearing (which could cause undesirable) "homing", or more quickly by turning at twice the difference between the bearing and the track made good until the bearing=desired track=true track.

Critical points
How to regain track either quickly or at the next waypoint.

Expectation of Student's level of understanding
Appreciation of how the track made good, bearing and desired track interact to enable the regaining of track quickly or at the next waypoint.

c. Simple Diversions Using GPS

Description
Demonstrate how to divert using GOTO (direct to). Explain how the techniques used in b above can be used to adjust for winds aloft. Explain the importance of drawing the diversion on a conventional chart in case the diversion track intersects items not shown in the GPS database; write the associated data to a flight log in case of GPS failure.

Critical points
How to Divert using Goto (Direct to). Associated Database risks.

Expectation of Student's level of understanding
Appreciation of how GPS can be used to divert easily but also an appreciation of the need to combine with a conventional chart.

d. More Complex Diversions

Description
Demonstrate how the techniques in b can be used to divert around weather (such as a CB or heavy shower), in conjunction with using a conventional chart to ensure hazards not in the GPS database are encountered.

Critical points
How to Divert around hazards. Associated Database risks.

Expectation of Student's level of understanding
Appreciation of how GPS can be used to divert easily but also an appreciation of the need to combine with a conventional chart.

e. Inverting the Route

Description
Explanation of how a route can easily be inverted; and also the potential for use of this function in case of a diversion back to departure aerodrome. Introduction of how to activate a specific leg.

Critical points
Inverting a route; activating a specific leg of a route

Expectation of Student's level of understanding
Appreciation that the route can easily be inverted for the return trip, or in a diversion scenario. Activation of a specific leg.

8. Acronyms used in this syllabus

DoD	Department of Defense (US)
DOP	**D**ilution **O**f **P**recision. A dimensionless number that accounts for the contribution of relative satellite geometry to errors in position determination.
EGNOS	**E**uropean **G**eostationary Navigation **O**verlay **S**ervice. Space-based augmentation system to provide augmentation to GPS and GLONASS. Same format as and compatible with WAAS.
GLONASS	The Russian Federation's **GLO**bal **N**Avigation **S**atellite **S**ystem.
HAT	Checks of **H**eading, **A**ltitude and **T**iming carried out before and after a turning point.
RAIM	**R**eceiver **A**utonomous **I**ntegrity **M**onitoring. A technique whereby all navigation sensor information available at a receiver is autonomously processed to monitor the integrity of the navigation signals.
SA	(S/A) **S**elective **A**vailability. The intentional degradation of the GPS Standard Positioning Service. Set to zero on 1 May 2000 and now removed completely from current batch of satellites.
WAAS	**W**ide-**A**rea **A**ugmentation **S**ystem. FAA augmentation of civil GPS from geostationary satellites with additional information plus differential and integrity data. Same format as and compatible with EGNOS.
WGS84	**W**orld **G**eodetic **S**ystem. A consistent set of parameters describing the size and shape of the earth. Most common system is WGS-84 (1984), used by GPS.

ABOUT THIS SYLLABUS

The Royal Institute of Navigation since its inception has aimed to improve the standards of navigation on land, sea and in the air. To that end, they have published material to assist recreational pilots (the aerial navigators of today), including a booklet on Visual Navigation Techniques and another on GPS.

Over recent years, satellite navigation system receivers and their associated computers have become available at low cost to the general public, and recreational aviators have seized on the opportunities they have offered. However, it has become clear that, despite manufacturers providing instruction manuals and CDs, many users are limited in their understanding of their equipment. There is a need for pilots to have access to detailed training before they can feel confident to use the system as an effective back up to the visual techniques which should remain their primary means of navigation for reasons explained in the "GPS Use" leaflet. The Institute's General Aviation Navigation Group has produced this syllabus of training to cover the competencies which they consider pilots should have in order to use their GPS equipment successfully in VFR flight, and this has been accepted by the Airspace & Safety Initiative Communication & Education Programme (ACEP) as the recognised syllabus for GA GPS visual navigation training. It is supported by the major UK GA organisations.

Those providing the training should refer to this Instructors Guide, which expands on the Student's Basic Syllabus to assist in preparing individual lessons. However, because the instructor needs to become familiar with whatever individual system his student intends to use before attempting to teach, this Instructor's Guide can also be used to structure that preparatory self-study. Details of individual systems can only be found in the manufacturers' instructions, which must of necessity be the source of the basic information being taught.

There is no requirement for anyone to be formally associated with the RIN in order to use this or any other of its training material. However, if training providers, or their students, feel an affinity with the aims of the Institute, various categories of individual and group membership are available as detailed on the RIN web site www.rin.org.uk .

For their help, advice, and financial support in producing this syllabus, the RIN wishes to record its thanks to the Guild of Air Pilots and Air Navigators, the Aircraft Owners and Pilots Association, the Light Aircraft Association, the British Gliding Association, the British Microlight Aircraft Association, the British Women Pilots' Association, and the General Aviation Safety Council.

The Royal Institute of Navigation (RIN) is a learned society formed in 1947. It has three main aims:

to unite all those with a professional or personal interest in any aspect of navigation in one unique body;

to further the development of navigation in every sphere; and

to increase public awareness of both the art and science of navigation, how it has shaped the past, how it impacts our world today, and how it will affect the future.