ENR 4. RADIO NAVIGATION AIDS / SYSTEMS

ENR 4.1 RADIO NAVIGATION AIDS -EN-ROUTE

Name of Station (VOR/VAR)	*ID*	*FREQ (CH)*	*Hours of Operation*	*Coordinates*	*ELEV DME antenna*	*Remarks*
1	2	3	4	5	6	7
☛						
VOR/DME CARRASCO (7º59'W)	CRR	116.9 MHZ	H24	344957.8S 0560130.5W	30 M	☛Coverage 100 NM
VOR/DME DURAZNO (9º06W)	DUR	117.5 MHZ (CH 122X)	H24	332122.5S 0562945.8W	90 M	☛Coverage 100 NM
VOR/DME CURBELO (9º24'W)	LDS	117.6 MHZ (CH 123X)	H24	345129.9S 0550530.2W	30 M	☛Coverage 100 NM

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ENR 4.2 SPECIAL NAVIGATION SYSTEMS

Name Of Station (ID) or chain	*Type of SVC*	*Frequency*	*Hours of operation*	*Coordinates TRANS STN*	*Remarks*
1	2	3	4	5	6
Global Positioning System (GPS)	Satellital	L1 - 1575.42 MHZ L2 - 1227.60 MHZ	H24	-	Use authorized as ☛primary en- ☛route navigation ☛aid and within oceanic airspace

☛ENR 4.2.1 GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

Global navigation satellite system (GNSS) is the generic name used by ICAO to define any overall range system to determine position and hour, which comprises one or more satellite constellation, onboard receivers and several integrity monitoring systems, including those appropriate augmentation devices to comply with the operational performance requirements.

(GPS) Global Positioning System description

a) Space segment
24 NAVSTAR satellites arranged in 6 orbital planes (four by plane) at 20,200 KM above the earth. Completing an orbit every 12 hours and are located so that a minimum of 4 satellites will be seen from a user anywhere in the world. Each satellite has high precision atomic clocks to synchronize messages, which are used by the onboard receivers to compute the distance to the user
b) Control segment
One Master Station, 5 monitoring stations and 3 antennas which monitor and control the satellite system
c) User segment
GPS onboard receiver. Knowing satellite positions, GPS could determine the exact location by measuring the delay that the signal takes to reach the receiver, converting that measure into distance. Four satellites measures will be required to obtain a 3 dimension (3D) navigation fix.

ONBOARD RECEIVER

a) For VFR use

Use limitations:
1.- If Receiver autonomous integrity monitoring (RAIM) is not available, it could not warn the pilot in case of a faulty satellite was sending erroneous signals;

2.- Inadequate antenna installation and absence of database unable to update itself could also disturb the proper signal reception; and

3.- Incorrect waypoints insertion also could cause navigation error.

These receptors have in their Operations Manual a Note:

FOR VFR USE ONLY

and should not be used, under any circumstances, for IFR flights

b) For IFR use

Approved IFR receivers must comply with requirements detailed in Federal Aviation Administration (FAA) Technical Standard Order TSO C-129a (TECHNICAL STANDARD ORDER TSO C-129a AIRBORNE SUPPLEMENTAL NAVIGATION EQUIPMENT USING THE GLOBAL POSITIONING SYSTEM) of 20 FEB 96 and must be installed according to FAA AC-20-138 (AIRWORTHINESS APPROVAL OF GPS NAVIGATION EQUIPMENT FOR USE AS A VFR AND IFR SUPPLEMENTAL NAVIGATION SYSTEM) of 25 MAY 94.

These receivers has the (Receiver Autonomous Integrity Monitoring - RAIM) function. This function detect the failure of a GPS signal by comparing position information and time obtained from varied 4 satellite combinations, from a joint of at least 5 satellites in sight.
If a faulty satellite is detected, the receiver warns pilot that the system is not appropriate for navigational use, must switch to traditional navigation methods.
A minimum of 6 satellites must be in sight if RAIM function is desirable, after detection and faulty satellite deactivation from navigation solution.

USE OF GPS WITHIN MONTEVIDEO FIR

1. ☛Within República Oriental del Uruguay jurisdictional airspace, it is possible to use GPS as the **only primary aid** to navigation.

OPERATIONAL REQUIREMENTS FOR GPS USE WITHIN URUGUAYAN OCEANIC AIRSPACE

1.1 For GPS use as primary navigation device within the República Oriental del Uruguay oceanic airspace, pilots must comply with the procedures and operation techniques described in the aircraft GPS IFR Receiver Manufacturer Operator Manual and with those described in N8110.60 / FAA.

1.2 Pilot in command should have the appropriate knowledge about:

a) Fundamentals of GPS navigation
   i. Software use
   ii. Hardware operations and GPS interfaces with other navigation systems
   iii. Data base update procedures
   iv. Equipment limitation
b) GPS operation
c) Before departure procedures
d) Enroute procedures
e) Emergency/contingency procedures

1.3 Uruguayan registered aircraft could use GPS as primary navigation device and, must have the airworthiness certificate issued by the competent authority.

☛ONBOARD EQUIPMENT

1.4 ☛**GPS Double navigation system for oceanic flights.**

In accordance with ICAO Annex 6 to the Convention on International Civil Aviation, Chapter 7 Communication Equipment and Onboard Navigation, paragraph 7.2.4 and to the Notice N8110.60 of F.A.A., point 4 paragraph f, Performance Requirements, the aircraft must be equipped with double GPS navigation system which must comply with technical specifications detailed in paragraph 5.2 of that AIC.

1.5 ☛**Technical specifications.**

GPS navigation systems used over oceanic airspace flights must comply with technical requirements specified in FAA Technical Standard Order C-129a (Airborne Supplemental Navigation Equipment Using the GPS) of 20 FEB 96, with those contained in Notice N8110.6 of FAA (GPS as a Primary Means of Navigation for Oceanic/Remote Operations) of 4 DEC 96 and must have been installed in accordance with FAA Circular AC-20-130a (Airworthiness Approval of Navigation or Flight Management System Integrating Multiple Navigation Sensors) and/or to Circular AC 20-138 of FAA (Airworthiness Approval of GPS Navigation Equipment for Use as a VFR and IFR Supplemental Navigation System) of 25 MAY 94, as appropriate.
In addition, the aircraft must have the GPS navigation systems connected with FMS, or Auto Pilot, or Flight Director.

☛ REQUIRED GPS SATELLITE GEOMETRY

1.6 ☛**Overview**
GPS navigation accuracy depends mostly of satellite geometry related with the receiver.
A minimum of four satellites simultaneously over horizon to obtain a three dimension fix (3-D).
RAIM technique could be used if five satellites are in a proper position range with the receiver, so five independent positions could be calculated. If the information compared between them does not fit, the receiver deduces that one satellite is giving incorrect information, and a warning light turns on the equipment panel (failure detection).
If there are six or more satellites in range, more positions could be calculated and receiver could identify exactly which satellite fails and exclude it from position calculations (failure exclusion).
From the foregoing it is clear that pilots should take into consideration that if there are only four satellites in view of receiver in case of any defective, such failure will not be reported by the receiver.

1.7 **Procedures in case of GPS navigation failure**
(Ref. Order 8400.10 of FAA Appendix 4 HBAT 95-09 "Guidelines for Operational Approval of GPS to ☛Provide the Primary means of Class II Navigation in Oceanic and Remote Areas of Operation")

a) Lost of navigation function *(four satellites in sight or less)*
If GPS receiver indicates a lost of navigation warning, the pilot will use immediately dead reckoning navigation (D/R) until GPS navigation could be reestablished.

b) Lost of RAIM *(five satellites in sight or less)*
If GPS receiver indicates lost of RAIM, navigation integrity will be obtained by comparing GPS position with an extrapolated calculated position of last verified position against true airspeed, heading and estimated winds. If both positions do not fit within 10 NM, pilot will reassume immediately dead reckoning navigation (D/R) until the excluding function or navigation integrity reappear.

c) Fault detection warning *(less of 6 satellites in sight)*
If GPS receiver indicates a fault detection warning (faulty satellite), pilot could continue navigation by using positions obtained by GPS, if monitors continually the actual dead reckoning of position ambiguity which appears on GPS display and was obtained from Failure Detection and Exclusion algorithm (FDE). If that value exceed 10 NM or is not available, the pilot will immediately reassume dead reckoning navigation (D/R) until faulty satellite was excluded.
In that three examples, if navigate with GPS is not possible, the pilot will report to ATC **"GPS navigation lost"** and when reassume GPS navigation **“GPS navigation reestablished"**

FLIGHT PLAN

In the Flight Plan form blank 10 the letter "R" must be inserted. In blank 18 the following letters must be inserted NAV/GPS-RNAV when GPS IFR receivers are available for oceanic airspace flights.

DEFINITIONS

a) Algorithm
Step by step procedure to solve problems.

b) Augmentation
Technique that provides the system with input data (input) in addition to those derived from the(s) principal(s) constellation(s) in a new service to provide distance information, or corrections or improvements in input data. This allows the system to improve performance in relation to that be obtained only with the basic information (raw data) from the satellites.

c) Continuity
The ability of the whole system to perform its function without interruption during the planned period of operation. The risk of continuity is the probability that the system is interrupted and not provides guidance information for the proposed operation

d) ☛ (Fault Detection and Exclusion - FDE)
GPS equipment capability for:
1. Satellite failure detection which affects navigation, and
2. Possibility to exclude these satellite automatically from the navigation solution

e) ☛Availability
Percentage of time that services are usable navigation system.

f) ☛Integrity
Navigation system capability to send appropriate warnings to users when the system must not be used with navigation objectives.

g) Airborne Autonomous Integrity Monitoring - AAIM
Onboard augmentation technique which is enhanced by the availability of the navigation function. This includes the INS, who can impersonate the GNSS antennas when aircraft satellite equipment are masked or when there is sufficient number of satellites to reach a more accurate time reference, a particular combination of data entry sensor through filtering techniques, and so on.

h) ☛Receiver Autonomous Integrity Monitoring - RAIM
Onboard augmentation technique for which a receiver / processor determines the integrity of GPS navigation signals using only GPS signals or the signals augmented with altitude information. This determination is obtained through an ongoing monitoring of the received signals. At least one other satellite, in addition to those used for navigational purposes, should be available to the receiver to perform RAIM.

i) ☛Dead Reckoning - D/R
Navigation made only by means of calculations based on airspeed, course, heading, wind direction and speed, ground speed and elapsed time

j) ☛Accuracy
It is the ability of a navigation aid to warn the pilot that it has failed or is giving incorrect markings.

k) ☛Flight Management System - FMS
Interactive computer system and display navigation to assist the pilot in flight with maximum economy by a route previously planned, defined in terms of waypoints and altitude changes.

l) ☛Global Navigation Satellite System - GNSS
Global System for determining position and time, which includes one or more satellite constellations, receivers onboard monitoring systems and system integrity, augmented as necessary to support the required navigation performance for the actual phase of operations.

m) ☛Main navigation system
Navigation system approved for a given operation or phase of flight and must meet accuracy and integrity, but not with the availability and continuity. Security is achieved by limiting flights to specific time periods and with certain procedural restrictions.

n) Airborne-Based Augmentation System - ABAS
GPS Built-in receivers/processors augmentation system installed onboard the aircraft. Could be AAIM or RAIM type.

INFORMATION ABOUT GPS CONSTELLATION STATUS

Information about GPS NAVSTAR satellites constellation availability could be obtained by contact U.S. Coast Guard Center, internet address:

☛**http://www.navcen.uscg.gov/**

WARNING

It is the responsibility of the pilot in command of the aircraft which plans to conduct an oceanic airspace flight to verify their GPS receivers are in comply with FAA/TSO-129A, and are installed according to the AC 20-130A and / or 20-138 / FAA and meet the performance requirements of the N8110.60/FAA.
It will also be responsibility of the pilot in command to meet the other requirements of Chapter ENR 4.2 Global Navigation Satellite System (GNSS).
It should be understood that República Oriental del Uruguay is not responsible for the continuity of the GPS signals

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ENR 4.3 NAME-CODE DESIGNATORS FOR SIGNIFICANT POINTS

Name-code designator	*Coordinates*	*ATS routes or other routes*	*Remarks, including supplementary definition of positions where required*
1	2	3	4
AKNUS	341957.96S 0575012.96W	SUCA IAC RNAV (GNSS) 13	Nil
AKPOD	322757S 0533341W	☛UM540	Nil
☛ AKSET	342848.96S 0575552.98W	SUCA IAC RNAV (GNSS) 13	Nil
☛ ALBES	332209.24S 0564234.20W	SUDU IAC RNAV (GNSS) 10	Nil
☛ ALDUS	313429.83S 0580641.90W	SUSO IAC RNAV (GNSS) 05	Nil
☛ ANKIR	310617.82S 0553643.74W	SURV IAC RNAV (GNSS) 05	Nil
ANLUN	304230S 0563605W	UL324 UM418	Nil
ANRUP	334741S 0561209W	UM402 UN857	Nil
ARAPE	310100S 0572213W	W19 W20	Nil
AROMO	333002S 0550244W	A310 W18	Nil
ASIVA	335026S 0562035W	P526 W19	Nil
ASUMA	315203S 0540919W	A310	Nil
☛ BISOK	325246S 0564041W	P526 W19	Nil
BOLAT	333949S 0540039W	A305	Nil

Name-code designator	*Coordinates*	*ATS routes or other routes*	*Remarks, including supplementary definition of positions where required*
1	2	3	4
BUTSI	331149.53S 0562459.14W	SUDU IAC RNAV (GNSS) 21	Nil
CUARA	302211S 0562659W	UL324	Nil
DAGUS	350217S 0560725W	A306 A310 UL405 UM792	Nil
☛DAMEV	322001.29S 0580324.23W	SUPU IAC GNSS (RNAV) 20	Nil
DAMPA	312935.18S 0580212.84W	SUSO IAC RNAV (GNSS) 05	Nil
DARKA	351758S 0561502W	A310 UM792	Nil
DAYMA	314714S 0570514W	UL324 UP526	Nil
DIDER	332152.08S 0563636.48W	SUDU IAC RNAV (GNSS) 10	Nil
DORVO	344258S 0573102W	A305 UM424 UN857	Nil
DRACA	342524S 0562227W	W25	Nil
EGDOK	343214.89S 0573508.94W	SUCA IAC RNAV (GNSS) 31	Nil
EGUPI	342519.80S 0575054.30W	SUCA IAC RNAV (GNSS) 13	Nil
EKEKI	310706S 0561124W	W16 W25	Nil
ENSAS	315440S 0570849W	UL324 UM534	Nil
ENTED	331047S 0563348W	UN741 UP526	Nil
ESORI	331625.70S 0562720.32W	SUDU IAC RNAV (GNSS) 21	Nil

Name-code designator	*Coordinates*	*ATS routes or other routes*	*Remarks, including supplementary definition of positions where required*
1	2	3	4
GAMOT	305640S 0552937W	UA432 UM654	Nil
☛ GEBAR	342423.34S 0575302.34W	SUCA IAC RNAV (GNSS) 13	Nil
GEMOT	332058.38S 0561843.92W	SUDU IAC RNAV (GNSS) 10	Nil
GEMSU	301600S 0573818W	P526 UP526 W19	Nil
GORIO	330747S 0570139W	W23	Nil
GUTUD	302245.87S 0564220.45W	SUAG IAC RNAV (GNSS) 11	Nil
GUVIN	342302S 0561737W	W23	Nil
GUVON	335332S 0572303W	UL417 UN741	Nil
☛ ILMUL	320844S 0562832W	UM402 UM654	Nil
ILNAN	302323.06S 0563636.27W	SUAG IAC RNAV (GNSS) 11	Nil
☛ ILSIM	314400S 0563232W	☛UM402 UM534	Nil
☛ ISALA	314034S 0542647W	A314	Nil
☛ KORBU	330726S 0555805W	W15	Nil
KOSPI	344202S 0563856W	W29	Nil
☛			

Name-code designator	*Coordinates*	*ATS routes or other routes*	*Remarks, including supplementary definition of positions where required*
1	2	3	4
KUDEN	310234.22S 0553250.21W	SURV IAC RNAV (GNSS) 05	Nil
KUGUG	342939.60S 0574103.40W	SUCA IAC RNAV (GNSS) 31	Nil
KUKEN	341058S 0581302W	UL324 UM654	Nil
LITOS	342732S 0544334W	A305	Nil
LOLIL	315259S 0570303W	UM534 UP526	Nil
LOMID	335308S 0561945W	UN857 UP526	Nil
LUCIO	350318S 0555218W	A306 UL405	Nil
MEVIV	311839S 0571546W	W19 W25	Nil
MIGOT	305248S 0564042W	UM402 UL324	Nil
☛MIMOL	322033S 0541319W	W3, W18, UM792, UN857	Nil
MOLBI	342050S 0553018W	UM540	Nil
MONSA	342056S 0561053W	P526 W19 UP526	Nil
MUKIB	304311S 0564213W	UM418 UM402	Nil
MUMET	330038S 0560353W	A314	Nil
NEGIR	334054S 0565702W	A314	Nil

Name-code designator	*Coordinates*	*ATS routes or other routes*	*Remarks, including supplementary definition of positions where required*
1	2	3	4
NEMAS	343503S 0571111W	W29	Nil
NIMBO	343049S 0562932W	B555 UL417	Nil
OGMAR	331735S 0540856W	A309	Nil
OGRUN	320343S 0535034W	UN857	Nil
☛ OPSOS	322418S 0565125W	P526 G680	Nil
ORELO	310036.90S 0553048.00W	SURV IAC RNAV (GNSS) 05	Nil
☛ PABOT	341536S 0565134W	UL417 UN857	Nil
☛ PAPIX	342458S 0580002W	A314 UN741	Nil
PONPA	335625S 0571859W	A314 B555 UA314	Nil
PORLI	313419S 0560010W	UM534 UM654	Nil
PUKAL	305917.34S 0552924.95W	SURV IAC RNAV (GNSS) 05	Nil
PUMIL	323227S 0564820W	UM654 UP526	Nil
☛ RAVEL	342802S 0544249W	UM424	Nil
REBIN	325758S 0570718W	W23 W27	Nil
REGOV	341956S 0560029W	W15	Nil

Name-code designator	*Coordinates*	*ATS routes or other routes*	*Remarks, including supplementary definition of positions where required*
1	2	3	4
RIONE	330330S 0565830W	W27	Nil
RODOV	305004S 0574817W	UM418	Nil
SANDU	321204S 0573323W	W23	Nil
SASKU	304754S 0572651W	UM418 UP526	Nil
SEKLO	300629S 0564758W	UM402	Nil
☛SEKMI	312605S 0575903W	W20, W23, W25	Nil
SIMOL	321130.14S 0580150.34W	SUPU IAC RNAV (GNSS) 20	Nil
SISEL	333654S 0555903W	W15	Nil
SOLIS	342057S 0552529W	A309	Nil
SUGRA	321234S 0581124W	UM534	Nil
SURBO	342658S 0575738W	Corredor SURBO VFR	Nil
TELAK	342034S 0553938W	A310 W18 UM792	Nil
☛TEMAL	314501S 0555526W	W15, W16	Nil
TESAD	333931S 0570052W	W25	Nil
TIDRU	340057S 0550102W	A309	Nil
TILDA	333820S 0574432W	UL417 UM654	Nil

Name-code designator	*Coordinates*	*ATS routes or other routes*	*Remarks, including supplementary definition of positions where required*
1	2	3	4
TOGAL	333131S 0575406W	UL417 UL324	Nil
TOKAM	344653S 0564256W	A305 UM424	Nil
TOLEP	324341S 0530510W	UM424 UM661	Nil
TOSIB	342106S 0551955W	UM661	Nil
TULIO	313223S 0543001W	G680	Nil
UBLAM	303935S 0560944W	UM418	Nil
UGELO	324042S 0530850W	A305	Nil
UGIMI	345858S 0565302W	A306 UL405	Nil
UGRES	321627.18S 0580244.75W	SUPU IAC GNSS (RNAV) 20	Nil
UGURA	323617S 0532027W	A309	Nil
UMRUD	312650S 0543933W	UN741	Nil
URURI	311810S 0550726W	UM534	Nil
VUDUP	325854S 0562018W	UM402 UN741	Nil
VUGNI	315744S 0535501W	UM792	Nil
VUKAS	342013S 0560637W	UM402	Nil
VULRO	335053S 0563637W	W23	Nil

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ENR 4.4 AERONAUTICAL GROUND LIGHTS - EN ROUTE

Name IDENT (coordinates)	*Type and intensity (sparks)*	*Characteristics*	*Operating Hours*	*Remarks*
1	2	3	4	5
Adami TWR 344700S/0561600W (*)	☛ABn ☛W 1000	☛Gp Flg (WGW)	☛HN IMC	
Cabo Polonio (Polonio Cape) 342400S/0534700W (*)	Marine 290.600	Flg W	HN	
Cabo Santa María (Santa María Cape) 344000S/0540900W (*)	Marine 480.000	Flg W ev 60 sec W F	HN	
Capitán Curbelo TWR 345100S/0550600W (*)	ABn 300	Gp Flg W G ev 5 sec	HN IMC	
Carrasco Terminal Building 344500S/0500200W (*)	ABn W 880	Gp Flg W G W ev 8 sec	HN IMC	
Cerro Montevideo 345300S/0561600W (*)	Marine 480.000	Gp Flg W ev 10 sec 3 Flg	HN	
Colonia del Sacramento 342800S/0575200W (*)	Marine 620	Flg R ev 9 sec	HN	
Farallón 342800S/0575600W (*)	Marine 1.300	Gp Flg W ev 10 sec 2 Flg	HN	
Isla de Flores 345700/0555600W (*)	Marine 200.000	Gp Flg W ev 16 sec 2 Flg	HN	
Isla de Lobos 350200S/0545300W (*)	Marine 1.084.800	Flg W ev 5 sec F R al SE	HN	
La Panela 345500S/0562700W (*)	Marine 600	Gp Flg W ev 10 sec	HN	
Punta Brava 345600S/0561000W (*)	Marine 14.400	Flg W ev 10 sec	HN	
Punta del Este 345800S/0545700W (*)	Marine 43.000	Flg W ev 8 sec	HN	

Name IDENT (coordinates)	*Type and intensity (1 000 candelas)*	*Characteristics*	*Operating Hours*	*Remarks*
1	2	3	4	5
☛	☛	☛	☛	
Punta José Ignacio 345100S/0543800W (*)	Marine 1.150	Flg W ev 2 sec	HN	
Punta Palmar 340400S/0533300W (*)	Marine 1.150	Flg W ev 6 sec	HN	