Agenda Item -6
WP-09
Presented by Secretariat

GBAS-SBAS Procedure Design Overview

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Regional Officer, PBN,
ICAO APAC RSO

LPV(SBAS) Procedure Design criteria

Types of LPV(SBAS) procedures-

- APV 1 – Type A, 3D operation, Minima(DH) >= 250 ft.
- Cat I - Type B, 3D operation, Minima(DH) < 250 ft.

Both procedures will be represented by LPV minima(DH) on Instrument Approach chart.

OAS(Obstacle Assessment Surface) for LPV(SBAS) Procedures-

- SBAS APV1 OAS – 7 sloping Surfaces, W, W', X,Y & Z – No CRM
- SBAS Cat I OAS – 6 sloping Surfaces, W, X,Y & Z – ILS Cat I surfaces – ILS Cat I CRM
- Separate sets of constants are provided for APV I or CAT I.
- SBAS CAT I OAS uses the ILS CAT I OAS constants.
- **LLZ-THR replaced by GARP(**GNSS azimuth reference point)**-THR**
- FAS (Final Approach Segment) Data Block to be developed and promulgated along with the IAP chart.

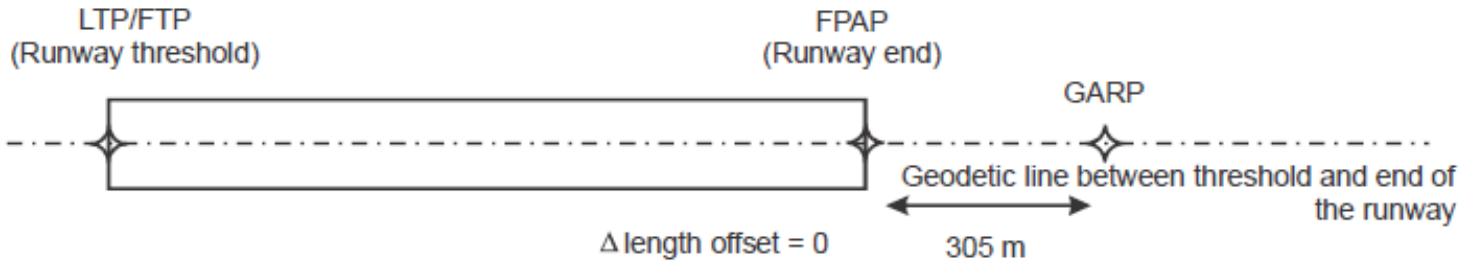


Figure III-2-6-1. FPAP location (no existing ILS for the approach)

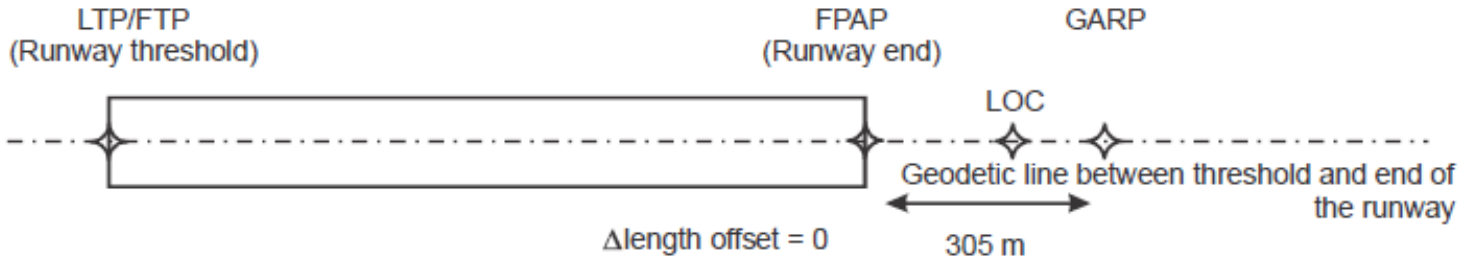


Figure III-2-6-2. FPAP location (ILS exists for the approach and LOC within 305 metres from runway end)

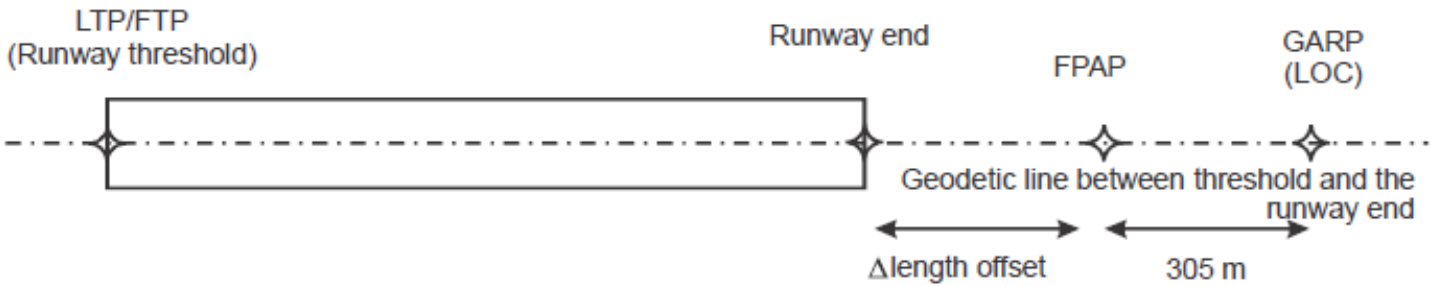


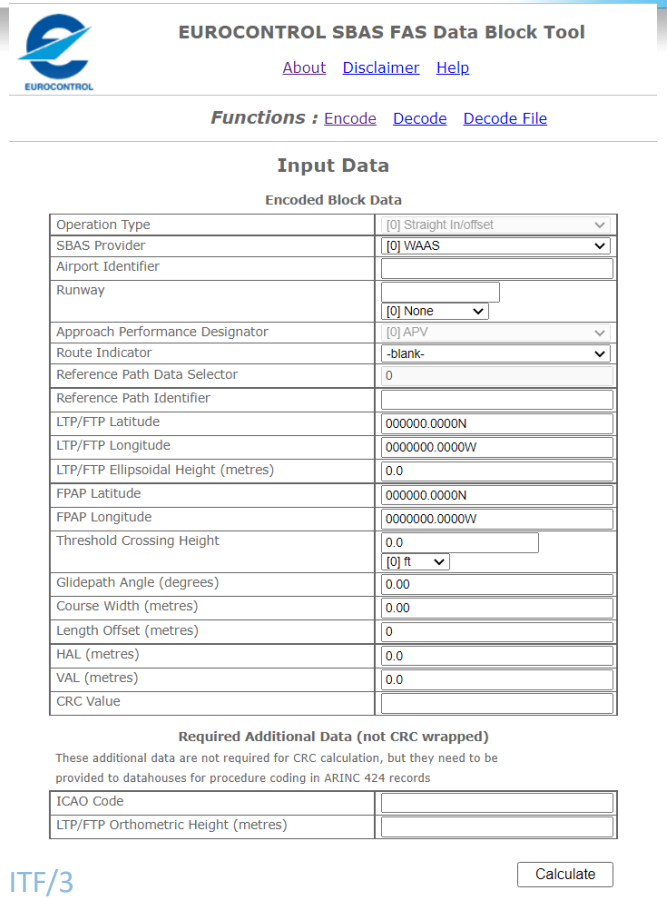
Figure III-2-6-3. FPAP location (ILS exists and LOC more than 305 m from the runway end)

Table III-3-5-1. Example of textual description of data required for the final approach segment data block

Data Content	*Example Data*
Operation Type	0
SBAS Provider Identifier	1
Airport Identifier	LFLC
Runway Number	26
Runway Letter	
Approach Performance Designator	0
Route Indicator	Z
Reference Path Data Selector	0
Reference Path Identifier	E26A
LTP/FTP Latitude	454718.3185N
LTP/FTP Longitude	0031114.4545E
LTP/FTP Height above ellipsoid	372.3
FPAP Latitude	454705.1260N
FPAP Longitude	0030900.4790E
Approach Threshold Crossing Height (TCH)	15
Approach TCH Units Selector	1
Glidepath Angle (GPA)	3
Course Width at threshold	105
Length Offset	48
Horizontal Alert Limit (HAL)	40
Vertical Alert Limit (VAL)	0
Final Approach Segment CRC	AB8761C6

FAS DB (Final Approach Segment) Data Block can be generated through most of the flight procedure Design software. This can also be developed through EUROCONTROL SBAS FAS Data Block Tool at the following link:

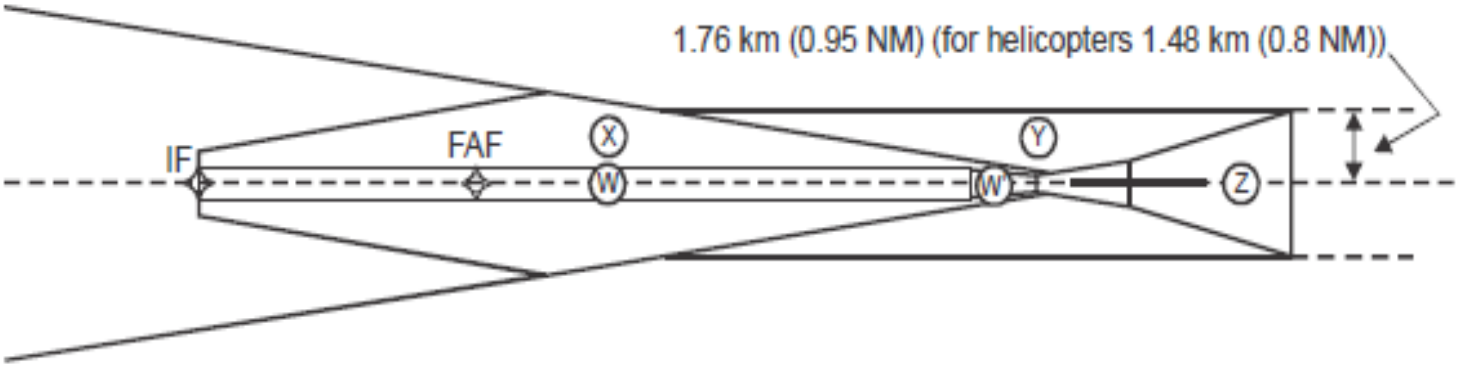
https://fasdb.eurocontrol.int/fasdb/app/fasForm.htm



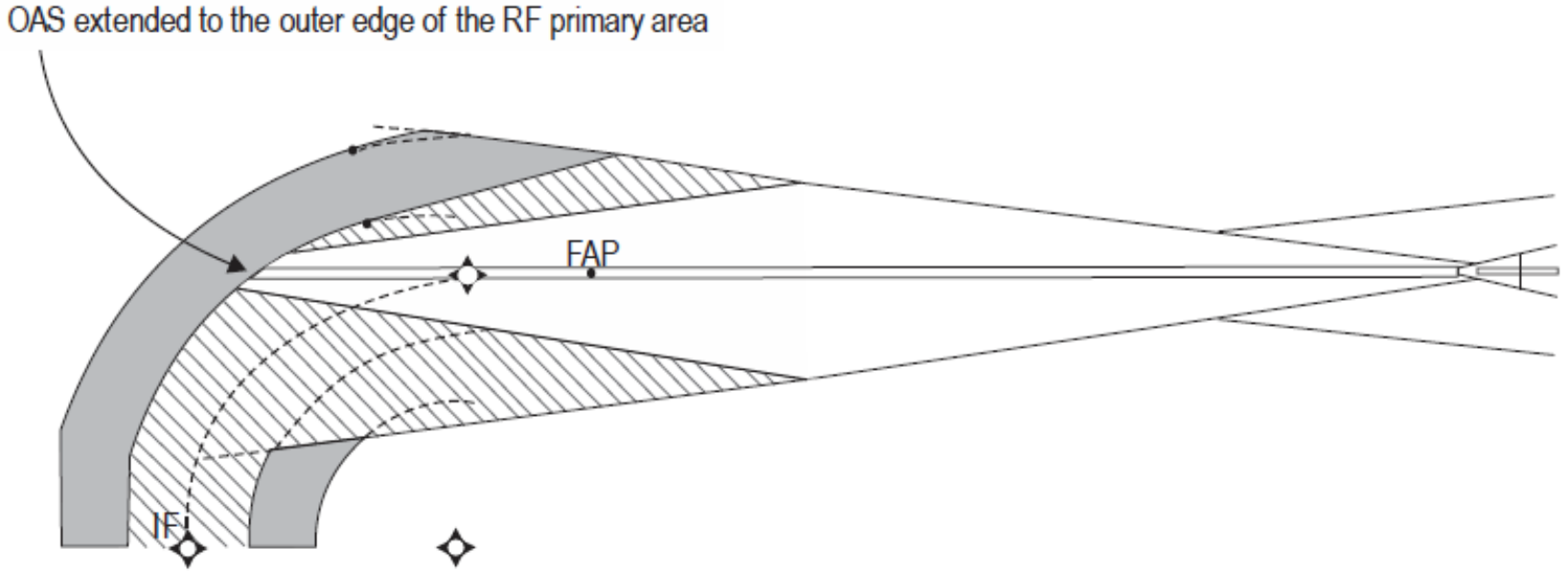
LPV(SBAS) Procedure Design criteria

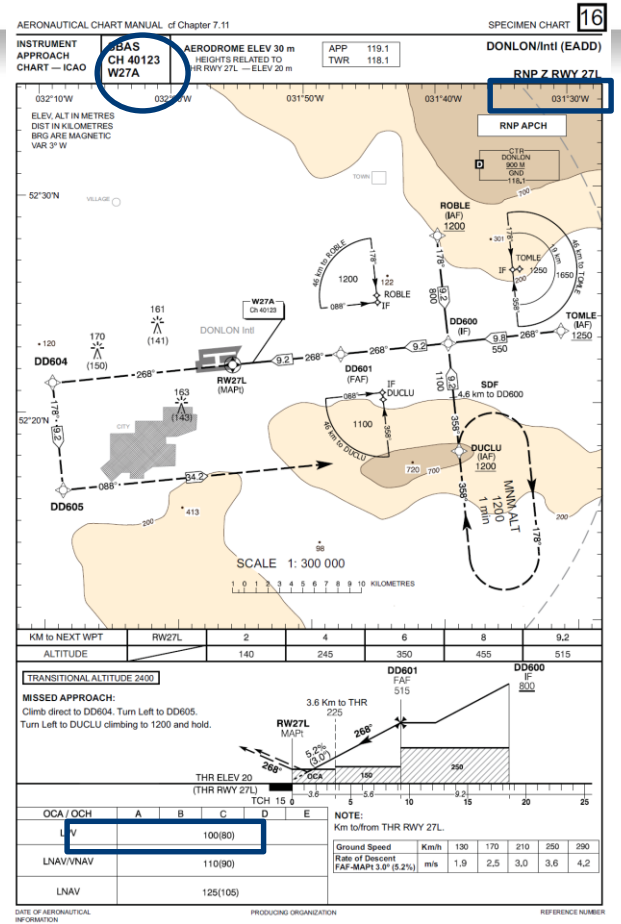
- A globally unique channel number in the range 40 000 to 99 999 to be promulgated with each procedure.
- The Channel number to be obtained from ICAO SBAS Channel number Allocation tool.
- The intermediate approach segment may incorporate a PBN route ending with a radius-to-fix(RF) turn to the final approach course(4 Nov 2021 onwards).
- The RF turn shall terminate at a waypoint aligned with the final approach course(4 Nov 2021 onwards).
- Missed approach turn shall be prescribed at a designated TP.
- Turns at a designated altitude/height or “as soon as practicable” cannot be implemented because of the current SBAS receiver capabilities.

SBAS APV I obstacle assessment surfaces



Area construction for radius-to-fix turn to the final approach course (Applicable as of 4 November 2021)




AERONAUTICAL CHART MANUAL cf Chapter 7.11
SPECIMEN CHART 16
INSTRUMENT APPROACH CHART — ICAO
GBAS CH 40123 W27A
AERODROME ELEV 30 m
APP 119.1
TWR 118.1
DONLON/Intl (EADD)
RNP Z RWY 27L
RNP APCH
ELEV, ALT IN METRES
DIST IN KILOMETRES
BRG ARE MAGNETIC
VAR 3° W
ROBLE (IAF) 1200
TOMLE (IAF) 1250
DD600 (IF)
DD601 (FAF)
DD604
DD605
DUCLU (IAF) 1200
SDF 4.6 km to DD600
RW27L (MAPt)
DONLON Intl
SCALE 1: 300 000
KM to NEXT WPT
ALTITUDE
TRANSITIONAL ALTITUDE 2400
MISSED APPROACH:
Climb direct to DD604. Turn Left to DD605.
Turn Left to DUCLU climbing to 1200 and hold.
3.6 Km to THR
THR ELEV 20
(THR RWY 27L)
OCA / OCH
LNAV/VNAV 110(90)
LNAV 125(105)
NOTE:
Km to/from THR RWY 27L.
Ground Speed
Rate of Descent FAF-MAPt 3.0° (5.2%)

AERONAUTICAL CHART MANUAL cf Chapter 7.11 — SPECIMEN CHART 16

INSTRUMENT APPROACH CHART — ICAO	SBAS CH 40123 W27A	AERODROME ELEV 30 m HEIGHTS RELATED TO THR RWY 27L — ELEV 20 m	DONLON/Intl (EADD) RNP Z RWY 27L

TABULAR DESCRIPTION

RNP Z RWY 27L

Serial Number	Path Descriptor	Waypoint Identifier	Fly-Over	Course °M(°T)	Magnetic Variation	Distance (km)	Turn Direction	Altitude(m)	Speed limit (km/h)	VPA/ TCH	Navigation Specification
010	IF	TOMLE	-	-	-	-	-	+1250	-	-	RNP APCH
020	TF	DD600	-	268(264,7)	-	9,8	-	+800	-	-	RNP APCH
010	IF	DUCLU	-	-	-	-	-	+1200	-	-	RNP APCH
020	TF	DD600	-	358(355,3)	-	9,2	-	+800	-	-	RNP APCH
010	IF	ROBLE	-	-	-	-	-	+1200	-	-	RNP APCH
020	TF	DD600	-	178(175,3)	-	9,2	-	+800	-	-	RNP APCH
010	IF	DD600	-	-	-	-	-	+800	-	-	RNP APCH
020	TF	DD601	-	268(265,3)	-	9,2	-	@615	-	-	RNP APCH
030	TF	RW27L	Y	268(265,3)	-	9,2	-	@35	-	-3,0/15	RNP APCH
040	FA	RW27L	-	268(265,3)	+3,0	-	-	-1)	-	-	RNP APCH
050	DF	DD604	-	-	-	-	-	-	-	-	RNP APCH
060	TF	DD605	-	178(175,0)	-	9,2	L	-	+610	-	RNP APCH
070	TF	DUCLU	-	088(085,0)	-	34,2	L	+1200	-	-	RNP APCH
080	HM	DUCLU	-	358(355,0)	-	-	R	+1200	-	-	RNP APCH

1) This value is provided by industry.

WAYPOINT LIST

RNP Z RWY 27L

Waypoint Identifier	Coordinates
TOMLE	52°22'20.8"N 031°36'50.5"W
ROBLE	52°21'59.7"N 031°16'01.5"W
DUCLU	52°17'53.6"N 031°38'41.6"W
DD600	52°22'52.2"N 031°39'01.4"W
DD601	52°22'57.4"N 031°47'59.3"W
RW27L	52°22'52.71"N 031°55'37.08"W
DD604	52°21'50.1"N 032°09'13.7"W
DD605	52°18'52.2"N 032°08'31.5"W

FAS DATA BLOCK

Operation Type	0	LTP/FTP ellipsoidal height	31,7
SBAS Provider	0	FPAP latitude	522155,5020N
Airport Identifier	EADD	FPAP longitude	0315605,4200W
Runway	RW27L	Threshold crossing height	15
Approach performance designator	0	TCH units	1
Route indicator	Z	Glide path angle	3
Reference path data selector	0	Course width at threshold	100
Reference path ID	W27A	Length offset	48
LTP/FTP latitude	522202,7050N	Horizontal alert limit (HAL)	40
LTP/FTP longitude	0315537,0790W	Vertical alert limit (VAL)	50
Precision approach path point data CRC remainder	F1A360CC		
LTP Orthometric Height	*20.1*		
FPAP Orthometric Height	*20.3*		

DATE OF AERONAUTICAL INFORMATION — PRODUCING ORGANIZATION — REFERENCE NUMBER

ICAO SBAS Channel Assignment Tool

- A globally unique channel number in the range 40 000 to 99 999 to be promulgated with each procedure.
- FAA used to manage the world Master Database for ICAO initially.
- As per ICAO State letter 2019/87 new ICAO SBAS channel assignment tool rolled out.
- States wishing to develop SBAS procedures should request SBAS channel numbers through this platform.
- States to nominate one or two focal points by sending an email to sbas@icao.int.
- Focal points will be provided access to the ICAO tool.

GLS(GBAS Landing System) Procedure Design Criteria

- GLS criteria same as ILS criteria
- ILS CRM can be used to determine Minima(DH).
- *Final approach segment (FAS) data*. Final approach segment defined by FAS data block in electronic form with a cyclic redundancy check (CRC).
- The intermediate approach segment may incorporate a PBN route ending with a radius-to-fix turn to the final approach course.
- The RF turn shall terminate at a waypoint located on the final approach course.
- Initial approach segment – RNAV-1 or RNP-1 or better.
- FAP mandatory as Descent Fix and GP verification check.

GBAS/GLS FAS Data Block

- FAS Data Block contains the safety critical information for a precision approach
- FAS Path is a line in space defined by:
  - Landing threshold point/fictitious threshold point (LTP/FTP)
  - Flight path alignment point (FPAP)
  - Threshold crossing height (TCH)
  - Glide path angle (GPA)
- FAS data block is protected by CRC
- Transfer of FAS DB to the GBAS ground station should be electronically via media or via network.

- *GBAS channel number.* The channel number for the procedure as defined in Annex 10, Volume I, Attachment D, paragraph 7.7, shall be promulgated with the procedure information.
- A channel number in the range from 20 001 to 39 999 is assigned when the FAS data are broadcast in the Type 4 message.
- The VDB is automatically tuned with the selection of the channel number.

GBAS obstacle assessment surfaces

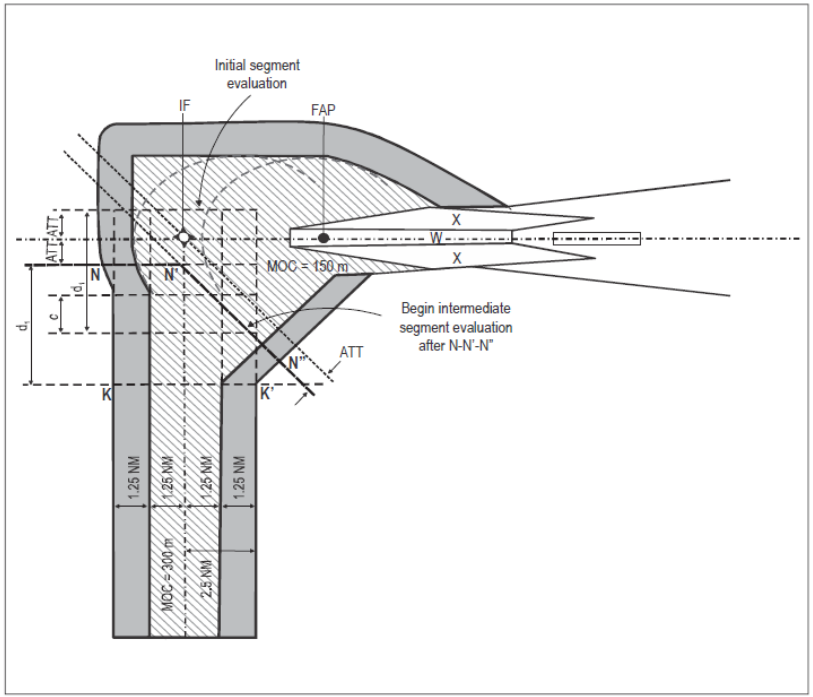
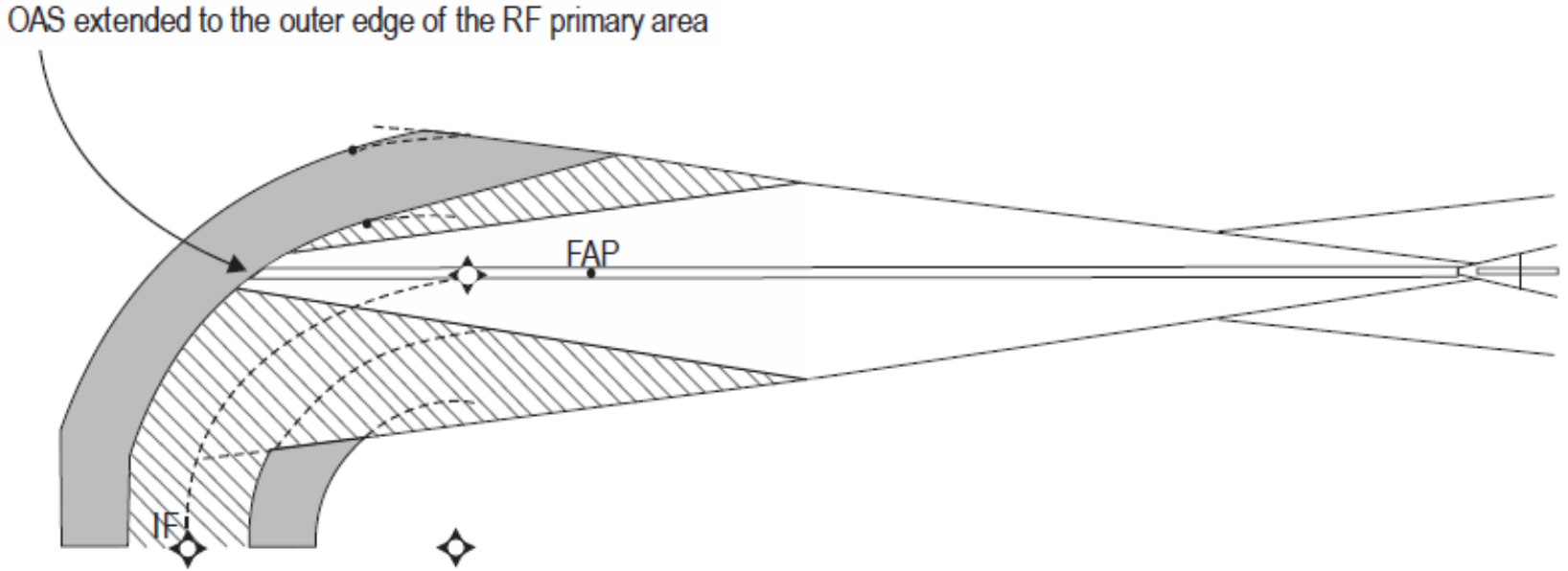
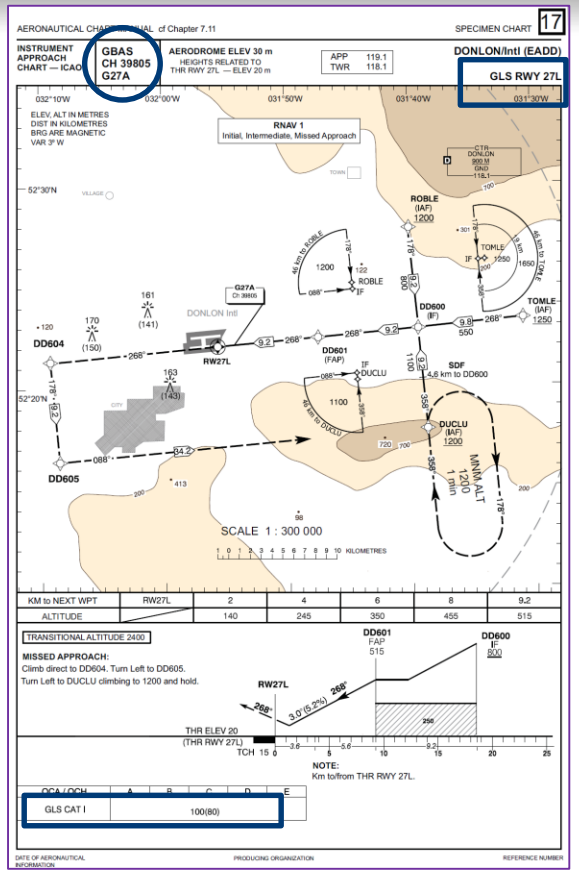


Figure III-3-6-6. Example: RNAV 1 or RNP 1 to GBAS transition, 90° intercept (max)

Area construction for radius-to-fix turn to the final approach course (Applicable as of 4 November 2021)




AERONAUTICAL CHART — ICAO Chapter 7.11
SPECIMEN CHART
17
INSTRUMENT APPROACH CHART — ICAO
GBAS CH 39805 G27A
AERODROME ELEV 30 m
HEIGHTS RELATED TO THR RWY 27L — ELEV 20 m
APP 119.1
TWR 118.1
DONLON/Intl (EADD)
GLS RWY 27L
ELEV, ALT IN METRES
DIST IN KILOMETRES
BRG ARE MAGNETIC
VAR 3° W
RNAV 1
Initial, Intermediate, Missed Approach
ROBLE (IAF) 1200
TOMLE (IAF) 1250
DD604
DD605
DD600 (IF)
DD601 (FAP)
IF DUCLU
DUCLU (MAF) 1200
SDF
4,6 km to DD600
MNM ALT 1200 1 min
RW27L
G27A Ch 39805
DONLON Intl
SCALE 1 : 300 000
KM to NEXT WPT
ALTITUDE
TRANSITIONAL ALTITUDE 2400
MISSED APPROACH:
Climb direct to DD604. Turn Left to DD605.
Turn Left to DUCLU climbing to 1200 and hold.
THR ELEV 20
(THR RWY 27L)
TCH 15
NOTE:
Km to/from THR RWY 27L.
GLS CAT I
100(80)

AERONAUTICAL CHART MANUAL cf Chapter 7.11 — SPECIMEN CHART 17

INSTRUMENT APPROACH CHART — ICAO	GBAS CH 39805 G27A	AERODROME ELEV 30 m HEIGHTS RELATED TO THR RWY 27L — ELEV 20 m	DONLON/Intl (EADD) GLS RWY 27L

TABULAR DESCRIPTION

GLS RWY 27L

Serial Number	Path Descriptor	Waypoint Identifier	Fly-Over	Course °M(°T)	Magnetic Variation	Distance (km)	Turn Direction	Altitude(m)	Speed limit (km/h)	VPA/ TCH	Navigation Specification
010	IF	TOMLE	-	-	-	-	-	+1250	-	-	RNAV 1
020	TF	DD600	-	268(264,7)	-	9,8	-	+800	-	-	RNAV 1
010	IF	DUCLU	-	-	-	-	-	+1200	-	-	RNAV 1
020	TF	DD600	-	358(355,3)	-	9,2	-	+800	-	-	RNAV 1
010	IF	ROBLE	-	-	-	-	-	+1200	-	-	RNAV 1
020	TF	DD600	-	178(175,3)	-	9,2	-	+800	-	-	RNAV 1
010	IF	DD600	-	-	-	-	-	+800	-	-	N/A
020	TF	DD601	-	268(265,3)	-	9,2	-	@515	-	-	N/A
030	TF	RW27L	Y	268(265,3)	-	9,2	-	@35	-	-3,0/15	N/A
040	FA	RW27L	-	268(265,3)	+3,0	-	-	-[1]	-	-	RNAV 1
050	DF	DD604	-	-	-	-	-	-	-	-	RNAV 1
060	TF	DD605	-	178(175,0)	-	9,2	L	-	-410	-	RNAV 1
070	TF	DUCLU	-	088(085,0)	-	34,2	L	+1200	-	-	RNAV 1
080	HM	DUCLU	-	358(355,0)	-	-	R	+1200	-	-	RNAV 1

1) This value is provided by industry.

WAYPOINT LIST

GLS RWY 27L

Waypoint Identifier	Coordinates
TOMLE	52°23'20,6"N 031°30'50,0"W
ROBLE	52°27'50,7"N 031°40'01,5"W
DUCLU	52°17'53,6"N 031°38'41,6"W
DD600	52°22'52,2"N 031°39'51,4"W
DD601	52°22'27,4"N 031°47'29,3"W
RW27L	52°22'52,71"N 031°59'57,09"W
DD604	52°21'55,1"N 032°09'13,7"W
DD605	52°16'22,2"N 032°08'31,0"W

FAS DATA BLOCK

Operation Type	0	LTP/FTP ellipsoidal height	31,7
SBAS Provider	14	FPAP latitude	522155,5020N
Airport Identifier	EADD	FPAP longitude	0315805,4200W
Runway	RW27L	Threshold crossing height	15
Approach performance designator	1	TCH units	1
Route indicator		Glide path angle	3
Reference path data selector	0	Course width at threshold	100
Reference path ID	G27A	Length offset	48
LTP/FTP latitude	522202,7050N		
LTP/FTP longitude	0315537,0790W		
Precision approach path point data CRC remainder	0E294056		
LTP Orthometric Height	*20,1*	*Horizontal alert limit (HAL)*	*40*
FPAP Orthometric Height	*20,3*	*Vertical alert limit (VAL)*	*50*

DATE OF AERONAUTICAL INFORMATION — REFERENCE NUMBER


MONTRÉAL
(HEADQUARTERS)
ICAO
PARIS
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(WESTERN AFRICA)
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THANK YOU!