

# RNAV APPROACH MANAGEMENT OF DEGRADED NAVIGATION A330



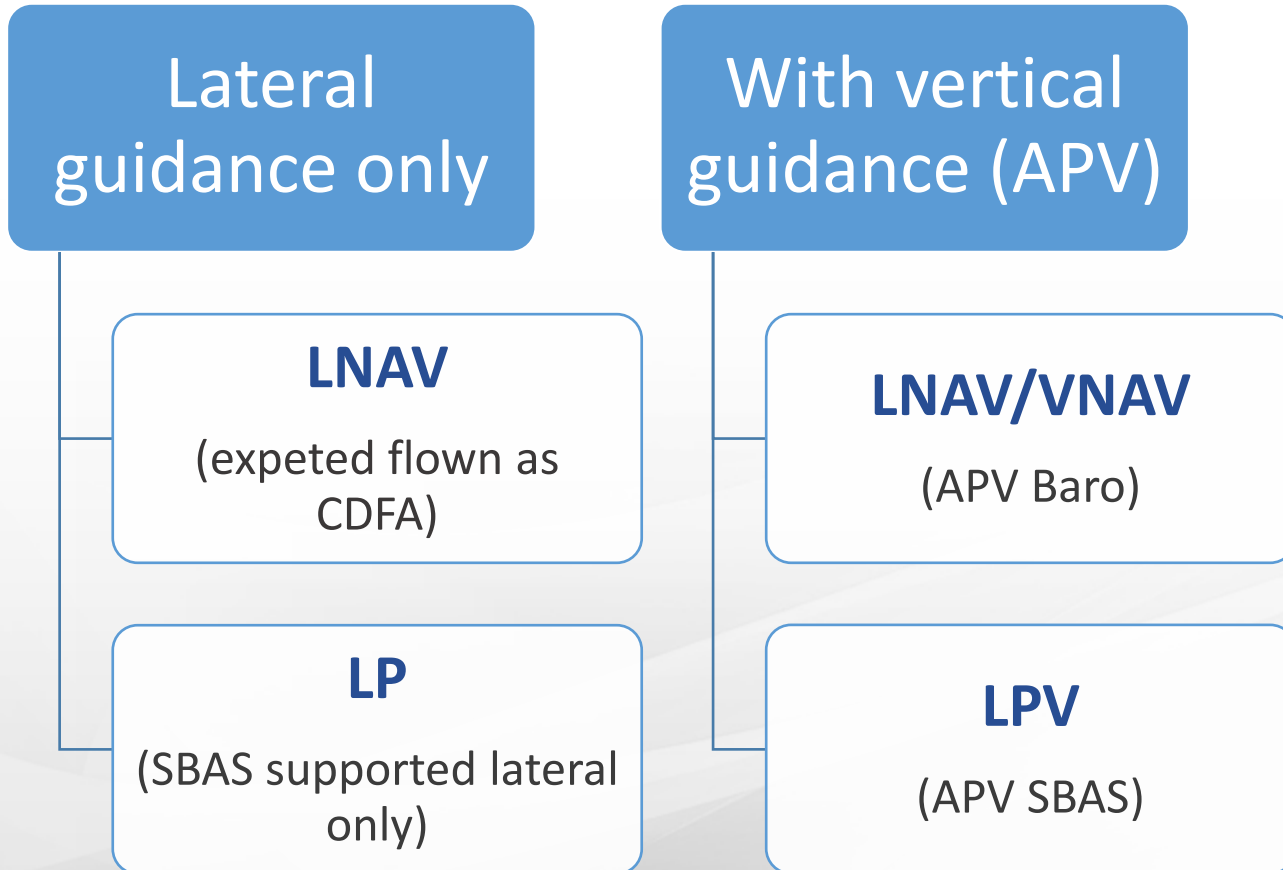
## .... the 5 minutes review

### REQUIRED RNAV 10 EQUIPMENT

The minimum -Oceanic- equipment required to enter RNAV 10 airspace is:

- Two FMGCs (or one FMGC and one BACK UP NAV
- Two MCDUs
- Two IRS
- Two NDs (the temporary display of ND information via the PFD/ND sw is permitted on PM side)
- One GPS if the flight time outside radio navaid coverage is longer than:
  - 6.2 hr from the time of IRS ground alignment, or
  - 5.7 hr from the time of the last FM position update

# Design of RNP Approaches



# GPS-Approaches: RNAV, GPS, RNP

## ✈ *Approaches*

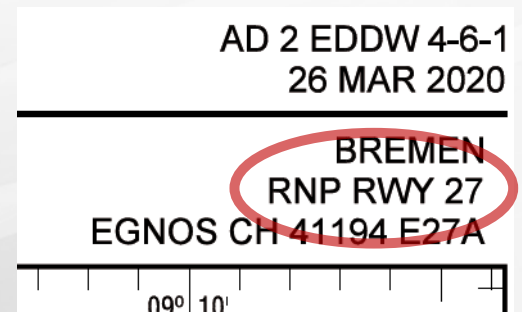
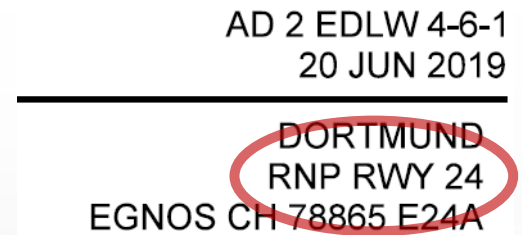
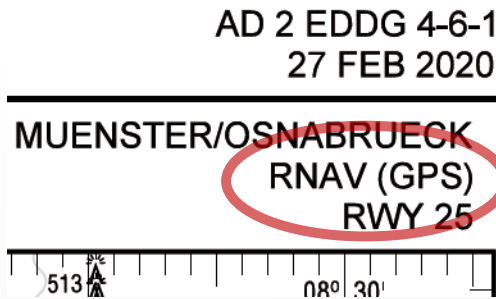
- GPS
- RNAV
- RNP

## ✈ *Procedure lateral & vertical guidance*

- LNAV
- LNAV/VNAV
- LP
- LPV
- APV

# Approaches: RNAV, GPS, RNP

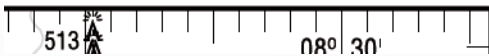
What are the differences?



# Approaches: LNAV, LNAV/VNAV, LPV

AD 2 EDDG 4-6-1  
27 FEB 2020

MUENSTER/OSNABRUECK  
RNAV (GPS)  
RWY 25



OCA (OCH)	A	B
LNAV	600 (440)	600 (440)
LNAV / VNAV	470 (311)	480 (321)

AD 2 EDLW 4-6-1  
20 JUN 2019

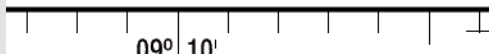
DORTMUND  
RNP RWY 24  
EGNOS CH 78865 E24A

OCA (OCH)	A	B
LNAV	790 (390)	800 (400)
LNAV / VNAV	700 (300)	700 (300)
LPV	702 (300)	702 (300)

AD 2 EDDW 4-6-1  
26 MAR 2020

BREMEN  
RNP RWY 27  
EGNOS CH 41194 E27A

OCA (OCH)	A	B
LNAV	400 (380)	400 (380)
LNAV / VNAV	400 (380)	400 (380)
LPV	159 (145)	169 (155)



# Approaches: RNAV, GPS, RNP

– RNAV (GPS)

– RNP



*Exactly the same. Name depends on the time of appointment*

– LNAV

*Only lateral guidance (cylindrical)*

– LNAV/VNAV

*Lateral guidance (cylindrical) plus vertical guidance barometric \**

– LP

*Lateral guidance (conical) SBAS*

– LPV

*Lateral guidance (conical) SBAS plus vertical guidance SBAS*

– APV

*Generic term for LNAV/VNAV und LPV*

# RNP – Vertical descent procedures

– LNAV

*Descent according to altimeter and VSI*

– LNAV/VNAV

*Descent to HSI but no existing FAS DB*

– LP

*Descent according to altimeter and VSI*

– LPV

*Descent to HSI with existing FAS DB*

– APV i. e. S.

*Descent to HSI with existing FAS DB*

# Minima LNAV/VNAV and LPV

AD 2 EDDG 4-6-1  
27 FEB 2020

MUENSTER/OSNABRUECK  
RNAV (GPS)  
RWY 25



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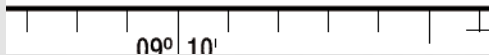
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LNAV	400 (380)	400 (380)
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LPV	159 (145)	169 (155)





# Differences Minima LPV?

DORTMUND  
RNP RWY 24  
EGNOS CH 78865 E24A

OCA (OCH)	A	B	C	D
LNAV	790 (390)	800 (400)	800 (400)	810 (400)
LNAV / VNAV	700 (300)	700 (300)	740 (340)	740 (340)
LPV	702 (300)	702 (300)	702 (300)	702 (300)

BREMEN  
RNP RWY 27  
EGNOS CH 41194 E27A

OCA (OCH)	A	B	C	D
LNAV	400 (380)	400 (380)	400 (380)	400 (380)
LNAV / VNAV	400 (380)	400 (380)	400 (380)	400 (380)
LPV	150 (145)	169 (155)	175 (165)	180 (175)

BREMEN  
ILS CAT II & III or LOC  
RWY 27

OCA (OCH)	A	B	C	D
ILS CAT I	159 (145)	169 (155)	179 (165)	180 (175)
ILS CAT II	71 (57)	87 (73)	100 (86)	113 (99)
LOC-DME	410 (390)	410 (390)	410 (390)	410 (390)

# Why different minimums?

## → *EDDG Münster*

- RNP without EGNOS  
(no FAS DB)

## → *EDLW Dortmund*

- RNP with EGNOS mit APV-I  
(EGNOS APV-I since 2011)
- In Chart as LPV
- **Non-precision approach**



## → *EDDW Bremen*

- RNP with EGNOS with LPV-200  
(= ILS CAT I) (LPV200 since 2015)
- **Precision approach**

# Requirements for LPV as a precision approach



## ✈ ***EGNOS***

- The system is designed to improve accuracy to 1-2 m horizontally and 3-5 m vertically
- Integrity and safety are improved by alerting users within **6 seconds** if a GPS malfunction occurs (up to 3 hrs GPS alone)

## ✈ ***Runway and approach design***

- Especially obstacle clearance

# DA(H), MDA(H), OCA(H), MAPt

Standard		LNAV/VNAV		STRAIGHT-IN LANDING RWY 25		LNAV CDFA	
DA(H)		A: <b>470'</b> (311')	C: <b>489'</b> (330')			DA/MDA(H) <b>600'</b> (441')	
		B: <b>480'</b> (321')	D: <b>499'</b> (340')	ALS out		ALS out	
A	RVR 750m <b>1</b>	RVR 1400m		RVR 1400m		RVR 1500m	
B						RVR 2100m	
C	RVR 800m	RVR 1500m					
D							

Standard		LPV		LNAV/VNAV		STRAIGHT-IN LANDING RWY 24		LNAV CDFA	
DA(H)		<b>70'</b> (300')		DA(H)		DA/MDA(H)		BC: <b>800'</b> (399')	
		ALS out		AB: <b>701'</b> (300')		CD: <b>741'</b> (340')		D: <b>810'</b> (409')	
		ALS out		ALS out		ALS out		ALS out	
A				RVR 750m <b>1</b>	RVR 1400m	RVR 1100m		RVR 1500m	
B	RVR 750m <b>1</b>	RVR 1400m						RVR 1800m	
C				RVR 800m	RVR 1500m			RVR 1900m	
D						RVR 1200m			

OCA (OCH)	A	B	C	D
LNAV	400 (380)	400 (380)	400 (380)	400 (380)
LNAV / VNAV	400 (380)	400 (380)	400 (380)	400 (380)
LPV	159 (145)	169 (155)	179 (165)	189 (175)

# Approach-Minima-Terms

## → *OCA/H*

**The lowest altitude** or the lowest **height** above the elevation of the relevant runway threshold or the aerodrome elevation as applicable, used in establishing compliance **with appropriate obstacle clearance criteria**.

In a precision approach procedure (or APV), the OCA/H is defined as **the lowest altitude/height at which a missed approach must be initiated** to ensure compliance with the appropriate obstacle clearance design criteria.

# Approach - Minima - Terms

## → *MDA(H)*

Minimum descent altitude (MDA) or minimum descent height (MDH). A specified altitude or height **in a nonprecision approach** or circling approach, below which, descent should not be made without the required visual reference.

## → *DA(H)*

Decision altitude (DA) or Decision height (DH). A specified altitude or height **in the precision approach** or **approach with vertical guidance** at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

# Decision making

Event	Action
FINAL APP not engage	Discontinue approach
Dual loss of FINAL APP mode	Discontinue approach
GPS primary lost (on both NDs)	Discontinue approach
GPS primary lost (on one ND)	Continue the approach by engaging AP on not affected side
Dual NAV ACCURACY DOWNGRAD	Discontinue approach
FM/GPS POSITION DISAGREE	Discontinue approach
FMS1/FMS2 POS DIFF	Discontinue approach
One FMGS only	Continue the approach by engaging AP on not affected side
Dual loss of FMGS	Discontinue approach
Loss of GPWS TERRAIN function (in case of inconsistencies affecting obstacles or terrain computation)	Discontinue approach
NAV ALT DISCREPANCY	Discontinue approach
Dual FCU channel fault	Discontinue approach
One EFIS ND only	Continue the approach by engaging AP on not affected side
Dual EFIS ND fault	Discontinue approach
One MCDU only	Continue the approach by engaging AP on not affected side
Dual MCDU fault	Discontinue approach
One GPS (MMR) only	Continue the approach by engaging AP on not affected side
Dual GPS fault	Discontinue approach
One FD only	Continue the approach by engaging AP on not affected side
Dual FD fault	Discontinue approach