

# Update of ICAO DOC 8071 Volume 1

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The European Organisation for the Safety of Air Navigation



# Overview

- Motivation for update and process summary
- Volume 1 in context of other related documents
- Doc 8071 Status
- Editorial Principles
- Chapter by Chapter Novelties
- Some dedicated examples
- Conclusion

# Motivation and Context

- Amendment 84 to Annex 10 (2008) implemented changes due to a general review of Standards and Recommended Practices (SARPS) of conventional radio navigation aids
  - Delete obsolete and clarify ambiguous provisions
  - Only ILS CSA part of Amendment 84 was rejected
  - Amendment 91 implements new CSA without impact on Doc 8071 (applicable in Nov 2018)
- Take into account move of flight validation material to Doc 9905 Vol. 5, IFP Quality Manual under IFPP responsibility
- Maintain 2 Volumes (Ground-Based and Space-Based) to minimize editorial effort in subsequent transposition into national languages and contract documents
- NSP/4 (OCT 2017) completed update, now in ICAO secretariat editorial process, first English version expected **Summer 2018**





# The Neighbours of Vol I

- Vol II: GNSS
  - Conventional Navigation *AND TESTING* WG of NSP has now started update of Vol II in cooperation with other NSP WG's (GBAS, GNSS SARPS, Spectrum)
    1. General: GNSS-specifics only, no more duplication of chapter 1 in Vol I
    2. ABAS for NPA becomes GNSS Core Constellations and ABAS
      - Link to new material in Doc 9849, GNSS Manual, on Performance Monitoring
    3. SBAS: Testing relevant to SBAS service provider, TBD?
    4. GBAS: Most significant update including GAST D
    5. Flight Validation becomes new GNSS RFI measurement chapter
      - Building on attachment 3 to chapter 1
- Vol III: Surveillance Radar Systems
  - SUR Panel minimum update, link to Doc 9924 SUR Manual
  - MLS remains unpublished at ICAO NSP Secretariat

## Doc 8071 Status

- Only SARPS and PANS have official status, rest is **guidance material only**, including ALL of Doc 8071
  - Standard: “shall” statement in an ICAO Annex
  - Recommended practice: marked “recommendation” in Annex
  - Attachments in Annex (“green pages”): also guidance
- ICAO Annex 10, Chapter 2, Section 2.2.1:

*“Radio navigation aids of the types covered by the specifications in Chapter 3 and available for use by aircraft engaged in international air navigation shall be the subject of periodic ground and flight tests.”*

- Note refers to Doc 8071 to explain how it can be done, based on best practices established in some States experienced with the provision of radio navigation aid services
- To ensure continued compliance to Annex 10 during operational service life; NOT for design assurance testing

## “Guidance” in Doc 8071 Context

- Some States make 8071 guidance mandatory through national regulation: OK but difficult to manage
  - Guidance documents have much reduced validation requirements
  - Represents a best effort by available experts
  - Cannot spell out every detail
  - Responsive to requests from users which may not be a common need for all users
  - Never intended to lead to excessive effort
  - Difficult to predict consequences of too strict interpretation
- ICAO insists that sound engineering practice and common sense must be applied
  - Only high level objective is to ensure facility compliance with Annex 10 shall's in installed environment
  - 8071 is one acceptable means which never excludes smarter ways of meeting the same objective



# Doc 8071 Editorial Principles

- Guidance Doc may never contradict the Annex
- Annex 10 Vol 1 is quoted only for convenience
  - Newer, amended versions of Annex 10 automatically supersede outdated text in Doc 8071
- Test procedure describes process and measurement aspects
- **Tables summarize!**
  - For quick and easy reference
  - Not meant to describe perfectly the requirements; that is what Annex 10 is for
  - Not meant to describe perfectly the test procedures; that is what the main body of Doc 8071 is for

# Volume I Structure and Summary

Structure remains essentially intact:

1. General:

- Update to align with current practice
- Quality processes
- Inspection Intervals
- New section on use of RPAS

2. VOR

3. DME

4. ILS

5/6/7. NDB, MB, PAR

8. New: Flight Validation is move to Doc 9906 and replaced by Navigation Aids Supporting PBN, like DME-DME for RNAV

Appendix: Deletion of copies of ITU Docs on FM Immunity

Consistency of units (esp. field strength)



## **Criteria examples for extended flight inspection intervals:**

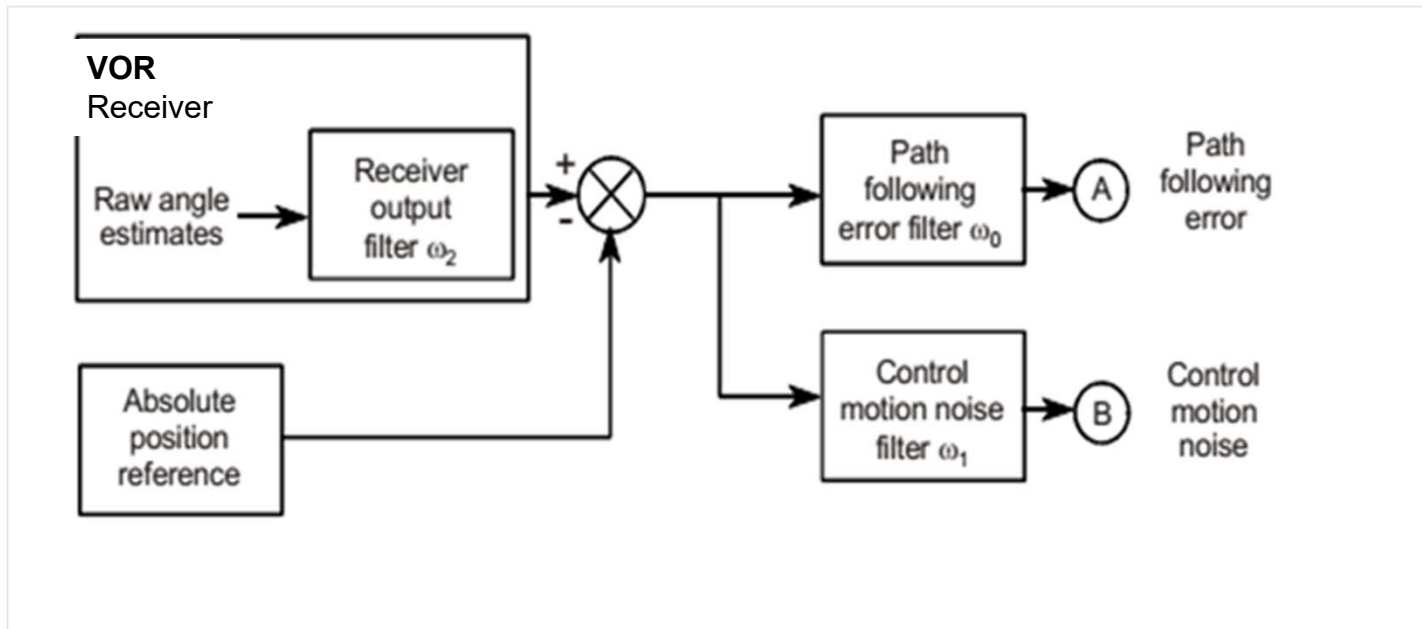
- Demonstration of stability
- Correlation between ground and airborne results
- Evidence of high maintenance quality
- Tolerance decrease within 75% of acceptance standards for  
LOC / GP alignment and DS

New in 1.4.5 ....Information regarding flight inspection service providers can be obtained ... online from the International Committee for Airspace Standards and Calibration

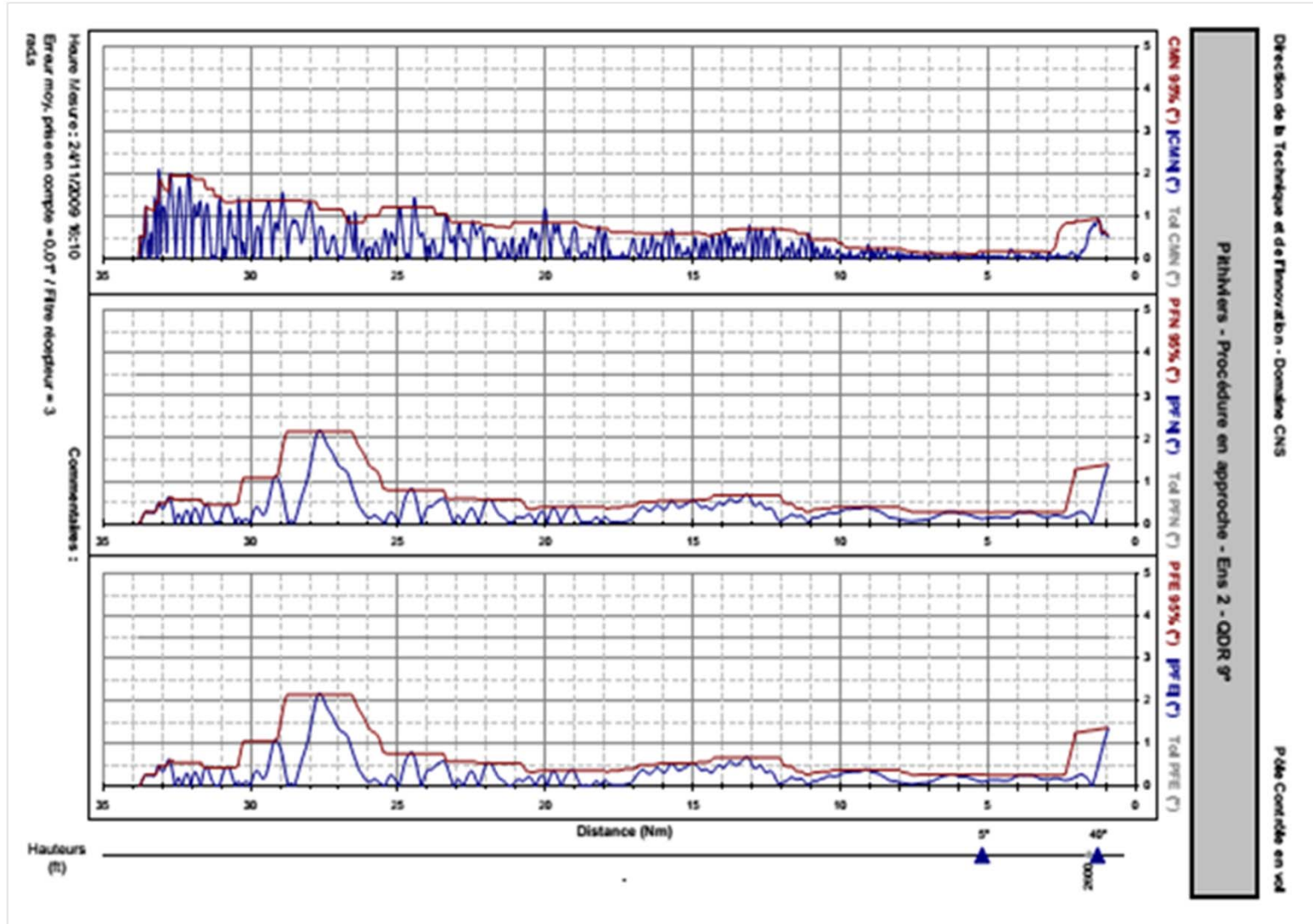
[www.ICASC.co](http://www.ICASC.co)

# VOR Chapter

- Addition of alternative technique for PFE / PFN / CMN:
  - ✓ Alignment error tolerance 2°
  - ✓ Bends or PFE / PFN tolerance 3.5°
  - ✓ Roughness and scalloping or CMN tolerance 3°



# PFE/PFN/CMN Technique



## DME Chapter

- Taking account of built-in test equipment
- DME/DME RNAV aspects moved to chapter 8 for better visibility
- Coverage measurements
  - Range measurement uncertainty: from 20 m to 50 m
    - To align with available equipment outputs
  - Field strength uncertainty corrected from 1 dB to 5 dB
    - Footnote on repeatability deleted
- DME will continue to play an important role to support PBN as a reversionary capability
  - Primary short-term A-PNT system in case of GNSS outages



# ILS Chapter

- Updated definition of ILS (“means for glide path verification check”)
- Ensuring interference free operation when both LOCs at RWY radiate
- Displacement sensitivity: new ground figure and general update
- Cat I course alignment accuracy
- Consistent removal of need for mod balance flight check (“on special engineering request only”)
- Clarifications on alignment and power monitors
- New flight inspection report example
- New reference system accuracy table for DGNSS to complement angular tolerance table



## Cat I LOC course alignment

Previous:

- In the vicinity of ILS point B

New:

- For at least 0.5 NM containing of ILS point B

# Prepare flight plan before flying

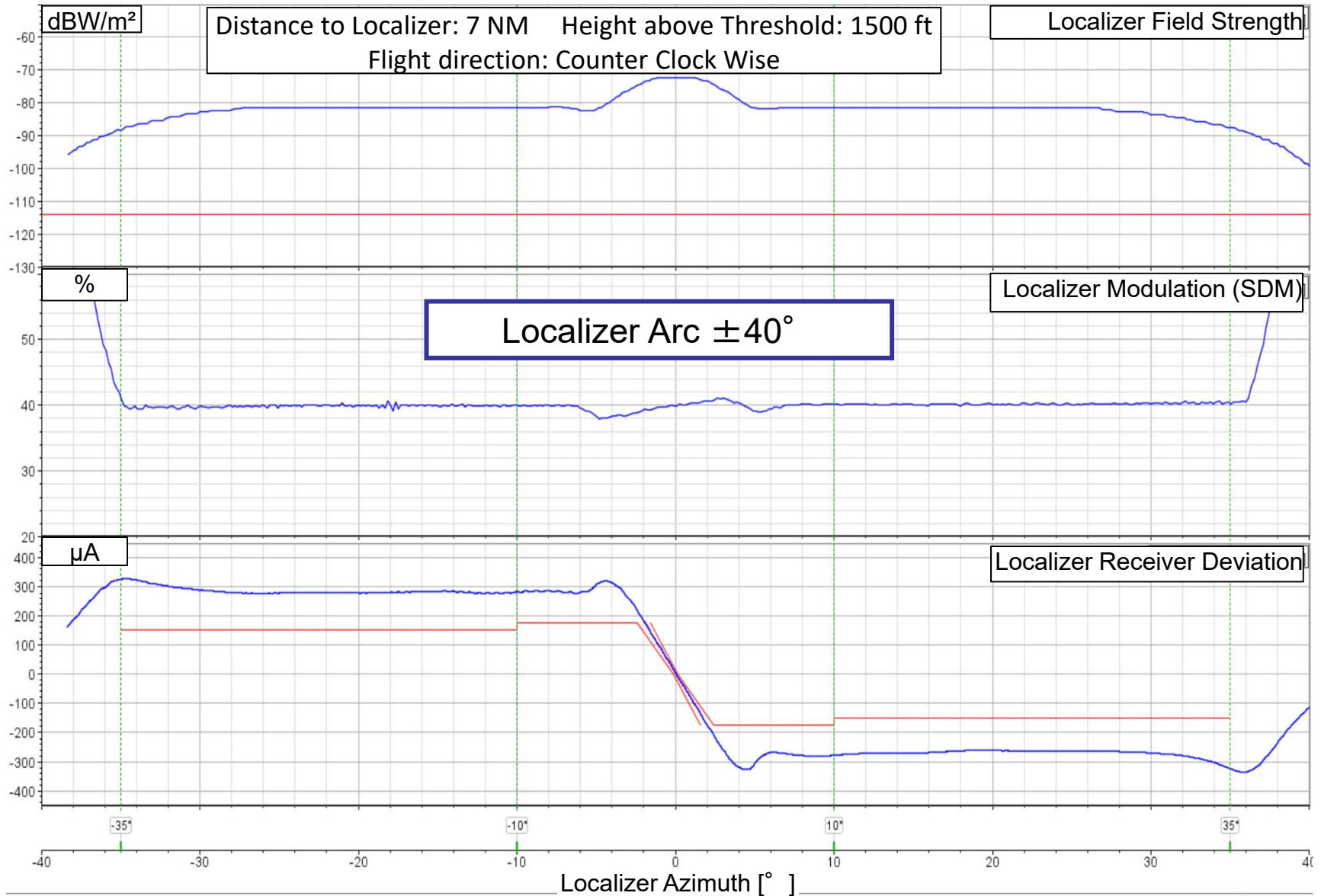
Run	Recordings, Flight Profile, Specifics and Remarks
#1	GP-Tx1, LOC-Tx1, DME-Tx1, Approach 8 to -1 NM
#2	GP-Tx2, LOC-Tx2, DME-Tx2, Approach 8 to -1 NM
#3	LOC-Tx2, Arc $\pm 40^\circ$ , 7 NM, 1500 ft, CCW
#4	LOC-Tx1, Arc $\pm 40^\circ$ , 7NM, 1500 ft, CW
#5	LOC-Tx1, Wide Alarm, Arc $\pm 10^\circ$ , 7NM, 1500 ft, CCW
#6	LOC-Tx1, Narrow Alarm, Arc $\pm 10^\circ$ , 7NM, 1500 ft, CW
#7	GP-Tx2, 90Hz Alignment Alarm, LOC-Tx2, 90Hz Alignment Alarm, Approach 5 to 0 NM
#8	GP-Tx2, 150Hz Alignment Alarm, LOC-Tx2, 150Hz Alignment Alarm, Approach 5 to 0 NM
#9	GP-Tx1, 90Hz Alignment Alarm, LOC-Tx1, 90Hz Alignment Alarm, Approach 5 to 0 NM
#10	GP-Tx1, 150Hz Alignment Alarm, LOC-Tx1, 150Hz Alignment Alarm, Approach 5 to 0 NM
#11	GP-Tx1, Level 12 to 2 NM, CL Az $0^\circ$ , 1500 ft
#12	GP-Tx1, Level 12 to 2 NM, CL Az $8^\circ$ , 1500 ft
#13	GP-Tx1, Level 12 to 2 NM, CL Az $-8^\circ$ , 1500 ft
#14	GP-Tx2, Level 12 to 2 NM, CL Az $0^\circ$ , 1500 ft
#15	GP-Tx1, Wide Alarm, Level 6 to 2 NM, 1500 ft, Width Adjustment
#16	GP-Tx1, Wide Alarm, Level 6 to 2 NM, 1500 ft
#17	GP-Tx1, Narrow Alarm, Level 6 to 2 NM, 1500 ft

Note: 1) Ranges and heights are site dependant and the information provided here is for example only  
 2) Some states may perform more or less runs than this example protocol shows





# Graphs from real inspection



# ILS report example

Flight Inspection Report										
ILS/DME 18 CCXX Airport, Country										
Service Provider Name/Logo		Sys Config		FIS-123-02 V8.44.1		Inspection Id		2016-10-13 Airport ILS DME 18		
Ident	I-ILS		Cal. Aircraft		XX-ILS		GP		LOC	
Frequency	110.1 MHz		Flight Inspector		Kilo		System	Type No	Type No	
Category	I		Pilot		Alpha		Antenna	M, 2F	2F	
Inspection Type	Periodic Monitor		1st Officer		Bravo		Nom Angle	3.00°	0.00°	
Date of Inspection	13.10.2016		Ref Source		DGPS+INS		Nom $\mu$ s	0.72°	1.67°	
Significant MET Cond.	None		Sel. Ref Point		Ref1		Nom Cs	1.44°	3.33°	
Facility / Transmitter No / Requirements / Unit										
GP Angle / LOC Align.		GP (°)		LOC (μA)		1 GP		2 GP		Tolerance
GP Angle / LOC Align.		GP (°)		LOC (μA)		2.99		2.99		-1.5 -1.8
Alignment		150Hz GP (μA)		LOC (μA)		-36.0		-37.0		-12.9 -13.4
Monitor		90Hz GP (μA)		LOC (μA)		34.2		33.8		12.6 12.7
Modulation Depth		SDM		(%)		79.4		79.4		39.9 40.0
GP / Course Structure		(%)		100		100		100		100 95 95
Zone 1		A - B		GP (μA)		LOC (μA)		-4.8 -4.8		-1.5 -1.5
Zone 2		A - B		GP (μA)		LOC (μA)		8.5		8.2 -2.0
Zone 3		B - C/T		GP (μA)		LOC (μA)		7.0		7.3 -1.5
Zone 4		T - D		LOC (μA)				N/A		N/A
Zone 5		D - E		LOC (μA)				N/A		N/A
RDH / Polarization 220° bank		GP (m)		LOC (μA)		16.6		16.6		N/A N/A
Aiming Point Offset		(m)		0.33		0.37				
Clearance		GP (μA/θ)		LOC (μA*)		-320/0.45		-316/0.45		-262/21* -260/20*
Clearance		GP (μA/θ)		LOC (μA*)		370/1.75		380/1.75		278/-28° 276/-12°
LOC Course/Clearance Ratio		(dB)								-15 -15
DS ¼ Sector 150Hz		GP (μA)		LOC (μA)		72		75		74 72
DS ¼ Sector 90Hz		GP (μA)		LOC (μA)		78		78		75 75
Wide Monitor		DS ¼ 150Hz GP (μA)		(μA)		58		N/A		63 N/A
Narrow Monitor		DS ¼ 90Hz GP (μA)		(μA)		63		N/A		64 N/A
Wide Monitor		DS ¼ 150Hz GP (μA)		(μA)		90		N/A		85 N/A
Narrow Monitor		DS ¼ 90Hz GP (μA)		(μA)		98		N/A		85 N/A
Field Str		GP/LOC		min at 10 NM (dBW/m <sup>2</sup> )		-82		-80		-85 -84
Field Str		LOC/LOC		min 17 and 25 NM (dBW/m <sup>2</sup> )		N/A		N/A		N/A -114
Ident								ok		ok
Marker		OM (m)		MM (m)		N/A		N/A		N/A
Beacon				IM (m)				N/A		N/A
Facility / Transmitter No / Requirements / Unit										
Range Error		(m)						17		18
Field Str		min at 25 NM (dBW/m <sup>2</sup> )						N/A		N/A
Ident								ok		ok
<b>Operational Status:</b>										Clearly audible
<b>Remarks:</b>										* Out of Tolerance @ Adjustment
<b>Flight Inspector:</b>		Oscar Kilo								OK
<b>Phone:</b>		+98 76 54 32 10 00		<b>Signature, Date:</b>		14.10.2016				
<b>Email:</b>		post@amc.com		<b>Distribution:</b>		Airport Management Comp., Country				

# ILS report example

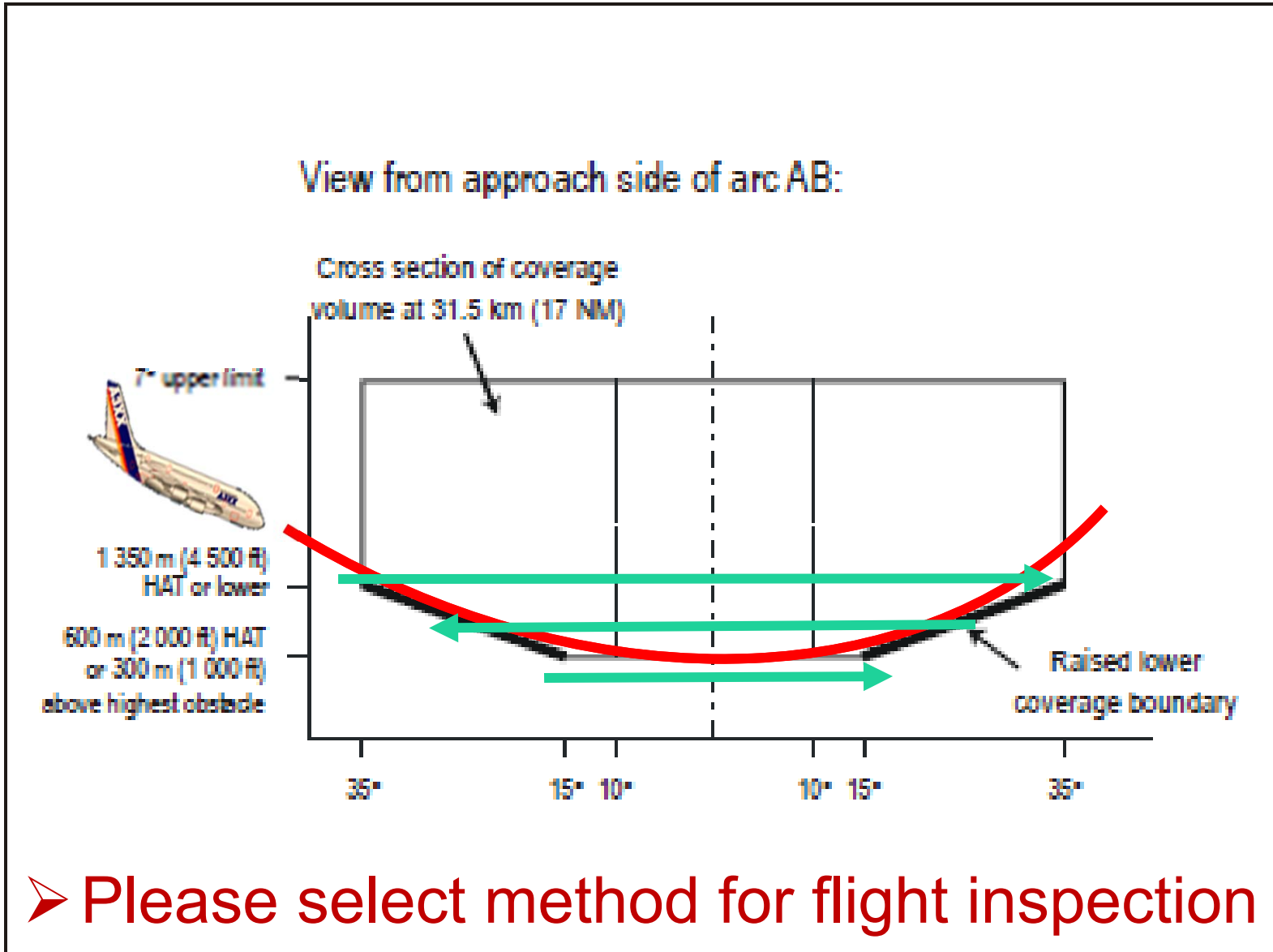
Flight Inspection Report											
ILS/DME 18 CCXX Airport, Country											
Service Provider Name/Logo			Sys Config		FIS-123-02 V8.44.1		Inspection Id		2016-10-13 Airport ILS DME 18		
Ident	I-ILS		Cal. Aircraft		XX-ILS			GP	LOC		
Frequency	110.1 MHz		Flight Inspector		Kilo		System	Type No	Type No		
Category	I		Pilot		Alpha		Antenna	M, 2F	2F		
Inspection Type	Periodic Monitor		1st Officer		Bravo		Nom Angle	3.00°	0.00°		
Date of Inspection	13.10.2016		Ref Source		DOPD+INS		Nom %cs	0.72°	1.67°		
Significant MET Cond.	None		Sel. Ref Point		Ref1		Nom Cs	1.44°	3.33°		
Facility / Transmitter No / Requirements / Unit					1	GP	2	1	LOC	2	Tolerance
GP Angle / LOC Align.		GP (°)	LOC (µA)		2.99	2.99	-1.5	-1.8		2.78/3.22	±15.5
Alignment	150Hz	GP (µA)	LOC (µA)		-36.0	-37.0	-12.9	-13.4		-47	-14.5
Monitor	90Hz	GP (µA)	LOC (µA)		34.2	33.8	12.6	12.7		62	14.5
Modulation Depth		SDM	(%)		79.4	79.4	39.9	40.0		75/85	36/44
GP / Course Structure			(%)		100	100	100	100		95	95
Zone 1	- A	GP (µA)	LOC (µA)		-4.6	-4.8	-1.5	-1.5		30	30
Zone 2	A - B	GP (µA)	LOC (µA)		8.5	8.2	-2.0	-2.1		30	30-15
Zone 3	B - C/T	GP (µA)	LOC (µA)		7.0	7.3	-1.5	-1.8		30	15
Zone 4	T - D		LOC (µA)				N/A	N/A			N/A
Zone 5	D - E		LOC (µA)				N/A	N/A			N/A
RDH / Polarization +30° bank		GP (m)	LOC (µA)		16.6	16.6	N/A	N/A		15-18	15



## PBN Chapter

- Recognize PBN navigation infrastructure assessment as an activity
- Align with PBN Manual (Doc 9613) reference on flight inspection
- Link to facility-specific chapters
- Reference to attachment H in Annex 10 “Strategy for rationalization of conventional radio navigation aids and evolution towards supporting performance-based navigation”
- Mainly discusses DME but also covers VOR

# Reduced LOC elevation coverage





## Conclusion

- In addition to realignment with Annex 10 Vol. I updates, goal was to resolve or at least improve long-standing issues of some debate in the flight inspection community
- Many errors were corrected, but for sure some remain
- Support from ICASC much appreciated
- Volume I effort is closed now, but feedback on Volume II matters will be timely