



ICAO

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Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

SUBJECT 6: NAVIGATION*TOPIC 1: INTRODUCTION*

SUB-TOPIC 1.1: Purpose and use of navigation

1.1.1	Explain the need for navigation in aviation.	2	Positioning, guidance, planning.
1.1.2	Characterize navigation methods.	2	e.g. Historical overview, visual, celestial, electronic (on-board, radio, space-based and relative).

TOPIC 2: THE EARTH

SUB-TOPIC 2.1: Form of the Earth

2.1.1	Name the shape of the Earth.	1	
2.1.2	Explain the Earth's properties and their effects.	2	East, West, North and South, polar axis, direction of rotation.
2.1.3	State the accepted conventions for describing 2D position on a globe.	1	Meridians, parallels of latitude, equatorial plane.

SUB-TOPIC 2.2: Coordinate systems, direction and distance

2.2.1	State the general principles of reference systems.	1	Geoid, reference ellipsoids, WGS 84 Latitude and longitude, undulation.
2.2.2	Explain why a global reference system is required for aviation.	2	—

SUB-TOPIC 2.3: Earth's magnetism

2.3.1	State the general principles of Earth's magnetism.	1	True North, magnetic North e.g. Variation, declination, deviation, inclination.
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TOPIC 3: NAVIGATIONAL SYSTEM PERFORMANCE

SUB-TOPIC 3.1: Factors affecting electronic navigation performance

3.1.1	State how radio waves propagate.	1	Ground, sky, direct.
3.1.2	State why the siting of a terrestrial navigation aid is important.	1	Multipath, blanking.

SUB-TOPIC 3.2: Performance of navigation systems

3.2.1	State the performance of navigation systems.	1	Coverage, accuracy, integrity, continuity of service, availability.
3.2.2	Explain the need for redundancy in navigation systems.	2	Ensuring continuity of service, maintainability, reliability.

SUB-TOPIC 3.3: Means of navigation

3.3.1	State the different means of navigation.	1	Sole, primary, supplementary.
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TOPIC 4: NAVIGATION SYSTEMS

SUB-TOPIC 4.1: Terrestrial navigation aids

4.1.1	Explain the basic working principles of electronic positioning.	2	Distance measurements (time and phase), angular measurements.
4.1.2	Describe ground-based navigation systems.	2	NDB, VOR, DME, ILS, DF e.g. Loran C, MLS, TACAN, marker beacons.

4.1.3	Recognize how the navigation information is displayed on the relevant pilot HMI.	1	—
4.1.4	Explain the operational use of ground-based navigation systems in the different phases of flight.	2	NDB, VOR, DME, ILS, DF.
4.1.5	Recognize the frequency bands used by the ground-based navigation systems.	1	—
4.1.6	State the need for calibration.	1	Flight calibration, ground-based calibration and/or maintenance.

SUB-TOPIC 4.2: On-board navigation systems

4.2.1	State the use of on-board navigation systems.	1	e.g. Barometric altimetry, radio altimetry, INS/IRS, compass.
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SUB-TOPIC 4.3: Space-based navigation systems

4.3.1	Explain the basic working principles of satellite positioning.	2	GPS e.g. Galileo.
4.3.2	Recognize the basic architecture of a core satellite positioning system.	1	GPS e.g. Galileo.
4.3.3	Recognize the frequency bands used by the space-based navigational systems.	1	—
4.3.4	State the benefits of satellite-based navigation.	1	Global coverage, accuracy, time dissemination e.g. Redundancy, interoperability, single set of avionics.
4.3.5	State the current limitations of space-based navigation systems.	1	e.g. Single frequency, weak signal, ionospheric delay, institutional, military, multipath.
4.3.6	State the basic working principles of satellite augmentation.	1	e.g. ABAS (RAIM, AAIM), SBAS (WAAS, EGNOS), GBAS (GRAS, S-CAT 1)
4.3.7	State the current implementations of satellite-based navigation systems.	1	GPS, GLONASS, GALILEO and augmentations e.g. ABAS, GBAS, SBAS

TOPIC 5: PERFORMANCE-BASED NAVIGATION

SUB-TOPIC 5.1: PBN

5.1.1	Describe the basic principle of area navigation.	2	ICAO RNAV definition and PBN concept Conventional and area navigation e.g. Navigation computer and FMS functionality.
5.1.2	List the navigation applications in use in the region.	1	e.g. B-RNAV-5, P-RNAV-1, RNP approaches.

SUB-TOPIC 5.2: Future developments

5.2.1	State future navigation developments.	1	e.g. 4D-RNAV, free routes, rationalization plans, advanced RNP1.
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EASA
European Aviation Safety Agency



ATM/ANS
(IR + AMC/GM)

eRules

Appendix 2a – ATSEP Basic training – Streams

ATSEP UID (Unique Objective Identifier)	CORPUS	Tax	CONTENT
ATSEP.BAS.NAV	NAVIGATION		
ATSEP.BAS.NAV_1	INTRODUCTION		
ATSEP.BAS.NAV_1.1	Purpose and Use of Navigation		
ATSEP.BAS.NAV_1.1.1	Explain the need for navigation in aviation	2	Positioning, guidance, planning
ATSEP.BAS.NAV_1.1.2	Characterise navigation methods	2	e.g. historical overview, visual, celestial, electronic (on-board, radio, space-based and relative)
ATSEP.BAS.NAV_2	THE EARTH		
ATSEP.BAS.NAV_2.1	Form of the Earth		
ATSEP.BAS.NAV_2.1.1	State the shape of the Earth and its parameters	1	Oblate spheroid e.g. diameter, gravity, rotation, axis, magnetic field
ATSEP.BAS.NAV_2.1.2	Explain the Earth's properties and their effects	2	Polar axis, direction of rotation
ATSEP.BAS.NAV_2.1.3	State the accepted conventions for describing 2D position on a globe	1	Meridians, parallels of latitude, equatorial plane
ATSEP.BAS.NAV_2.2	Coordinate Systems, Direction and Distance		
ATSEP.BAS.NAV_2.2.1	State the general principles of reference systems	1	Geoid, reference ellipsoids, WGS 84 Latitude and longitude, undulation
ATSEP.BAS.NAV_2.2.2	Explain why a global reference system is required for aviation	2	-
ATSEP.BAS.NAV_2.3	Earth's Magnetism		
ATSEP.BAS.NAV_2.3.1	State the general principles of Earth's magnetism	1	True North, magnetic North e.g. variation, declination, deviation, inclination
ATSEP.BAS.NAV_3	NAVIGATIONAL SYSTEM PERFORMANCE		
ATSEP.BAS.NAV_3.1	Factors Affecting Electronic Navigation Performance		
ATSEP.BAS.NAV_3.1.1	State how radio waves propagate	1	Ground, sky, line of sight
ATSEP.BAS.NAV_3.1.2	State why the siting of a terrestrial navigation aid is important	1	Multipath, blanking
ATSEP.BAS.NAV_3.2	Performance of Navigation Systems		
ATSEP.BAS.NAV_3.2.1	State the performance of navigation systems	1	Coverage, accuracy, integrity, continuity of service, availability
ATSEP.BAS.NAV_3.2.2	Explain the need for redundancy in navigation systems	2	Ensuring continuity of service, maintainability, reliability

Appendix 2a – ATSEP Basic training – Streams

ATSEP UID (Unique Objective Identifier)	CORPUS	Tax	CONTENT
ATSEP.BAS.NAV_3.3	Means of Navigation		
ATSEP.BAS.NAV_3.3.1	State the different means of navigation	1	Sole, primary, supplementary
ATSEP.BAS.NAV_4	NAVIGATION SYSTEMS		
ATSEP.BAS.NAV_4.1	Terrestrial Navigation Aids		
ATSEP.BAS.NAV_4.1.1	Explain the basic working principles of electronic positioning	2	Distance measurements (time and phase), angular measurements
ATSEP.BAS.NAV_4.1.2	Describe ground-based navigation systems	2	NDB, VOR, DME, ILS, DF e.g. TACAN, marker beacons
ATSEP.BAS.NAV_4.1.3	Recognise how the navigation information is displayed on the relevant pilot HMI	1	-
ATSEP.BAS.NAV_4.1.4	Explain the operational use of ground-based navigation systems in the different phases of flight	2	NDB, VOR, DME, ILS, DF
ATSEP.BAS.NAV_4.1.5	Recognise the frequency bands used by the ground-based navigation systems	1	-
ATSEP.BAS.NAV_4.1.6	State the need for calibration	1	Flight calibration, ground-based calibration and/or maintenance
ATSEP.BAS.NAV_4.2	On-board Navigation Systems		
ATSEP.BAS.NAV_4.2.1	State the use of on-board navigation systems	1	e.g. barometric altimetry, radio altimetry, INS/IRS, compass
ATSEP.BAS.NAV_4.2.2	State the use of an FMS	1	Sensors, navigation database
ATSEP.BAS.NAV_4.3	Space-based Navigation Systems		
ATSEP.BAS.NAV_4.3.1	Explain the basic working principles of satellite positioning	2	GNSS e.g. Galileo, GPS
ATSEP.BAS.NAV_4.3.2	Recognise the basic architecture of a core satellite positioning system	1	GNSS e.g. Galileo, GPS
ATSEP.BAS.NAV_4.3.3	Recognise the frequency bands used by the space-based navigational systems	1	-
ATSEP.BAS.NAV_4.3.4	State the benefits of satellite-based navigation	1	Global coverage, accuracy, time dissemination e.g. redundancy, interoperability, single set of avionics
ATSEP.BAS.NAV_4.3.5	State the current limitations of space-based navigation systems	1	e.g. single frequency, weak signal, ionospheric delay, institutional, military, multipath

Appendix 2a – ATSEP Basic training – Streams

ATSEP UID (Unique Objective Identifier)	CORPUS	Tax	CONTENT
ATSEP.BAS.NAV_4.3.6	Describe the basic working principles of satellite augmentation	2	ABAS (RAIM, AAIM), SBAS (WAAS, EGNOS), GBAS
ATSEP.BAS.NAV_4.3.7	State the current implementations of satellite-based navigation systems	1	Core systems: GPS, GLONASS, GALILEO , BEIDOU, Augmentation systems: RAIM, AAIM, EGNOS, WAAS, GBAS
ATSEP.BAS.NAV_5	PERFORMANCE-BASED NAVIGATION (PBN)		
ATSEP.BAS.NAV_5.1	PBN		
ATSEP.BAS.NAV_5.1.1	Describe the performance-based navigation concept	2	ICAO Doc 9613
ATSEP.BAS.NAV_5.1.2	List the navigation applications in use in Europe	1	RNAV-5 (B-RNAV), RNAV-1 (P-RNAV), RNP approaches
ATSEP.BAS.NAV_5.2	Current Developments		
ATSEP.BAS.NAV_5.2.1	State current navigation developments	1	e.g. 4D-RNAV, free routes, rationalisation plans, advanced RNP