



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 7: SURVEILLANCE

TOPIC 1: INTRODUCTION TO SURVEILLANCE

SUB-TOPIC 1.1: Introduction to surveillance

1.1.1	Define surveillance in the context of ATM.	1	What (positioning/identification) and why (maintain separation).
1.1.2	Define the various surveillance domains.	1	Air-air, ground-air, ground-ground.
1.1.3	List the surveillance techniques.	1	Non-cooperative, cooperative, dependent, independent techniques.
1.1.4	Define the current and emerging surveillance systems in use in ATM.	1	Radar technology, ADS technology, multilateration, TIS.
1.1.5	Explain the role and the current use of surveillance equipment by ATM.	2	Separation, vectoring, data acquisition, Detection and ranging, safety nets, e.g. Weather mapping.
1.1.6	State ICAO and any local legal requirements.	1	e.g. ICAO SARPS, Annex 10 Vol. IV.
1.1.7	List the main users of surveillance data.	1	HMI, safety nets, FDPS, air defense systems, flow management.

SUB-TOPIC 1.2: Avionics

1.2.1	State the avionics used for the surveillance in ATM and their interdependencies.	1	Transponder, GNSS, data link equipment, ACAS, ATC control panel, e.g. FMS.
1.2.2	Define the role of TCAS as a safety net.	1	e.g. FMS.

SUB-TOPIC 1.3: Primary radar

1.3.1	Describe the need for and the use of primary radar in ATC.	2	Non-cooperative detection, improvement of detection and tracking e.g. Types of PSR (en-route, terminal, SMR, weather).
1.3.2	Explain the principles of operation, basic elements and overall architecture of a primary radar.	2	Detection, range measurement, azimuth indication. Doppler shift. Antenna system, TX/RX, signal processing, plot extraction, local tracking, data transmission e.g. Use of the parameters of the radar equation.
1.3.3	State the limitations of primary radar.	1	Line of sight, environmental, clutter, no identification of the target, no height information (in case of 2D radar).

SUB-TOPIC 1.4 Secondary radars

1.4.1	Describe needs for and the use of secondary radars in ATC.	2	Cooperative detection, ICAO-defined standard, IFF, military and civil modes (include Mode S) and related code protocols, code limitations e.g. Identification, SPI, flight level, BDS, specific and emergency codes.
1.4.2	Explain the principles of operation, basic elements and overall architecture of a secondary radar.	2	SSR, MSSR, Mode S antenna, TX/RX, extractor, tracking processor e.g. Use of the parameters of the radar equations.
1.4.3	State the limitations of secondary radar.	1	FRUIT, garbling, ghost reply, code shortage, cooperation by the aircraft needed.

SUB-TOPIC 1.5: Surveillance data message format

1.5.1	State the need for harmonization.	1	Surveillance data sharing, interoperability.
1.5.2	State the techniques used for transmission of surveillance data.	1	e.g. Point-to-point, network, microwave, satellite.
1.5.3	State main formats in use.	1	e.g. ASTERIX.

SUB-TOPIC 1.6: Automatic dependent surveillance (ADS)

1.6.1	State surveillance-related FANS concepts and their impact on ATM.	1	Sources of aircraft parameters (e.g. FMS outputs), communication mediums. Application within oceanic and other non-radar airspace, ATC requirements.
1.6.2	Explain the principles of operation, basic elements and overall architecture of ADS-C and ADS-B and the differences between them.	2	Advantages/disadvantages, standards, data update rates.
1.6.3	State the data link technologies proposed and the current situation of deployment.	1	Extended squitter 1 090 MHz, e.g. VDL 4, HFDL,UAT, AMSS.

SUB-TOPIC 1.7: Weather radar

1.7.1	Define the use of weather radar in ATM.	1	e.g. Role in adverse weather in dense airspace, antenna, coverage, polarization, multi elevation scanning, frequency band.
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SUB-TOPIC 1.8: Integration of surveillance information

1.8.1	Describe complementary use of different sensors.	2	—
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SUB-TOPIC 1.9: Multilateration

1.9.1	State the use of MLAT in ATC.	1	LAM and WAM.
1.9.2	Explain the principles of operation, basic elements and overall architecture of MLAT.	2	TDOA principle, hyperbolic positioning, accuracy, transmissions used.

SUB-TOPIC 1.10: Airport surface surveillance

1.10.1	State typical ATC requirements.	1	e.g. Safety (aircraft and mobiles), clear runway, low visibility, collision warnings, displays, mapping, data merging, aircraft identification, ground mobiles.
1.10.2	State the current technologies for airport surface surveillance.	1	Radar-based and MLAT-based technologies, example layout of airport surveillance infrastructure. e.g. Other systems (acoustic, vibration, induction loop, video, infrared, GNSS, ADS-B).

SUB-TOPIC 1.11: Display of surveillance information

1.11.1	Recognize surveillance information on a display.	1	e.g. PSR and MSSR tracks, position identification, FL, speed vector, RDP and FDP information.
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SUB-TOPIC 1.12: Analysis Tools

1.12.1	State analysis tools.	1	e.g. SASS-C.
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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.SUR	SURVEILLANCE		
ATSEP.BAS.SUR_1	INTRODUCTION TO SURVEILLANCE		
ATSEP.BAS.SUR_1.1	Introduction to Surveillance		
ATSEP.BAS.SUR_1.1.1	Define surveillance in the context of ATM	1	What (positioning/identification) and why (maintain separation)
ATSEP.BAS.SUR_1.1.2	Define the various surveillance domains	1	Air-air, ground-air, ground-ground
ATSEP.BAS.SUR_1.1.3	List the surveillance techniques	1	Non-cooperative, cooperative, dependent, independent techniques
ATSEP.BAS.SUR_1.1.4	Define the current and emerging surveillance systems in use in ATM	1	Radar technology, ADS technology, multilateration e.g. TIS
ATSEP.BAS.SUR_1.1.5	Explain the role and the current use of surveillance equipment by ATM	2	Separation, vectoring, data acquisition Detection and ranging, safety nets e.g. weather mapping
ATSEP.BAS.SUR_1.1.6	State ICAO and any local legal requirements	1	e.g. ICAO Annex 10 Vol. IV
ATSEP.BAS.SUR_1.1.7	List the main users of surveillance data	1	HMI, safety nets, FDPS, air defence systems, flow management
ATSEP.BAS.SUR_1.2	Avionics		
ATSEP.BAS.SUR_1.2.1	State the avionics used for the surveillance in ATM and their interdependencies	1	Transponder, GNSS, data link equipment, ACAS, ATC control panel e.g. FMS
ATSEP.BAS.SUR_1.2.2	Define the role of TCAS as a safety net	1	e.g. FMS
ATSEP.BAS.SUR_1.3	Primary Radar		
ATSEP.BAS.SUR_1.3.1	Describe the need for and the use of primary radar in ATC	2	Non-cooperative detection, improvement of detection and tracking e.g. types of PSR (en-route, terminal, SMR, weather)
ATSEP.BAS.SUR_1.3.2	Explain the principles of operation, basic elements and overall architecture of a primary radar	2	Detection, range measurement, azimuth indication, Doppler shift, antenna system, TX/RX, signal processing, plot extraction, local tracking, data transmission e.g. use of the parameters of the radar equation
ATSEP.BAS.SUR_1.3.3	State the limitations of primary radar	1	Line of sight, environmental, clutter, no identification of the target, no height information (in case of 2D radar)

Appendix 2a – ATSEP Basic training – Streams

ATSEP UID (Unique Objective Identifier)	CORPUS	Tax	CONTENT
ATSEP.BAS.SUR_1.4	Secondary Radar		
ATSEP.BAS.SUR_1.4.1	Describe needs for and the use of secondary radars in ATC	2	Cooperative detection, ICAO-defined standard, IFF, military and civil modes (include Mode S) and related code protocols, code limitations e.g. identification, SPI, flight level, BDS, specific and emergency codes
ATSEP.BAS.SUR_1.4.2	Explain the principles of operation, basic elements and overall architecture of a secondary radar	2	SSR, MSSR, Mode S antenna, TX/RX, extractor, tracking processor e.g. use of the parameters of the radar equation
ATSEP.BAS.SUR_1.4.3	State the limitations of secondary radar	1	FRUIT, garbling, ghost reply, code shortage, cooperation by the aircraft needed
ATSEP.BAS.SUR_1.5	Surveillance Data Message Format		
ATSEP.BAS.SUR_1.5.1	State the need for harmonisation	1	Surveillance data sharing, interoperability
ATSEP.BAS.SUR_1.5.2	State the techniques used for transmission of surveillance data	1	e.g. point-to-point, network, microwave, satellite
ATSEP.BAS.SUR_1.5.3	State main formats in use	1	ASTERIX, etc.
ATSEP.BAS.SUR_1.6	Automatic Dependent Surveillance (ADS)		
ATSEP.BAS.SUR_1.6.1	State surveillance-related FANS concepts and their impact on ATM	1	Sources of aircraft parameters (e.g. FMS outputs), communication mediums, application within oceanic and other non-radar airspace, ATC requirements
ATSEP.BAS.SUR_1.6.2	Explain the principles of operation, basic elements and overall architecture of ADS-C and ADS-B and the differences between them	2	Advantages/disadvantages, standards, data update rates
ATSEP.BAS.SUR_1.6.3	State the data link technologies proposed and the current situation of deployment	1	Extended squitter 1090 MHz e.g. VDL 4, HF DL, UAT, AMSS
ATSEP.BAS.SUR_1.7	Weather Radar		
ATSEP.BAS.SUR_1.7.1	Define the use of weather radar in ATM	1	e.g. role in adverse weather in dense airspace, antenna, coverage, polarisation, multi-elevation scanning, frequency band
ATSEP.BAS.SUR_1.8	Integration of Surveillance Information		
ATSEP.BAS.SUR_1.8.1	Describe complementary use of different sensors	2	-

Appendix 2a – ATSEP Basic training – Streams

ATSEP UOID (Unique Objective Identifier)	CORPUS	Tax	CONTENT
ATSEP.BAS.SUR_1.9	Multilateration (MLAT)		
ATSEP.BAS.SUR_1.9.1	State the use of MLAT in ATC	1	LAM and WAM
ATSEP.BAS.SUR_1.9.2	Explain the principles of operation, basic elements and overall architecture of MLAT	2	TDOA principle, hyperbolic positioning, accuracy, transmissions used
ATSEP.BAS.SUR_1.10	Airport Surface Surveillance		
ATSEP.BAS.SUR_1.10.1	State typical ATC requirements	1	e.g. safety (aircraft and mobiles), clear runway, low visibility, collision warnings, displays, mapping, data merging, aircraft identification, ground mobiles
ATSEP.BAS.SUR_1.10.2	State the current technologies for airport surface surveillance	1	Radar-based and MLAT-based technologies, example layout of airport surveillance infrastructure e.g. other systems (acoustic, vibration, induction loop, video, infrared, GNSS, ADS-B)
ATSEP.BAS.SUR_1.11	Display of Surveillance Information		
ATSEP.BAS.SUR_1.11.1	Recognise surveillance information on a display	1	e.g. PSR and MSSR tracks, position identification, FL, speed vector, RDP and FDP information
ATSEP.BAS.SUR_1.12	Analysis Tools		
ATSEP.BAS.SUR_1.12.1	State analysis tools	1	e.g. SASS-C, SASS-S, RAPS