ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL TO COMMISSION REGULATION (EU) NO XXX/XXXX

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ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL TO COMMISSION REGULATION (EU) No XXX/XXXX

GM1 Article 4(4) Competent authority
FUNCTIONAL LEVEL SEPARATION

'Functional level separation' means that a competent authority may be engaged in operational activities and the oversight of organisations in the same domain, provided that the different functions are clearly separated and that the organisational governance ensures effective oversight by avoiding conflicts of interest by personnel and preventing their engagement in operational activities of the entities that they are meant to oversee. This could be achieved by applying appropriate management and control mechanisms.

GM2 Article 4(4) Competent authority
FUNCTIONAL LEVEL SEPARATION

When achieving independence between the competent authority and the service provider(s) through functional level separation, the Member State should ensure that:

(a) the responsibility for the service provision and the responsibility for the certification, receipt of declarations and oversight activities are allocated to separate personnel;

(b) the former should not have any control over the latter; and

(c) this happens within a just culture environment.

AMC1 Article 6(5)(e) Oversight capability
INVESTIGATIONS AND ASSESSMENTS

Investigations and assessments should include tests and exercises as determined by the competent authority.

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ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL TO ANNEX I — DEFINITIONS OF TERMS USED IN ANNEXES II TO XIII

GM1 10.Air traffic safety electronics personnel (ATSEP)

AUTHORISED PERSONNEL

(a) The achievement of competence is independent of the permission to perform any task. Therefore, the ATSEP should be authorised to work on operational systems.

(b) It is intentionally not specified who is responsible for providing this authorisation. This is usually done by the service provider, but it might be done by another entity depending on the national arrangements for managing the competence and performance of ATSEP.

OPERATE, MAINTAIN, RELEASE FROM, AND RETURN INTO OPERATIONS

(a) The term 'operate' refers to the ability of the ATSEP to actively control a system and should not be confused with, for example, the air traffic controllers' function to operate particular equipment in order to provide air traffic services. However, it is necessary for ATSEP to have an understanding of how air traffic controllers operate or make use of operational systems, in order to repair and maintain them appropriately. An ATSEP usually manages the engineering operation of operational systems, for example by:

(1) making a radiotelephony test transmission to check a voice communication and control system or a recording system;

(2) switching between systems A and B, or switching off the stand-by system, in case of duplicated systems; or

(3) changing the range and gating maps of a radar system processor.

(b) The term 'maintain' refers to planned, preventative and corrective maintenance, including fault-finding.

(c) The term 'release from operations' refers to the process of withdrawal from use of a system/equipment from the operational environment, and 'return into operations' refers to the process whereby the system/equipment is checked and restored to operational use, in accordance with both risk assessment and mitigation.

MAINTENANCE TASKS BY ATSEP

(a) An operational system that has been released from operational service, but remains connected to the operational environment must be maintained by ATSEP.

(b) An operational system that has been removed and fully isolated from the operational environment by ATSEP, and cannot be returned without ATSEP intervention, may be maintained by a non-ATSEP, but will be subject to the ANSP's checks before return to the operational environment.

(c) A non-ATSEP is not authorised to remove an operational system from the operational environment.

(d) A non-ATSEP is not authorised to return a system into the operational environment.

(e) An ATSEP is responsible for determining the operational system status/serviceability before returning it to the operational environment.

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GM2 10.Air traffic safety electronics personnel (ATSEP)
OUT OF SCOPE

The design, testing, installation and commissioning of operational systems and equipment are excluded from the scope of this section.

DESIGN OF OPERATIONAL SYSTEMS AND EQUIPMENT

Design also includes software.

COMMISSIONING OF OPERATIONAL SYSTEMS AND EQUIPMENT

The term 'commissioning' is understood to be the process by which a system/equipment, which has been installed, is tested to ensure that it works according to its design objectives or specifications, and that it is ready to be operated and maintained in accordance with the users' operational requirements.

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ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL TO ANNEX II — REQUIREMENTS FOR COMPETENT AUTHORITIES – SERVICES PROVISIONS AND ATM NETWORK FUNCTIONS (Part-ATM/ANS.AR)

SUBPART A — GENERAL REQUIREMENTS (ATM/ANS.AR.A)

AMC1 ATM/ANS.AR.A.005(b) Oversight function
REVIEW OF THE AGREEMENT

The agreement on the supervision in a functional airspace block (FAB) or in cases of cross-border provision should include the frequency of the review.

GM1 ATM/ANS.AR.A.005(b) Oversight function
CONCLUSION OF AN AGREEMENT

The agreement on the supervision in a FAB or in cases of cross-border provision may be concluded among:

(a) the competent authorities nominated or established under agreements concluded among Member States in accordance with Article 4(1)(b) of this Regulation; or

(b) the competent authorities of the service providers in cases of cross-border provision; or

(c) the competent authorities nominated or established in accordance with Article 4(1)(a) and (b) of this Regulation and the Agency.

GM2 ATM/ANS.AR.A.005(b) Oversight function
REVIEW OF THE AGREEMENT

During the review of the agreement, the competent authorities should address the practical implementation considering the results of the assessment performed in accordance with ATM/ANS.AR.C.001.

AMC1 ATM/ANS.AR.A.015(d)(3) Means of compliance
GENERAL

The information to be provided to other Member States following approval of an alternative means of compliance (AltMOC) should contain a reference to the Acceptable Means of Compliance (AMC) to which such means of compliance provides an alternative, where such AMC exists, as well as a reference to the corresponding Implementing Rule (IR), indicating, as applicable, the subparagraph(s) covered by the AltMOC.

GM1 ATM/ANS.AR.A.015 Means of compliance
GENERAL

Alternative means of compliance used by a competent authority or by organisations under its oversight may be used by other competent authorities or service providers only if processed again in accordance with ATM/ANS.AR.A.015(d) and (e).

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GM1 ATM/ANS.AR.A.020(b) Information to the Agency
MEANING OF SAFETY-SIGNIFICANT INFORMATION STEMMING FROM OCCURRENCE REPORTS

The following should be considered safety-significant information stemming from occurrence reports:

(a) Conclusive safety analyses that summarise individual occurrence data and provide an in-depth assessment of the safety issue. These safety analyses can be used for Agency rulemaking or for safety promotion activities such as the European Aviation Safety Plan; and

(b) Individual occurrence data where the Agency is the competent authority in accordance with Article 4(1)(c) and (d) of this Regulation.

GM2 ATM/ANS.AR.A.020(b) Information to the Agency
RECOMMENDED CONTENT FOR CONCLUSIVE SAFETY ANALYSES

(a) The following content should be provided in conclusive safety analyses:

(1) a detailed description of the safety issue, containing the scenario in which the safety issue takes place; and

(2) an indication of the users affected by the safety issue, including types of services and organisations.

(b) The content of such safety analyses may additionally include, as appropriate, the following:

(1) a risk assessment quantifying the severity and frequency of the safety issue;

(2) information about the existing safety barriers that the aviation system has in place to prevent the safety issue from releasing its likely consequences;

(3) any mitigating actions already being in place or developed to deal with the safety issue;

(4) recommendations for future actions to mitigate the reported safety issue; and

(5) any other element the competent authority understands as essential in order for the Agency to properly assess the safety issue.

GM3 ATM/ANS.AR.A.020(b) Information to the Agency
REPORTING CRITERIA FOR SAFETY-SIGNIFICANT INFORMATION STEMMING FROM OCCURRENCE REPORTS WHERE THE AGENCY IS THE COMPETENT AUTHORITY

In the case of occurrences related to organisations certified by the Agency, safety-significant information stemming from occurrence reports should be notified to the Agency if:

(a) the occurrence is defined as a reportable occurrence for organisations certified as Pan-European service providers and service providers in the airspace of the territory to which the Treaty applies and having their principal place of operation or, if any, their registered office located outside the territory subject to the provisions of the Treaty; and

(b) the competent authority has come to the conclusion that:

(1) the organisation certified by the Agency to which the occurrence relates, has not been informed of the occurrence; or

(2) the occurrence has not been properly addressed or has been left unattended by the organisation certified by the Agency.

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Such occurrence data should be reported in a format compatible with the European Coordination Centre for Accident and Incident Reporting Systems (ECCAIRS) and should provide all relevant information for its assessment and analysis, including necessary additional files in the form of attachments.

GM4 ATM/ANS.AR.A.020(b) Information to the Agency
EXCHANGE OF SAFETY-SIGNIFICANT INFORMATION WITH THE AGENCY

A coordinator should be appointed by each competent authority, as appropriate, to exchange information regarding safety-significant information between the authority reporting the occurrence and the Agency.

GM1 ATM/ANS.AR.A.030 Safety directives
GENERAL

(a) The safety directive is a document issued by the competent authority, mandating actions to be performed by one or more service providers, when evidence shows that aviation safety may otherwise be compromised. Thus, the competent authority is responsible for the determination of the actions required and their rationale.

(b) The competent authority is required to perform a verification of compliance of the service providers with the safety directives in accordance with ATM/ANS.AR.A.030(d). In this respect, ATM/ANS.AR.C.005(a)(6) requires the competent authority to establish a process to verify the implementation of safety directives by the service providers. The actions that need to be taken depend on the content of the safety directive and the nature of the unsafe condition.

GM2 ATM/ANS.AR.A.030(b) Safety directives
CONTENT

<table>
<tr><td>[Name of the competent authority]</td><td colspan="2">SAFETY DIRECTIVE</td></tr>
<tr><td>[Logo of the competent authority]</td><td colspan="2">SD No/ ISSUE No:[…]

Date: dd Month YYYY</td></tr>
<tr><td colspan="3">This Safety Directive is issued in accordance with Commission Implementing Regulation (EU) No XXX/XXXX</td></tr>
<tr><td colspan="2">[Name of the service provider(s)]</td><td>[Identification of the affected functional system]</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Safety Directive Title</td><td colspan="2">[Title]</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Unsafe condition identified:</td><td colspan="2">[Describe the unsafe condition that is the reason for the issuance of the SD]</td></tr>
</table>

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Required action(s), their rationale and compliance time(s):	[Describe the required action(s) and their rationale; indicate the compliance time(s) within which the action(s) should be accomplished]
Date of entry into force of SD:	dd Month YYYY
Distributed to:	(a) [service provider(s) address: Post code, City Country Email address:…] (b) [competent authorities concerned] (c) [European Aviation Safety Agency]
Remarks:	

GM3 ATM/ANS.AR.A.030(c) Safety Directives
FORWARDING OF SAFETY DIRECTIVES

For instance, a safety directive that should be forwarded to the Agency under ATM/ANS.AR.A.030 could be a case:

(a) where the competent authority has determined that there is an immediate need to take certain actions in order to respond to a safety recommendation; or

(b) following an accident or serious incident; or

(c) when this or a similar unsafe condition may be present in other service providers of the same Member State.

SUBPART B — MANAGEMENT (ATM/ANS.AR.B)

AMC1 ATM/ANS.AR.B.001(a)(2) Management system
QUALIFIED PERSONNEL

The competent authority should:

(a) define and document the education, training, technical and operational knowledge, experience and qualifications relevant to the duties of each position involved in oversight activities within their structure;

(b) ensure specific training for those involved in oversight activities within their structure; and

(c) ensure that personnel designated to conduct safety regulatory audits, including auditing personnel from qualified entities, meet specific qualification criteria defined by the competent authority. The criteria should address:

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(1) the knowledge and understanding of the requirements related to the services provision in ATM/ANS and other ATM network functions against which safety regulatory audits may be performed;

(2) the use of assessment techniques;

(3) the skills required for managing an audit; and

(4) the demonstration of competence of auditors through evaluation or other acceptable means.

AMC2 ATM/ANS.AR.B.001(a)(2) Management System
TRAINING PROGRAMME AND RECURRENT TRAINING

(a) The competent authority should establish a training programme for its personnel, including its inspectors for the oversight of services provision in ATM/ANS and other ATM network functions, and a plan for its implementation. The training programme should include, as appropriate to the role, current knowledge, experience and skills of the personnel, at least the following:

(1) organisation and structure of the aviation legislation;

(2) the Chicago Convention, relevant ICAO annexes and documents, the applicable requirements of Regulation (EC) No 216/2008[1], its IRs, as well as Regulations (EC) Nos 549/2004[2], 550/2004[3], 551/2004[4], and 552/2004[5] and their IRs and related Acceptable Means of Compliance (AMC), Certification Specifications (CSs) and Guidance Material (GM), as well as assessment methodology of the alternative means of compliance and the applicable national legislation;

(3) the applicable requirements and procedures; and

(4) areas of particular interest.

(b) The training programme and the training plan should be updated, as needed, to reflect at least changes in aviation legislation and industry. The training programme should also cover specific needs of the personnel and the competent authority.

(c) The competent authority should ensure that its personnel, including its inspectors for the oversight of services provision in ATM/ANS and other ATM network functions, undergo recurrent training at regular intervals as defined by the competent authority or whenever deemed necessary in order to keep being up to date.

1 Regulation (EC) No 216/2008 of the European Parliament and the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1).

2 Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky (the framework Regulation) - Statement by the Member States on military issues related to the single European sky (OJ L 96, 31.3.2004, p. 1).

3 Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the single European sky (the service provision Regulation) (OJ L 96, 31.3.2004, p. 10).

4 Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky (the airspace Regulation) - Commission statement (OJ L 96, 31.3.2004, p. 20).

5 Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (the interoperability Regulation) (OJ L 96, 31.3.2004, p. 26).

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GM1 ATM/ANS.AR.B.001(a)(2) Management system
SUFFICIENT PERSONNEL

(a) This guidance material for the determination of the required personnel is limited to the performance of certification and oversight tasks, excluding personnel required to perform tasks subject to any national regulatory requirements.

(b) The elements to be considered when determining required personnel and planning their availability may be divided into quantitative and qualitative:

(1) Quantitative elements:

(i) number of initial certificates to be issued;

(ii) number of service providers certified by the competent authority; and

(iii) number of flight information services providers having declared their activity to the competent authority.

(2) Qualitative elements:

(i) size, nature, and complexity of activities of service providers (cf. AMC1 ATM/ANS.OR.B.005(e));

(ii) results of past oversight activities, including audits, inspections and reviews, in terms of risks and regulatory compliance:

(A) number and level of findings; and

(B) implementation of corrective actions; and

(iii) size of the Member State's aviation industry and potential growth of activities in the field of civil aviation, which may be an indication of the number of new applications and changes to existing certificates to be expected.

(c) Based on existing data from previous oversight planning cycles and taking into account the situation within the Member State's aviation industry, the competent authority may estimate:

(1) the standard working time required for processing applications for new certificates;

(2) the standard working time required for processing declarations;

(3) the number of new declarations or changed declarations;

(4) the number of new certificates to be issued for each planning period; and

(5) the number of changes to existing certificates and changes to functional systems to be processed for each planning period.

(d) In line with the competent authority's oversight policy, the following planning data should be determined specifically for each service provider, certified or declared, as well as for the Network Manager:

(1) standard number of audits/inspections to be performed per oversight planning cycle;

(2) standard duration of each audit/inspection;

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(3) standard working time for audit/inspection preparation, on-site audit/inspection, reporting and follow-up per inspector for the oversight of services provision and other ATM network functions; and

(4) minimum number and required qualification of inspectors for the oversight of services provision and other ATM network functions for each audit/inspection.

(e) Standard working time could be expressed either in working hours or in working days per inspector for the oversight of services provision and other ATM network functions. All planning calculations should then be based on the same unit (hours or working days).

(f) For each service provider, the number of working hours/days per planning period for each qualified inspector for the oversight of services provision and other ATM network functions that may be allocated for certification, oversight and enforcement activities should be determined taking into account:

(1) purely administrative tasks not directly related to oversight and certification;

(2) training;

(3) participation in other projects;

(4) planned absence; and

(5) the need to include a reserve for unplanned tasks or unforeseeable events.

(g) The determination of working time available for certification, oversight and enforcement activities should also take into account the possible use of third parties.

AMC1 ATM/ANS.AR.B.001(a)(4) Management system
COMPLIANCE MONITORING PROCESS

The formal process to monitor the compliance of the management system with the relevant requirements, and the adequacy of the procedures should:

(a) include a feedback system of audit findings to ensure implementation of corrective actions as necessary; and

(b) be the responsibility of a person or group of persons who should be responsible to the senior management of the competent authority and who perform(s) compliance monitoring activities with functional independence from the units/departments (s)he (they) oversee(s) and with direct access to the senior management of the competent authority and to appropriate management for safety matters.

AMC1 ATM/ANS.AR.B.005 Allocation of tasks to qualified entities
ASSESSMENT OF THE QUALIFIED ENTITIES

(a) The competent authority should include in its system to initially and continuously assess the qualified entity's (ies') compliance with Annex V to Regulation (EC) No 216/2008, the possibility for the competent authority to perform audits of the qualified entity (ies).

(b) The competent authority should verify that all qualified entities' personnel concerned with the conduct of audits or reviews should be adequately trained and qualified. The competent authority should verify how the qualified entities:

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(1) define and document the education, training, technical and operational knowledge, experience and qualifications for those involved in oversight activities;

(2) ensure specific training for those involved in oversight activities; and

(3) ensure that personnel designated to conduct audits meet specific qualification criteria. The criteria should address:

(i) the knowledge and understanding of the requirements related to the services provision in ATM/ANS and other ATM network functions against which audits may be performed;

(ii) the use of assessment techniques;

(iii) the skills required for managing an audit; and

(iv) the demonstration of competence of auditors through evaluation or other acceptable means.

GM1 ATM/ANS.AR.B.005 Allocation of tasks to qualified entities
CERTIFICATION TASKS

The tasks that may be performed by a qualified entity on behalf of the competent authority include those related to the initial certification and continuing oversight of service providers as defined in this Regulation, with the exclusion of the issuance of a certificate.

AMC1 ATM/ANS.AR.B.015(a)(2) Record keeping
DURATION OF RETENTION PERIOD OF RECORDS

Records related to the training and qualification of the personnel of the competent authority should be kept until the end of their employment.

SUBPART C — OVERSIGHT, CERTIFICATION, AND ENFORCEMENT (ATM/ANS.AR.C)

AMC1 ATM/ANS.AR.C.010(a) Oversight
CHANGES TO THE FUNCTIONAL SYSTEM

[To be introduced under RMT.0469]

GM1 ATM/ANS.AR.C.010(b)(1) Oversight
IMPLEMENTING ARRANGEMENTS

Implementing arrangements should be considered to be the service provider's (safety) management system(s) documentation, manuals, service provision conditions or the certificate and the content of the declaration, as applicable.

AMC1 ATM/ANS.AR.C.015 Oversight programme
GENERAL

(a) When establishing an oversight programme appropriate to each provider, the competent authority should take into account the safety performance of the service provider to be audited. Inspectors for the oversight of services provision and other ATM network functions should work in accordance with the schedule provided to them.

(b) Having regard to the performance of service providers, the competent authority may vary the frequency of the audits or inspections.

(c) When defining the oversight programme, the competent authority should assess the risks related to the activity of each service provider, certified or declared, or the Network Manager, and adapt the audits and inspections to the level of risk identified.

AMC1 ATM/ANS.AR.C.015(a) Oversight programme
SPECIFIC NATURE AND COMPLEXITY OF THE ORGANISATION

(a) When determining the oversight programme for a service provider, the competent authority should consider in particular the following elements, as applicable:

(1) the implementation by the service provider of industry standards, directly relevant to the organisation's activity subject to this Regulation;

(2) the procedure applied for and scope of changes not requiring prior approval in accordance with ATM/ANS.OR.A.040(b); and

(3) specific procedures implemented by the service provider related to any alternative means of compliance used.

(b) For the purpose of assessing the complexity of an organisation's management system, AMC1 ATM/ANS.OR.B.005(e) should be used.

GM1 ATM/ANS.AR.C.020 Issue of certificates
OPERATIONAL CONDITIONS OR LIMITATIONS

(a) If, during the certification process, an operational condition or limitation has been determined as necessary to be imposed on or implemented by the service provider, the competent authority should ensure that such operational condition or limitation is prescribed in the service provision conditions attached to the service provider's certificate.

(b) Limitations in the certification may be used to identify restrictions to be applied in the provision of services and any other particularity of the service provided (e.g. intended usage, type of operations).

(c) Limitations may also relate to some restrictions on the service(s) provided associated with non-compliances with respect to some performance requirements.

(d) Conditions may address actions that require to be accomplished to confirm the validity of the certificate.

GM2 ATM/ANS.AR.C.020 Issue of certificates
EXAMPLES OF LIMITATIONS IN SERVICES

(a) Limitations for the provision of ILS Signal in Space could be:
(1) CAT I;

(2) CAT II; and

(3) CAT III.

(b) Limitations for the provision of GNSS signal could be:

(1) based on the system used to provided Signal-in-Space:

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(i) GNSS Core System;

(ii) Satellite-Based Augmentation System (SBAS); and

(iii) Ground-Based Augmentation System (GBAS); and/or

(2) based on the type of operations supported (e.g. en-route, en-Route terminal, NPA, APV-I, APV-II, Cat I, from ICAO Annex 10)

(c) Limitations for the Aeronautical Mobile Service (air-ground communication) could be:

(1) for flight information services;

(2) for area control service;

(3) for approach control service; and

(4) for aerodrome control service.

(d) Limitations for the provision of data from the Secondary Surveillance Radar (SSR) could be:

(1) mode A/C; and

(2) mode S.

(e) Limitations for the provision of data from Automatic Dependant Surveillance (ADS) could be:

(1) ADS-C; and

(2) ADS-B.

AMC1 ATM/ANS.AR.C.025(b) Changes
CHANGES REQUIRING PRIOR APPROVAL

(a) Upon receipt of a notification for a proposed change that requires prior approval, the competent authority should:

(1) formally acknowledge the receipt of the notification in writing within 10 working days;

(2) assess the proposed change in relation to the service provider's certificate or the conditions attached or management system of it, and the applicable requirements of Part-ATM/ANS.OR, as well as any other applicable requirements within 30 working days;

(3) assess the actions proposed by the service provider in order to show compliance; and

(4) notify the service provider of its approval/rejection without delay.

(b) The competent authority should, in due time, verify the compliance of the service provider and, depending on the change, examine the need for prescribing any condition for the operation of it during the change.

(c) For changes requiring prior approval, the competent authority may conduct an audit of the service provider in order to verify the service provider's compliance with the applicable requirements.

(d) When notifying, the competent authority should also inform the service provider of the right of appeal, as exists under the applicable national legislation.

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AMC2 ATM/ANS.AR.C.025(b) Changes
CHANGE OF THE NAME OF THE SERVICE PROVIDER

Upon receipt of the notification and the relevant parts of the service provider's documentation as required by Part-ATM/ANS.OR, the competent authority should reissue the certificate.

GM1 ATM/ANS.AR.C.025(b) Changes
CHANGE OF NAME OF THE SERVICE PROVIDER

A name change alone does not require the competent authority to audit the organisation unless there is evidence that other aspects of the organisation have changed.

GM2 ATM/ANS.AR.C.025(b) Changes
APPROPRIATE ACTION

Appropriate action by the competent authority may include suspension, limitation or revocation of the service provider's certificate.

AMC1 ATM/ANS.AR.C.025(c) Changes
CHANGES NOT REQUIRING PRIOR APPROVAL

(a) When the service provider submits the name of the nominee for the nominated persons in accordance with AMC2 ATM/ANS.OR.A.040(b), the competent authority should assess his/her qualification.

(b) Upon receipt of a notification for a proposed change that does not require prior approval by the competent authority, it should acknowledge receipt of the notification in writing within 10 working days from reception unless it is not specified under the relevant national legislation.

A simple management system documentation system status sheet should be maintained, which contains information on when an amendment was received by the competent authority and when it was approved, if applicable.

GM1 ATM/ANS.AR.C.050 Findings, corrective actions and enforcement measures
CATEGORIES OF FINDINGS — DOCUMENTARY EVIDENCE

Documentary evidence may include but not limited to:

(a) operations or technical manuals;

(b) contracts or other types of arrangements;

(c) training, qualification or medical records;

(d) inspection records;

(e) test or exercise results;

(f) internal audit results;

(g) maintenance records; and

(h) other similar material required to be maintained by the service provider, etc.

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GM2 ATM/ANS.AR.C.050 Findings, observations, corrective actions and enforcement measures
ENFORCEMENT MEASURES — FINANCIAL PENALTIES

In accordance with Article 7(7) of Regulation No 550/2004 and Articles 10, 22a(d), 25, and 68 of Regulation (EC) No 216/2008, the competent authority may additionally, and depending on the nature and the repetitiveness of the findings or the level of implementation of the corrective actions, impose appropriate enforcement measures that include financial penalties as appropriate, which are effective, proportionate, and dissuasive.

GM3 ATM/ANS.AR.C.050 Findings, corrective actions and enforcement measures
OBSERVATIONS

The observation should be a way to communicate and draw future audit teams' attention on specific matters that deserve scrutiny. It could be communicated to the audited service provider.

GM4 ATM/ANS.AR.C.050(e) Findings, corrective actions and enforcement measures
CORRECTIVE ACTION IMPLEMENTATION PERIOD

At the end of the corrective action implementation period included in an action plan approved by the competent authority and subject to the nature of the finding, the competent authority may extend it. It should be subject to a satisfactory corrective action plan agreed by the competent authority.

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ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL to ANNEX III — COMMON REQUIREMENTS FOR SERVICE PROVIDERS (Part-ATM/ANS.OR)

SUBPART A — GENERAL COMMON REQUIREMENTS (ATM/ANS.OR.A)

GM1 ATM/ANS.OR.A.001 Scope

A. DEFINITIONS AND SCOPE IN RELATION TO SERVICE PROVIDERS

(a) In order to understand which of the annexes applies to which service, it is necessary to understand how services are defined. These definitions have determined the structure and content of Annexes III to XIII.

(b) Article 3(q) of Regulation (EC) No 216/2008 defines ATM/ANS as 'the air traffic management functions as defined in Article 2(10) of Regulation (EC) No 549/2004, air navigation services defined in Article 2(4) of that Regulation, and services consisting in the origination and processing of data and formatting and delivering data to general air traffic for the purpose of safety-critical air navigation'.

(c) It should, therefore, be noted that ATM/ANS include more services than 'Air Traffic Management' and 'Air Navigation Services' together.

(d) In this Regulation, 'services' means those specified in Annex Vb(2) to Regulation (EC) No 216/2008. This Annex includes an additional service (airspace design) that is neither directly included in the definition of ATM/ANS nor in the definition of 'Air Traffic Management' or 'Air Navigation Service'.

(e) As already defined, 'ATM network functions' refers to functions performed by the Network Manager in accordance with Regulation (EU) No 677/2011.[6]

(f) Figure 1 below provides a pictorial representation of the services and how they interrelate through the various definitions.

(g) Figure 1 indicates both a further breakdown of ATS into air traffic control services (ATC), alerting services, air traffic advisory services, and flight information services and groupings of:

(1) air traffic management (ATM): comprising ATS, ASM, and ATFM;

(2) air navigation services (ANS): comprising ATS, CNS, MET, and AIS; and

(3) airspace design (ASD) and data provision (DAT) and ATM network functions.

(h) It is important to note that ATS is included in ATM and ANS.

[6] Commission Regulation (EU) No 677/2011 of 7 July 2011 laying down detailed rules for the implementation of air traffic management (ATM) network functions and amending Commission Regulation (EU) No 691/2010 (OJ L 185, 15.7.2011, p. 1).

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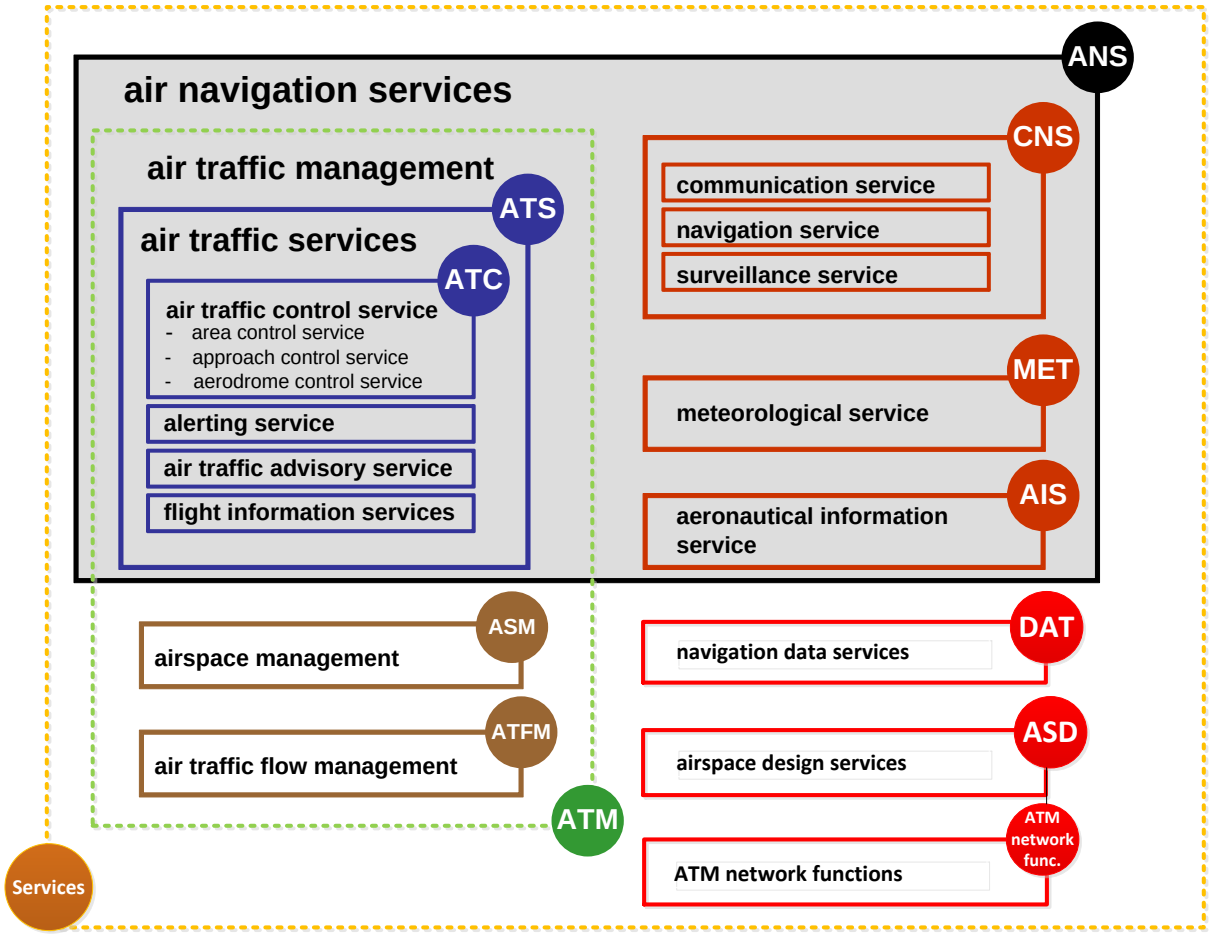

Figure 1: The scope of the services as specified in Annex Vb to Regulation (EC) No 216/2008 and, additionally, the ATM network functions.

B. SERVICES

(a) Annex III (Part-ATM/ANS.OR) applies to the service providers, as relevant, and contains the common requirements for the service providers. This Annex is broken down into four subparts:

(1) Subpart A — General requirements (ATM/ANS.OR.A);

(2) Subpart B — Management (ATM/ANS.OR.B);

(3) Subpart C — Specific organisational requirements for service providers other than ATS providers (ATM/ANS.OR.C); and

(4) Subpart D — Specific organisational requirements for ANS and ATFM providers and the Network Manager (ATM/ANS.OR.D).

(b) Subpart D applies only to ANS and ATFM providers and the Network Manager (and not to ASM and DAT providers).

(c) Thereafter, each service is allocated to an annex (Annexes IV to XII) which contains specific requirements for that service. Table 1 below indicates which annexes are applicable to each service.

(d) Annex XIII contains requirements for service providers regarding personnel training and competence assessment.

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C. AIR TRAFFIC SERVICES FOR FLIGHT TEST

(a) When the flight tests have one of the following characteristics:

(1) frequent changes in levels and headings, depending on the tests which are carried out with certain unpredictability;

(2) unless necessary for the purpose of the flight tests, navigation in general (route/destination, etc.) is not the primary objective of these flights;

(3) specific aircraft configurations sometimes resulting in reduced ability to manoeuvre;

(4) technical constraints, including airborne and ground testing facilities;

(5) airborne equipment is not proven to be up to the required certification level; and

(6) the planning for conducting flight tests can be of a very ad hoc nature giving little timing for carrying out strategy or pre-tactical air traffic flow management. (e.g. the need to test under specific weather conditions which would require flexibility for allocation of slots for these flight tests),

then the air traffic services provider providing services to this type of flight testing may need a specific privilege within the certificate issued by the competent authority because of the specificities of the air traffic services to be provided to this type of operations and because of the need to ensure safe operations in the airspace in which flight tests are being conducted.

(b) Given the characteristics in (a), flight tests can be made in cohabitation with other airspace users in controlled or non-controlled airspace, and sometimes in temporarily reserved areas when necessary.

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	Annex III (Part-ATM/ANS.OR)				Annex IV (Part-ATS)	Annex V (Part-MET)	Annex VI (Part-AIS)	Annex VII (Part-DAT)	Annex VIII (Part-CNS)	Annex IX (Part-ATFM)	Annex X (Part-ASM)	Annex XI (Part-ASD)	Annex XII (Part-NM)	Annex XIII (Part-PERS)
	Subpart A	Subpart B	Subpart C	Subpart D										
Air traffic services (see Note 1)	**X**	**X**		**X**	**X**									
Meteorological services	**X**	**X**	**X**	**X**		**X**								
Aeronautical information services	**X**	**X**	**X**	**X**			**X**							
Data providers	**X**	**X**	**X**					**X**						
Communication, navigation and surveillance service	**X**	**X**	**X**	**X**					**X**					
Air traffic flow management service	**X**	**X**	**X**	**X**						**X**				
Airspace management service	**X**	**X**	**X**								**X**			
Airspace design service	**X**	**X**	**X**									**tbd***		
Network Manager	**X**	**X**	**X**	**X**						**X**			**X**	
service providers (see Note 2)														**X**

Table 1: Applicability of annexes to service providers

X = Applicable annexes for each service provider.

Note 1: Section 3 of Annex IV (Part-ATS) only applies to providers of air traffic control services and not to providers of alerting, air traffic advisory, and flight information services.

Note 2: The applicability of Annex XIII is dependent upon the scope as specified within each of the subparts of Annex XIII.

* to be introduced under RMT.0445, as necessary.

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GM1 ATM/ANS.OR.A.010 Application for a limited certificate
GENERAL

The relationship between the type of service provision, criteria to be complied with and the applicable rules are indicated in Table 2 below.

Type of service	Type of approval	Criteria to be complied with	Applicable Rules
Air traffic service providers	Limited Certificate	ATM/ANS.OR.A.010(a)	ATM/ANS.OR.B.001 ATM/ANS.OR.B.005 ATM/ANS.OR.B.020 ATM/ANS.OR.A.075 Annex IV
Air navigation service providers (other than the air traffic services providers) (gross annual turnover of EUR 1 000 000 or less)	Limited Certificate	ATM/ANS.OR.A.015(b)(1)	ATM/ANS.OR.B.001 ATM/ANS.OR.B.005 ATM/ANS.OR.B.020 ATM/ANS.OR.A.075 Annexes V, VI and VIII depending upon service provision
Air navigation service providers (aerodrome flight information services providers operating regularly not more than one working position at any aerodrome)	Limited Certificate	ATM/ANS.OR.C.015(b)(2)	ATM/ANS.OR.B.001 ATM/ANS.OR.B.005 ATM/ANS.OR.B.020 ATM/ANS.OR.A.075 Annex IV

Table 2: Type of service provision, criteria to be complied with, and the applicable rules

GM1 ATM/ANS.OR.A.015(b)(1) Declaration by flight information services providers
MODEL TEMPLATE OF DECLARATION OF COMPLIANCE:

DECLARATION OF COMPLIANCE FOR THE PROVISION OF FLIGHT INFORMATION SERVICES in accordance with Commission Regulation (EU) No XXX/XXXX
Provider of flight information service Name: Principal place of operation and, if any, registered office: Name and contact details of the accountable manager:

Flight Information Service
Starting date of provision of flight information services/applicability date of the change:
Scope of flight information services: ☐ Aerodrome flight information services (AFIS) ☐ En-route flight information services (En-route FIS)
List of alternative means of compliance with references to the AMCs they replace (to be attached to the declaration)
Statements
☐ The management system documentation, including the operations manual, complies with the applicable requirements set out in Part-ATM/ANS.OR and Part-ATS.
☐ The provision of flight information services will be carried out in accordance with the requirements of Regulation (EC) No 216/2008 and its Implementing Rules, as well as Regulations (EC) Nos 549/2004, 550/2004, 551/2004, and 552/2004 and their Implementing Rules, and the procedures and instructions specified in the operations manual.
☐ All personnel are qualified, competent and trained in accordance with the applicable requirements.
☐ (If applicable) The provider of flight information services has implemented and demonstrated conformance to an officially recognised industry standard. Reference of the standard: Certification body: Date of the last conformance audit:
☐ Any change in the provision of flight information services that affects the information disclosed in this declaration will be notified to the competent authority.
☐ The provider of flight information service confirms that the information disclosed in this declaration is correct.
Date, name, and signature of the accountable manager

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AMC1 ATM/ANS.OR.A.040(b) Changes
PROCEDURE FOR CHANGES REQUIRING PRIOR APPROVAL

For changes requiring prior approval, a procedure should define how the service provider should notify the competent authority and obtain an approval issued by that authority:

(a) Notifications should be submitted before any such change is made in order to enable the competent authority to determine continued compliance with Regulation (EC) No 216/2008 and its Implementing Rules and also to amend, if necessary, the certificate and the related conditions attached to it.

(b) Changes should only be implemented upon receipt of approval by the competent authority in accordance with the procedure established by that authority.

(c) The service provider should operate under the conditions prescribed by the competent authority during such changes, as applicable.

AMC2 ATM/ANS.OR.A.040(b) Changes
PROCEDURE FOR DEALING WITH CHANGES NOT REQUIRING PRIOR APPROVAL

(a) For changes not requiring prior approval, the procedure should define how the service provider should notify of and manage the change.

(b) The service provider should inform the competent authority of any changes to nominated persons specified in ATM/ANS.OR.B.020(b) and ATS.OR.200(a)(1)(iii), as applicable.

(c) The procedure agreed by the service provider and the competent authority should not include any change affecting:

(1) any of the key elements of the management system as required in ATM/ANS.OR.B.005(a) and of the safety management system as required in ATS.OR.200(a), as applicable, or

(2) any additional elements as found necessary by the service provider in agreement with the competent authority and approved by that authority.

The changes specified above are changes requiring prior approval.

GM1 ATM/ANS.OR.A.040(b) Changes
PROCEDURE FOR DEALING WITH CHANGES NOT REQUIRING PRIOR APPROVAL

The procedure agreed by the service provider and the competent authority may also include the process for the reaction by the service provider to an unplanned change that may arise with the need for urgent action that would normally require prior approval of the competent authority. This is the case in which the service provider responds immediately to a safety problem as required in ATM/ANS.OR.A.060 or when an emergency situation arises in which the service provider has to take immediate action to ensure the safety of the services.

GM2 to AMC2 ATM/ANS.OR.A.040(b) Changes
KEY ELEMENTS

The key elements of the service provider's management system may be considered to be the elements of the organisation and processes for implementing related activities, including the corresponding control procedures and the measurement of the achieved standard.

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AMC1 ATM/ANS.OR.A.055(b) Findings and corrective actions
GENERAL

The corrective action plan defined by the service provider should address the effects of the non-conformity and its root cause.

GM1 ATM/ANS.OR.A.055 Findings and corrective actions
GENERAL

(a) Corrective action is the action taken to eliminate or mitigate the root cause(s) and prevent the recurrence of existing detected non-compliance or other undesirable condition or situation.

(b) The proper determination of the root cause is crucial for defining effective corrective actions.

AMC1 ATM/ANS.OR.A.065 Occurrence reporting
REPORTING PROCEDURES

The service provider should establish procedures to be used for reporting to the competent authority and any other organisation required which include:

(a) description of the applicable requirements for reporting;

(b) description of the reporting mechanism, including reporting forms, means and deadlines;

(c) personnel responsible for reporting; and

(d) description of mechanism and personnel responsibilities for identifying root causes, and the actions that may be needed to be taken to prevent similar occurrences in the future, as appropriate.

GM1 ATM/ANS.OR.A.065 Occurrence reporting
GENERAL

The reporting to the organisations defined in the ATM/ANS.OR.A.065 does not affect the need to report to other organisations with which the service provider interfaces, and which might be involved in or be affected by the reported event (e.g. other service providers involved in an occurrence, aerodrome operators, etc.).

AMC1 ATM/ANS.OR.A.065(a) Occurrence reporting
GENERAL

(a) The service provider should submit all reportable occurrences, including the ones:

(1) defined in the list contained in Annex I and its Appendix and Annex II and its Appendix of Directive 2003/42/EC[7] for service providers for which the Agency is the competent authority; and

(2) required by the applicable national rules implementing Directive 2003/42/EC of the European Parliament and of the Council on occurrence reporting in civil aviation for all other service providers.

[7] Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation (OJ L 167, 4.7.2003, p. 23).

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(b) In addition to the reports required by (a), the service provider should report volcanic ash clouds, encountered by aircraft operators, for which it has become aware of.

GM1 ATM/ANS.OR.A.065(b) Occurrence reporting
SYSTEMS AND CONSTITUENTS

(a) When determining which failures of systems and constituents are to be reported, a degree of practicality is required as it is not intended that every failure is reported. Only those that have or may have an impact on the safety of the provision of services are reported.

(b) When nothing is defined in European Union or national legislation, the determination of the failures of systems and constituents that need to be reported is done by the service provider and needs to be approved by the competent authority. This determination can be done as a result of an assessment of the installations or changes to the systems and constituents.

(c) The organisation responsible for the design of the systems and constituents may no longer exist or may no longer support the design. In this case, the service provider will have made arrangements to ensure that the safety of the systems and constituents can be assured by appropriate and practical means. In many cases, this means that the service provider has taken over the design responsibilities.

(d) Within the application of Regulation (EC) No 552/2004, the organisation responsible for the design of the constituent will be the entity that signs the Declaration of Conformity or Suitability for use. For systems and constituents which existed before the applicability date of Regulation (EC) No 552/2004, the service provider should identify the responsible organisation, otherwise the service provider should make appropriate arrangements.

GM1 ATM/ANS.OR.A.070 Contingency plans
GENERAL

The contingency plan may include the definition of the measures, the coordination with other actors (i.e. the State, the competent authorities, possibly the other service providers, the insurance companies, aerodrome operators, as applicable) and alternative services needed in case of degradation or interruption of the services, while the applicability of emergency response planning may be attributable to or affected by an aviation safety occurrence.

AMC1 ATM/ANS.OR.A.075(a) Open and transparent provision of services — providers of air navigation services and air traffic flow management
GENERAL

Providers of air navigation services and air traffic flow management should consult with the users of their services at least once a year.

SUBPART B — MANAGEMENT (ATM/ANS.OR.B)

AMC1 ATM/ANS.OR.B.001 Technical and operational competence and capability — air traffic services providers
TECHNICAL AND OPERATIONAL CAPACITY

Technical and operational capacity of air traffic services provider should include a sufficient number of personnel to perform its tasks and discharge its safety responsibilities.

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GM1 ATM/ANS.OR.B.005 Management system
DEFINITIONS AND CONCEPT OF MANAGEMENT SYSTEM

(a) ISO 9000:2005 defines a management system as a 'set of interrelated or interacting elements to establish policy and objectives and to achieve those objectives'.

(b) Another available definition of management system is the following: ‘The structure, processes and resources needed to establish an organisation's policy and objectives and to achieve those objectives.'

(c) Traditionally, separate management systems were developed to address issues such as safety, quality, environment, health and safety, finance, human resources, information technology and data protection. However, it is foreseen that more and more the services providers will establish integrated management systems following the harmonised set of requirements in this Implementing Rule.

(d) The Implementing Rule does not require that the different management systems are integrated but it facilitates their integration.

GM2 ATM/ANS.OR.B.005 Management system
RELATIONSHIP BETWEEN THE TYPE OF SERVICE AND SAFETY MANAGEMENT — QUALITY MANAGEMENT

(a) All service providers are required to establish and maintain a management system. However, only an air traffic services provider can have managerial control over functions directly affecting the safety of the flight (e.g. the ATCO to separate aircraft from each other). Hence, the management system requirements in Annex III, which apply to all service providers, are more broadly associated with the quality of the service rather than the safety of the service. Annex IV (Part-ATS) has specific safety management requirements for the provision of air traffic services. Therefore, only the air traffic services provider (that providing air traffic control, alerting service, air traffic advisory service or flight information service) is required to have a safety management system and undertake safety assessment of changes to the functional system.

(b) Service providers, other than the air traffic services provider, can still affect the safety of the flight through functions or services they provide, but this will always be influenced by the way in which the air traffic services provider or airspace user are using those functions or services. Therefore, service providers other than air traffic services providers have a management system which manages the performance of service (rather than the safe use of their services for flight navigation and the control which is beyond the managerial control of the service provider). This performance of the service refers to such properties of the service provided such as accuracy, reliability, integrity, availability, timeliness, etc.

(c) It is quite likely that air traffic services providers have contractual arrangements in place with other service providers, whose services they use, specifying the required performance and requiring the service provider to inform, in a timely manner, the air traffic services provider of any impact on the performance of services supplied.

(d) When the service provider other than an air traffic services provider provides services or functions directly to a flight (e.g. MET) without involving air traffic services, then the safe use of those services is the responsibility of the users of those services.

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(e) When the air traffic services provider also provides other services, it may choose to combine the necessary performance and safety management activities into an integrated management system covering all services.

AMC1 ATM/ANS.OR.B.005(a) Management system
ISO 9001 CERTIFICATE FOR AIR NAVIGATION SERVICES PROVIDERS

An EN ISO 9001 certificate, issued by an appropriately accredited organisation, addressing all the elements required in this Subpart should be considered as a sufficient means of compliance for air navigation service providers. In this case, the air navigation service provider should accept the disclosure of the documentation related to the certification to the competent authority upon the latter's request.

GM1 to AMC1 ATM/ANS.OR.B.005(a) Management system
ISO 9001 CERTIFICATE FOR ATS PROVIDERS

An ISO 9001 certificate may not give the presumption of compliance with the provisions of ATS.OR.200 safety management system.

AMC2 ATM/ANS.OR.B.005(a) Management system
GENERAL — NON-COMPLEX SERVICE PROVIDERS

(a) The policy should include a commitment to improve towards the highest standards, comply with all the applicable legal requirements, meet all the applicable standards, consider the best practices and provide the appropriate resources.

(b) The compliance monitoring task may be exercised by the accountable manager, provided that he or she has demonstrated having the related competence as defined in point (b)(4) of GM1 ATM/ANS.OR.B.005(c).

(c) Safety risk management may be performed using hazard checklists or similar risk management tools or processes, which are integrated into the activities of the service provider.

(d) A service provider should manage associated risks related to changes. Management of changes should be a documented process to identify external and internal changes.

(e) A service provider should identify persons who fulfil the role of managers and who are responsible with regard to safety, quality and security of its services, as applicable. These persons may be accountable managers or individuals with an operational role in the services provider.

GM1 ATM/ANS.OR.B.005(a)(1) Management system
RESPONSIBILITIES AND ACCOUNTABILITIES

(a) Senior management should ensure that responsibilities and accountabilities are defined and communicated within the service provider and documented within the management system. In the context of this rule, 'responsibilities' refers to obligations that can be delegated and 'accountabilities' refers to obligations that cannot be delegated.

(b) The appointment of an accountable manager who is given the required authorities and responsibilities, requires that the individual has the necessary attributes to fulfil the role. The accountable manager may have more than one function in the organisation. Nonetheless, the

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accountable manager's role is to ensure that the management system is properly implemented and maintained through the allocation of resources and tasks.

AMC1 ATM/ANS.OR.B.005(a)(2) Management system
POLICY

(a) The policy of the service provider should:

(1) be signed by the accountable manager;

(2) reflect organisational commitments regarding performance of its services and safety, where applicable, and its proactive and systematic management;

(3) include a commitment:

(i) to improve towards the highest performance standards so as to support the achievement of the highest level of safety;

(ii) to comply with all applicable legislation and requirements, meet all applicable standards and consider best practices;

(iii) to continually improve the effectiveness of the management system;

(iv) to provide appropriate resources;

(v) to enforce the performance of the service required to support the achievement of the highest level of safety in the airspace where the service is provided as one primary responsibility of all managers; and

(vi) that the purpose of reporting is improvement and not to apportion blame to individuals; and

(4) include reporting principles.

(b) Senior management should:

(1) ensure that the policy:

(i) is appropriate to the purpose of service providers;

(ii) provides a framework for establishing and reviewing objectives in relation to the provision of the service;

(iii) is communicated and understood within the service provider; and

(iv) is reviewed for continuing suitability;

(2) continually promote the policy to all personnel and demonstrate their commitment to it;

(3) provide necessary and appropriate human and financial resources for its implementation; and

(4) establish objectives in relation to the provision of the services and performance standards.

GM1 ATM/ANS.OR.B.005(a)(2) Management system
POLICY FOR AIR TRAFFIC SERVICES PROVIDERS VS POLICY FOR ALL OTHER SERVICE PROVIDERS

If a service provider does not undertake the provision of air traffic services, then the policy will be recognisable more as a quality policy that is concerned with the performance of the service and

conformance to the service provision requirements supporting the achievement of the highest level of safety in the airspace where the service is provided. Should the service provider undertake the provision of air traffic services , then ATS.OR.200 also applies and the policy will need to be expanded to include both the safety and the quality of the service.

GM2 ATM/ANS.OR.B.005 (a)(2) Management system
POLICY — NON-COMPLEX SERVICE PROVIDERS

The policy is the means whereby the service provider states its intention to maintain and, where practicable, improve performance levels in all their activities and to minimise their contribution to the risk of an aircraft accident as far as is reasonably practicable.

GM3 ATM/ANS.OR.B.005(a)(2) Management system
SAFETY CULTURE

The policy should actively encourage effective safety reporting and, by defining the line between acceptable performance (often unintended errors) and unacceptable performance (such as negligence, recklessness, violations or sabotage), provide fair protection to reporters. A safety or just culture may not, however, preclude the 'criminalisation of error', which is legally, ethically and morally within the sovereign rights of any Member State, provided that European Union law and established international agreements are observed. A judicial investigation, and consequences of some form, may be expected following an accident or serious incident especially if a system failure resulted in lives lost or property damaged, even if no negligence or ill intent existed. A potential issue could, therefore, exist if voluntary hazard reports, which relate to latent deficiencies of a system or its performance, are treated in the same way as those concerning accident and serious incident investigations. The intent of protecting hazard reports should not challenge the legitimacy of a judicial investigation or demand undue immunity.

AMC1 ATM/ANS.OR.B.005(a)(3) Management system
MANAGEMENT OF METEOROLOGICAL SERVICES PERFORMANCE

(a) The management system of the meteorological service provider should provide users with assurance that the meteorological information supplied complies with the stated requirements in terms of geographical and spatial coverage, format and content, time and frequency of issuance and period of validity, as well as the accuracy of measurements, observations and forecasts.

(b) When the management system indicates that the meteorological information to be supplied to users does not comply with the stated requirements, and automatic error correction procedures are not appropriate, such information should not be supplied to users unless it is validated with the originator.

(c) In regard to the exchange of meteorological information for operational purposes, the management system should include verification and validation procedures and resources for monitoring adherence to the prescribed transmission schedules for individual messages and/or bulletins required to be exchanged as well as the times of their filing for transmission. The management system should be capable of detecting excessive transit times of messages and bulletins received.

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AMC2 ATM/ANS.OR.B.005(a)(3) Management system
SAFETY PERFORMANCE MONITORING AND MEASUREMENT — ATS PROVIDERS

(a) Safety performance monitoring and measurement should be the process by which the safety performance of the air traffic services providers is verified in comparison to the safety policy and the safety objectives established by the air traffic services provider.

(b) This process should include:

(1) safety reporting;

(2) safety studies encompassing broad safety concerns;

(3) safety reviews including trends reviews, which would be conducted during introduction and deployment of new technologies, change or implementation of procedures, or in situations of structural change in operations;

(4) safety audits focussing on the integrity of the air traffic services provider's management system, and periodically assessing the status of safety risk controls; and

(5) safety surveys, examining particular elements or procedures of a specific operation, such as problem areas or bottlenecks in daily operations, perceptions and opinions of operational personnel, and areas of dissent or confusion.

GM1 ATM/ANS.OR.B.005(a)(3) Management system
SAFETY PERFORMANCE MONITORING AND MEASUREMENT — ATS PROVIDERS

(a) The means to monitor performance is often through one or more leading or lagging indicators.

(b) Indicators and performance measures provide feedback on what is happening so that the air traffic services provider can take appropriate actions to respond to changing circumstances. The indicators provide information on:

(1) what is happening around the air traffic services provider;

(2) how well the air traffic services provider is doing;

(3) what has happened so far; and

(4) warning of impending problems or dangers that the air traffic services provider may need to take action to avoid.

(c) Although 'lagging' performance indicators that measure the final outcomes resulting from the air traffic services provider's activities are often considered as the most interesting, lagging indicators themselves may not provide enough information to guide the air traffic services provider's actions and ensure success.

(d) By measuring the inputs to a process, leading performance indicators can complement the use of lagging indicators and compensate for some of their shortcomings. Leading indicators can be used to monitor the effectiveness of control systems and give advance warning of any developing weaknesses before problems occur. One purpose of leading performance indicators is, therefore, to show the condition of systems before accidents, incidents, harm, damage or failure occurs. In this way, they can help to control risks and prevent mishaps.

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(e) There is good evidence that when leading performance indicators are used correctly, they are effective in improving performance. However, there is also good evidence that they can be misused.

(f) For leading performance indicators to play an effective role in the improvement process, there should be an association between the inputs that the leading performance indicators measure and the desired lagging outputs. There needs to be a reasonable belief that the actions taken to improve leading performance indicators will be followed by an improvement in the associated lagging output indicators.

(g) The process for effective use of leading performance indicators can be summarised as:

(1) Identify where there are potential weaknesses or opportunities for improvement;

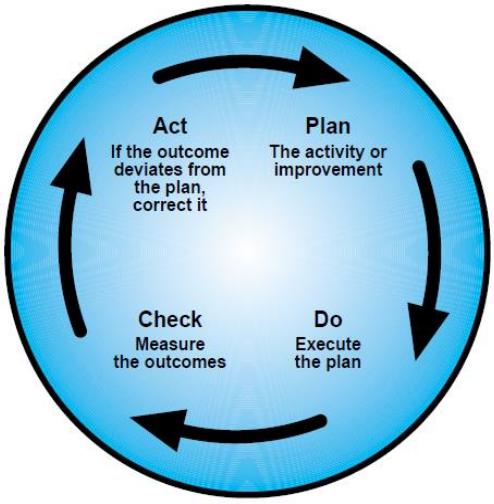
(2) Identify what can be done to counter weaknesses or deliver improvement;

(3) Set performance standards for the actions identified;

(4) Monitor performance against the standards;

(5) Take corrective actions to improve performance; and

(6) Repeat the process by using the following continuous improvement model:



(h) For any performance indicator to be effective, it is important that it is:

(1) objective and easy to measure and collect;

(2) relevant to the air traffic services provider whose performance is being measured;

(3) capable of providing immediate and reliable indications of the level of performance;

(4) cost-efficient in terms of the equipment, personnel and additional technology required to gather the information;

(5) understood and owned by the air traffic services provider whose performance is being measured;

(6) related to activities considered to be important for future performance;

(7) amenable to intervention/influence by the air traffic services provider whose performance is being measured;

(8) related to something where there is scope to improve; and

(9) a clear indication of a means to improve performance.

GM2 ATM/ANS.OR.B.005(a)(3) Management system
PERFORMANCE MONITORING AND MEASUREMENT — SERVICE PROVSDERS OTHER THAN AIR TRAFFIC SERVICES PROVIDERS

A performance indicator (PI) is a type of performance measurement. An organisation may use PIs to evaluate its success, or to evaluate the success of a particular activity in which it is engaged. Sometimes success is defined in terms of making progress towards strategic goals, but often success is simply the repeated, periodic achievement of some level of operational goal (e.g. zero defects). Accordingly, choosing the right PIs relies upon a good understanding of what is important to the organisation. Since there is a need to understand well what is important, various techniques to assess the present state of the business, and its key activities, are associated with the selection of PIs. These assessments often lead to the identification of potential improvements, so performance indicators are routinely associated with 'performance improvement' initiatives. When PIs have performance targets associated with them, they are known as key performance indicators (KPIs).

GM1 to AMC2 ATM/ANS.OR.B.005(a)(3) Management system
SAFETY SURVEYS — COMPLEX AIR TRAFFIC SERVICES PROVIDERS

(a) An air traffic services provider should:

(1) initiate safety surveys and ensure that all safety-related activities within its scope are addressed periodically;

(2) appoint an appropriate survey leader and survey team whose expertise is in accordance with the particular requirements of the intended survey, taking due account of the desirability of including staff from outside areas where relevant, and mindful of the opportunity such an activity provides for staff development and engagement;

(3) define an annual safety survey plan;

(4) take immediate remedial action as soon as any safety-related shortcomings are identified;

(5) ensure that the actions identified in the action plans are carried out within the specified timescales; and

(6) ensure that examples of lesson learning and good practice arising from safety surveys are disseminated and acted upon.

(b) The survey leader should:

(1) carry out the survey;

(2) record the results;

(3) make recommendations; and

(4) agree actions with the relevant operational management.

(c) The survey team should assist the survey leader in completing their responsibilities as determined by the survey leader.

(d) Safety surveys may be initiated by a number of means such as occurrence reports, safety performance, suggestions from members of staff, etc.

(e) Safety surveys may be documented in a safety survey report which should also contain the specific actions that will be taken to address the recommendations. The actions should specify those responsible for completion and the target dates. The actions should be tracked to closure through an action plan. This action plan may be implemented as part of an existing locally or centrally managed action tracker.

(f) A typical safety survey report would require the following content:

(1) Front sheet:

(i) reference number;

(ii) title;

(iii) survey period;

(iv) team members and team leader; and

(v) survey initiator;

(2) Survey description:

(i) introduction;

(ii) objective;

(iii) scope;

(iv) record of results;

(v) conclusions; and

(vi) recommendations and actions.

(g) Survey leader

The survey leader should be adequately trained and competent for the subject of the survey. Where this is not possible, at least one member of the survey team should be competent in the subject of the survey.

(h) Survey team

It is advantageous for the survey team to be multi-disciplined and, where possible, be drawn from differing parts of the air traffic services provider's organisation.

AMC1 ATM/ANS.OR.B.005(a)(7) Management system
ASSESSMENT OF THE MANAGEMENT SYSTEM

(a) Senior management should assess the service provider's management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness.

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(b) The review should include assessing opportunities for improvement and the need for changes to the management system, including the policy and objectives.

(c) Records from management assessments should be maintained.

AMC1 ATM/ANS.OR.B.005(a)(8) Management system
TRAINING AND COMPETENCY

A service provider should:

(a) determine the necessary competence for personnel performing activities supporting services provision;

(b) where applicable, provide training or take other actions to achieve the necessary competence;

(c) evaluate the effectiveness of the actions taken;

(d) ensure that personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives; and

(e) maintain appropriate records of education, training, skills and experience.

AMC1 ATM/ANS.OR.B.005(a)(9) Management system
COMMUNICATION RESPONSIBILITIES

Senior management should ensure that appropriate communication processes are established within the service provider and that communication takes place regarding the effectiveness of the management system.

AMC1 ATM/ANS.OR.B.005(b) Management system
SERVICE PROVIDER'S MANAGEMENT SYSTEM DOCUMENTATION

A service provider's management system documentation should at least include the following information:

(a) a statement signed by the accountable manager to confirm that the service provider will continuously work in accordance with the applicable requirements and the service provider's documentation as required by this Part and other applicable Parts;

(b) the service provider's scope of activities;

(c) the titles and names of nominated post holders referred to in ATM/ANS.OR.B.020(b);

(d) the service provider's chart showing the lines of responsibility between the persons referred to in ATM/ANS.OR.B.020(b);

(e) a general description and location of the facilities referred to in ATM/ANS.OR.B.025;

(f) procedures describing the function and specifying how the service provider monitors and ensures compliance with the applicable requirements referred to in ATM/ANS.OR.B.005(c); and

(g) the amendment procedure for the service provider's management system documentation.

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GM1 ATM/ANS.OR.B.005(b) Management system
SERVICE PROVIDER'S MANAGEMENT SYSTEM DOCUMENTATION

(a) It is not required to duplicate information in several manuals. The information may be contained in the service provider's manuals (e.g. operations manual, training manual), which may also be combined.

(b) A service provider may also choose to document some of the information required to be documented in separate documents (e.g. procedures). In this case, it should ensure that manuals contain adequate references to any document kept separately. Any such documents are then to be considered an integral part of the service provider's management system documentation.

(c) A service provider's management system documentation may be included in a separate manual or in (one of) the manual(s) as required by the applicable subpart(s). A cross reference should be included.

AMC1 ATM/ANS.OR.B.005(c) Management system
COMPLIANCE MONITORING — GENERAL FOR COMPLEX SERVICE PROVIDERS

(a) Compliance monitoring

The implementation and use of a compliance monitoring function should enable the service provider to monitor compliance with the relevant requirements of this Part and other applicable Parts.

(1) A service provider should specify the basic structure of the compliance monitoring function applicable to the activities conducted.

(2) The compliance monitoring function should be structured according to the size of the service provider and the complexity of the activities to be monitored, including those which have been subcontracted.

(b) A service provider should monitor compliance with the procedures they have designed to ensure that services are provided with the required safety levels and quality, as applicable. In doing so, they should as a minimum, and where appropriate, monitor:

(1) manuals, logs, and records;

(2) training standards; and

(3) management system procedures.

(c) Organisational set-up

(1) A person should be responsible for compliance monitoring to ensure that the service provider continues to meet the requirements of this Part and other applicable Parts. The accountable manager should ensure that sufficient resources are allocated for compliance monitoring.

(2) Personnel involved in the compliance monitoring should have access to all parts of service provider and, as necessary, any contracted organisation.

(3) In the case the person responsible for compliance monitoring acts also as safety manager, the accountable manager, with regard to his or her direct accountability for safety, should ensure that sufficient resources are allocated to both functions, taking into account the size of the service provider and the nature and complexity of its activities.

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(4) The independence of the compliance monitoring function should be established by ensuring that audits and inspections are carried out by personnel not directly involved in the activity being audited.

(d) Compliance monitoring documentation

(1) Relevant documentation should include relevant part(s) of the service provider's management system documentation.

(2) In addition, relevant documentation should also include:

(i) terminology;

(ii) specified activity standards;

(iii) a description of the service provider;

(iv) allocation of duties and responsibilities;

(v) procedures to ensure compliance;

(vi) the compliance monitoring programme, reflecting:

(A) the schedule of the monitoring programme;

(B) audit procedures;

(C) reporting procedures;

(D) follow-up and corrective action procedures; and

(E) the record keeping system;

(vii) the training syllabus referred to in (e)(2); and

(viii) document control.

(e) Training

(1) Correct and thorough training is essential to optimise compliance in every service provider. In order to achieve significant outcomes of such training, the service provider should ensure that all personnel understand the objectives as laid down in the service provider's management system documentation.

(2) Those responsible for managing the compliance monitoring function should receive training on this task. Such training should cover the requirements of compliance monitoring, manuals and procedures related to the task, audit techniques, reporting and recording.

(3) Time should be provided to train all personnel involved in compliance management and for briefing the remainder of the personnel.

(4) The allocation of time and resources should be governed by the volume and complexity of the activities concerned.

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GM1 ATM/ANS.OR.B.005(c) Management system
COMPLIANCE MONITORING ORGANISATIONAL SET-UP

(a) The role of the compliance monitoring may be performed by a compliance monitoring manager to ensure that the activities of the service provider are monitored for compliance with the applicable regulatory requirements and any additional requirements established by the service provider, and that these activities are being carried out properly under the supervision of other relevant nominated post holders and line managers.

(b) The compliance monitoring manager should:

(1) be responsible for ensuring that the compliance monitoring programme is properly implemented, maintained, and continually reviewed and improved;

(2) have direct access to the accountable manager;

(3) not be one of the line managers; and

(4) be able to demonstrate relevant knowledge, background and appropriate experience related to the activities of the service provider, including knowledge and experience in compliance monitoring.

(c) The compliance monitoring manager may perform all audits and inspections himself/herself or appoint one or more auditors by choosing personnel having the related competence as defined in point (b)(iii), either from within or outside the service provider.

(d) Regardless of the option chosen, it needs to be ensured that the independence of the audit function is not affected, in particular in cases where those performing the audit or inspection are also responsible for other activities within the service provider.

(e) In case external personnel are used to perform compliance audits or inspections:

(i) any such audits or inspections are performed under the responsibility of the compliance monitoring manager; and

(ii) the compliance monitoring manager remains responsible for ensuring that the external personnel has relevant knowledge, background and experience as appropriate to the activities being audited or inspected, including knowledge and experience in compliance monitoring.

(f) A service provider retains the ultimate responsibility for the effectiveness of the compliance monitoring function, in particular for the effective implementation and follow-up of all corrective actions.

AMC1 ATM/ANS.OR.B.005(e) Management system
SIZE, NATURE AND COMPLEXITY OF THE ACTIVITY

(a) An air traffic services provider should be considered as complex unless it is eligible to apply for a limited certificate and fulfils the criteria set out in ATM/ANS.OR.A.010(a).

(b) An air navigation services provider, other than an air traffic services provider, should be considered as complex unless it is eligible to apply for a limited certificate and fulfils the criteria set out in ATM/ANS.OR.A.010(b)(1).

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(c) An aerodrome flight information services provider should be considered as complex unless it is eligible to apply for a limited certificate and fulfils the criteria set out in ATM/ANS.OR.010(b)(2).

(d) A service provider, other than an air navigation services provider, should be considered as complex when it has a workforce of more than 20 full-time equivalents (FTEs) involved in the activity subject to Regulation (EC) No 216/2008 and its Implementing Rules.

GM1 ATM/ANS.OR.B.005(e) Management system.
SIZE, NATURE AND COMPLEXITY OF THE ACTIVITY

(a) In consideration of the EUR 1 000 000 gross annual turnover referred to in ATM/ANS.OR.A.010(b)(1), this is assessed against the income the air navigation services provider generates in the provision of the services specified in Annex Vb to Regulation (EC) No 216/2008 and does not include any income generated by the air navigation services provider who undertakes other commercial activity that generates income.

(b) In consideration of operating regularly not more than one working position at any aerodrome referred to in ATM/ANS.OR.A.010(b)(2), this means that for the majority (i.e. greater than 50 %) of time an aerodrome is operational, only one working position is used.

(c) Table 3 below illustrates the circumstances under which the service provider could be considered as non-complex.

Type of service	Criteria to be complied with
Air traffic services	Eligible for limited certificate and meets criteria in ATM/ANS.OR.A.010(a)
CNS/MET/AIS	Eligible for limited certificate and meets criteria in ATM/ANS.OR.A.010(b)(1)
AFIS	Eligible for limited certificate and meets criteria in ATM/ANS.OR.A.010(b)(2)
ASM/ATFM/ DAT	Workforce of 20 or less FTEs per service

Table 3: Non-complex service provider

GM1 ATM/ANS.OR.B.005(f) Management system
GENERAL

Within the scope of this Regulation, only the air traffic services providers can identify hazards, assess the associated risks and mitigate or propose mitigating measures where necessary. This requirement implies that all service providers (air traffic services and non-air traffic services) establish formal interfaces (e.g. service level agreements, letters of understanding, memorandum of cooperation) between the relevant services providers themselves or between the service providers and other aviation undertakings (e.g. aerodrome operators) so as to ensure that hazards associated with the use of the services they provide are identified and the risks assessed and whenever needed mitigated. It does not imply that this has to be done by the service providers themselves (e.g. MET or AIS providers cannot do this by themselves) as only the air traffic services provider can, but they need to establish the interfaces with those service providers (ATS

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providers) or other aviation undertaking (e.g. aerodrome operators) who are able to do so. The formal interfaces could address the mitigation means put on the different providers (e.g. via requirements in a service level agreement).

GM1 ATM/ANS.OR.B.005(f) Management system
LOCAL RUNWAY SAFETY TEAM

The service provider should participate in the local runway safety team (LRST) established by the aerodrome operator in accordance with AMC1 ADR.OR.D.027 and GM2 ADR.OR.D.027.

AMC1 ATM/ANS.OR.B.015 Contracted activities
RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

(a) A contract should exist between the service provider and the contracted organisation clearly defining the contracted activities and the applicable requirements.

(b) The contracted activities should be included in the service provider's oversight process.

(c) A service provider should ensure that the contracted organisation has the necessary authorisation, declaration or approval when required, and commands the resources and competence to undertake the task.

AMC2 ATM/ANS.OR.B.015 Contracted activities
RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

(a) When the contracted organisation is certified itself to carry out the contracted activities, the service providers' compliance monitoring should at least check that the approval effectively covers the contracted activities and that it is still valid.

(b) When the service provider is not certified itself to provide the service, it should only contract or purchase services from a certified organisation when so required by this Regulation.

AMC3 ATM/ANS.OR.B.015 Contracted activities — ATS providers
SAFETY

An air traffic services provider should ensure adequate justification of the safety of the externally provided and supplied services, having regard to their safety significance within the provision of its services.

GM1 ATM/ANS.OR.B.015 Contracted activities
CONTRACTING — GENERAL

(a) A service provider may contract certain activities to external organisations. 'Contracted activities' means those activities within the service provisions conditions attached to the certificate that are performed by other organisations either themselves certified to carry out such an activity or if not certified, working under the service provider's approval and oversight.

(b) Activities contracted to external organisations for the provision of services may include areas such as:

(1) aeronautical information services;

(2) meteorological services, etc.

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(c) Non-service activities contracted to external organisations may include the maintenance of systems and equipment.

(d) In the case of activities contracted, the service provider should define relevant management responsibilities within its own organisation.

(e) The ultimate responsibility for the services provided by contracted organisations should always remain with the contracting service provider.

GM2 ATM/ANS.OR.B.015 Contracted activities
RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

(a) A contract could take the form of a written agreement, Letter of Agreement, Service Letter agreement, Memorandum of Understanding, etc. as appropriate for the contracted activities.

(b) A service provider's assurance process could be included into the service provider's management system and compliance monitoring programmes.

(c) In order to ensure that the contracted organisation is able to perform the contracted activities, the service provider may conduct a prior audit of the contracted party.

GM3 ATM/ANS.OR.B.015 Contracted activities
RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

(a) Regardless of the approval status of the contracted organisation, the service provider is responsible for ensuring that all contracted activities are subject to compliance monitoring as required by ATM/ANS.OR.B.005(c), and in the case of air traffic services provider, also to hazard identification and risk management as required by ATS.OR.200(a)(2).

(b) If a service provider requires a contracted organisation to conduct an activity which exceeds the privileges of the contracted organisation's certificate, this will be considered as the contracted organisation working under the approval and oversight of the contracting service provider.

GM4 ATM/ANS.OR.B.015 Contracted activities
RESPONSIBILITY WHEN CONTRACTING ACTIVITIES

Table 4 below illustrates the responsibilities when contracting.

	Contracted Activity subject to certification and contracting service provider certified for the activity	**Contracted Activity subject to certification and contracting service provider NOT certified for the activity**
Contracted external organisation certified to provide the activity	A contracting service provider undertakes compliance monitoring of the contracted external organisation and should at least check that the certificate effectively covers the contracted activities and that it is valid.	A contracting service provider undertakes compliance monitoring of the contracted external organisation and should at least check that the certificate effectively covers the contracted activities and that it is valid.
Contracted	The contracted external	The activity cannot be contracted

external organisation NOT certified to provide the activity	organisation works under the approval and oversight of the contracting service provider.	to the external organisation.

Table 4: Responsibilities when contracting

GM1 ATM/ANS.OR.B.020(a) Personnel requirements
ACCOUNTABLE MANAGER

Depending on the size, structure and complexity of the organisation, the accountable manager may be:

(a) the chief executive officer (CEO);

(b) the chief operating officer (COO);

(c) the chairperson of the board of directors;

(d) a partner; or

(e) the proprietor.

AMC1 ATM/ANS.OR.B.020(b) Personnel requirements
GENERAL

Senior management should appoint a member of the service provider's management who, irrespective of other responsibilities, should have responsibility and authority that includes:

(a) ensuring that processes needed for the management system are established, implemented and maintained;

(b) reporting to senior management on the performance of the management system and any need for improvement; and

(c) ensuring the promotion of awareness of performance and service requirements throughout the service provider and of the impact it has on safety.

GM1 ATM/ANS.OR.B.025(b) Personnel requirements
COMBINATION OF NOMINATED POST HOLDERS RESPONSIBILITIES

(a) The acceptability of a single person holding more than one post, possibly in combination with being the accountable manager, should depend upon the service provider's organisation and the complexity of its activities. The two main areas of concern should be competence and an individual's capacity to meet his/her responsibilities.

(b) As regards competence in different areas of responsibility, there should not be any difference from the requirements applicable to persons holding only one post.

(c) The capacity of an individual to meet his/her responsibilities should primarily be dependent upon the complexity of the service provider's organisation and its activities. However, the complexity of the service provider's organisation or of its activities may prevent or limit the combination of posts.

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AMC1 ATM/ANS.OR.B.030 Record keeping
GENERAL

(a) The record keeping system should ensure that all the records required in ATM/ANS.OR.B.030(a) are accessible whenever needed. These records should be organised in a way that ensures traceability and retrieval throughout the retention period.

(b) Records should be kept in paper form or in electronic format or a combination of both. Records stored on microfilm or optical disc format are also acceptable. The records should remain legible throughout the required retention period. The retention period starts when a record has been created or last amended.

(c) Paper systems should use robust material which can withstand normal handling and filing.

(d) Computer systems should have at least one backup system which should be updated within 24 hours of any new entry. Computer systems should include safeguards against the ability of unauthorised personnel to alter the data.

(e) All computer hardware used to ensure data backup should be stored in a different location from that containing the working data and in an environment that ensures they remain in good condition. When hardware or software changes take place, special care should be taken that all necessary data continues to be accessible at least through the full retention period.

GM1 ATM/ANS.OR.B.035 Record keeping
GENERAL

The record keeping provision is intended to address the management system records rather than operational data which are covered by other record keeping applicable requirements.

AMC1 ATM/ANS.OR.B.030(b) Record keeping
RETENTION PERIOD

The records should be kept for a minimum period of at least 5 years unless otherwise specified by the competent authority.

SUBPART D — SPECIFIC ORGANISATIONAL REQUIREMENTS FOR ANS AND ATFM PROVIDERS AND THE NETWORK MANAGER (ATM/ANS.OR.D)

GM1 ATM/ANS.OR.D.010(d) Security management
INFORMATION SECURITY THREAT

Information security threat may be any circumstance or event with the potential to adversely impact the operation, systems and/or constituents due to human action (accidental, casual or purposeful, intentional or unintentional, mistaken) resulting from unauthorised access, use, disclosure, denial, disruption, modification, or destruction of information and/or information system interfaces. This should include malware and the effects of external systems on dependent systems, but does not include physical threats.

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ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL TO ANNEX III — SPECIFIC REQUIREMENTS FOR THE PROVISION OF AIR TRAFFIC SERVICES (PART-ATS)

SUBPART A — ADDITIONAL ORGANISATION REQUIREMENTS FOR THE PROVISION OF AIR TRAFFIC SERVICES (ATS.OR)

Section 2 — Safety of services

AMC1 ATS.OR.200 Safety management system
GENERAL — NON-COMPLEX ATS PROVIDERS

(a) The safety policy should include a commitment to improve towards the highest safety standards, comply with all the applicable legal requirements, meet all the applicable standards, consider the best practices and provide the appropriate resources.

(b) The safety policy should state the air traffic services provider's intention to maintain and, where practicable, improve safety levels in all their activities and to minimise their contribution to the risk of an aircraft accident as far as is reasonably practicable.

(c) In cooperation with other stakeholders, the air traffic services provider should develop, coordinate and maintain an emergency response plan that ensures orderly and safe transition from normal to emergency operations and return to normal operations. The ERP should determine the actions to be taken by the air traffic services provider or specified individuals in an emergency and reflect the size, nature and complexity of the activities performed by the air traffic services provider.

(d) Safety risk management may be performed using hazard checklists or similar risk management tools or processes, which are integrated into the activities of the air traffic services provider.

(e) An air traffic services provider should manage safety risks related to changes. Management of changes should be a documented process to identify external and internal changes that may have an adverse effect on safety. It should make use of the air traffic services provider's existing hazard identification, risk assessment and mitigation processes.

(f) An air traffic services provider should identify persons who fulfil the role of safety managers and who are responsible for coordinating the safety management system. These persons may be accountable managers or individuals with an operational role in the air traffic services provider.

(g) Within the air traffic services provider, responsibilities should be identified for hazard identification, risk assessment and mitigation.

AMC1 ATS.OR.200(a)(1)(i) Safety management system
SAFETY POLICY — COMPLEX ATS PROVIDERS

(a) The safety policy should:

(1) be signed by the accountable manager;

(2) reflect organisational commitments regarding safety and its proactive and systematic management;

(3) be communicated, with visible endorsement, throughout the air traffic services provider; and

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(4) include safety reporting principles.

(b) The safety policy should:

(1) include a commitment:

(i) to improve towards the highest safety standards;

(ii) to comply with all the applicable legal requirements, meet all the applicable standards and consider the best practices;

(iii) to provide appropriate resources; and

(iv) to enforce safety as one primary responsibility of all managers and staff;

(2) include the safety reporting procedures;

(3) clearly indicate which types of operational behaviours are unacceptable, and include the conditions under which disciplinary action would not apply; and

(4) be periodically reviewed to ensure it remains relevant and appropriate.

(c) The safety policy should state the air traffic services provider's intention to maintain and, where practicable, improve safety levels in all their activities and to minimise their contribution to the risk of an aircraft accident as far as is reasonably practicable.

(d) Senior management should:

(1) continually promote the safety policy to all personnel and demonstrate their commitment to it;

(2) provide necessary human and financial resources for its implementation; and

(3) establish safety objectives and performance standards.

GM1 ATS.OR.200(a)(1)(i) Safety management system
SAFETY POLICY — COMPLEX ATS PROVIDERS

Operational behaviour, when disciplinary action would not apply, could be where someone is not blamed for reporting something which would not have been otherwise detected.

GM2 ATS.OR.200(a)(1)(i) Safety management system.
SAFETY POLICY — COMPLEX ATS PROVIDERS

(a) The safety policy should state that the purpose of safety reporting and internal investigations is to improve safety, not to apportion blame to individuals.

(b) An air traffic services provider may combine the safety policy with the policy required by ATM/ANS.OR.B.005(a)(2).

GM2 ATS.OR.200(a)(1)(i) Safety management system
SAFETY POLICY — NON-COMPLEX ATS PROVIDERS

(a) The safety policy should state that the purpose of safety reporting is to improve safety, not to apportion blame to individuals.

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(b) An air traffic services provider may combine the safety policy with the policy required by ATM/ANS.OR.B.005(a)(2).

AMC1 ATS.OR.200(a)(1)(ii) Safety management system
ACCOUNTABILITIES — COMPLEX ATS PROVIDERS

The safety management system of the air traffic services provider should ensure that everyone involved in the safety aspects of the provision of air traffic services has an individual safety responsibility for their own actions; that managers should be responsible for the safety performance of their respective departments or divisions and that the top management of the provider carries an overall safety responsibility.

AMC1 ATS.OR.200(a)(1)(ii);(iii) Safety management system
ORGANISATION AND ACCOUNTABILITIES — COMPLEX ATS PROVIDERS

The safety management system of the air traffic services provider should encompass safety by including a safety manager and a safety review board in the organisational structure.

(a) Safety manager

(1) The safety manager should act as the focal point and be responsible for the development, administration and maintenance of an effective safety management system. He/she should be independent of line management, and accountable directly to the highest organisational level.

(2) The role of the safety manager should, as a minimum, be to:

(i) ensure that hazard identification, risk analysis and management are undertaken in accordance with the safety management system processes;

(ii) monitor the implementation of actions taken to mitigate risks;

(iii) provide periodic reports on safety performance;

(iv) ensure maintenance of safety management documentation;

(v) ensure that there is safety management training available and that it meets acceptable standards;

(vi) provide advice on safety matters; and

(vii) monitor initiation and follow-up of internal occurrence/accident investigations.

(3) The safety manager should have:

(i) adequate practical experience and expertise in air traffic services or a similar area;

(ii) adequate knowledge of safety and quality management;

(iii) adequate knowledge of the working methods and operating procedures; and

(iv) comprehensive knowledge of the applicable requirements in the area of air traffic services.

(b) Safety review board

(1) The safety review board should be a high-level committee that considers matters of strategic safety in support of the accountable manager’s safety accountability.

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(2) The board should be chaired by the accountable manager and composed of heads of functional areas.

(3) The safety review board should, as a minimum:

(i) monitor safety performance against safety policy and objectives;

(ii) ensure that any safety action is taken in a timely manner; and

(iii) monitor the effectiveness of the air traffic services provider's safety management system processes.

(4) The safety review board should ensure that appropriate resources are allocated to achieve the planned safety performance.

(5) The safety manager or any other relevant person may attend, as appropriate, safety review board meetings. He or she may communicate to the accountable manager all information, as necessary, to allow decision-making based on safety data.

GM1 ATS.OR.205(a)(1)(ii) Safety management system
SAFETY ACTION GROUP — COMPLEX ATS PROVIDERS

(a) A safety action group may be established as a standing group or as an ad hoc group to assist or act on behalf of the safety review board.

(b) More than one safety action group may be established depending on the scope of the task and the specific expertise required.

(c) The safety action group should report to and take strategic direction from the safety review board and should comprise managers, supervisors and personnel from operational areas.

(d) The safety action group should:

(1) monitor operational safety;

(2) resolve identified risks;

(3) assess the impact on safety of operational changes; and

(4) ensure that safety actions are implemented within agreed timescales.

(e) The safety action group should review the effectiveness of previous safety recommendations and safety promotion.

GM1 to GM1 ATS.OR.205(a)(1)(ii) Safety management system
SAFETY ACTION GROUP — COMPLEX ATS PROVIDERS

Members of the safety action group should participate in the Local Runway Safety Team as per GM2 ADR.OR.D.027 'Safety programmes'.

GM1 ATS.OR.200(a)(1)(iii) Safety management system
SAFETY MANAGER — COMPLEX ATS PROVIDERS

(a) Depending on the size of the air traffic services provider and the nature and complexity of their activities, the safety manager may be assisted by additional safety personnel in the performance of all the safety management-related tasks.

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(b) Regardless of the organisational set-up, it is important that the safety manager remains the unique focal point as regards the development, administration and maintenance of the air traffic services provider's safety management system.

GM2 ATS.OR.200(a)(1)(iii) Safety management system
SAFETY MANAGER — NON-COMPLEX AIR TRAFFIC SERVICES PROVIDERS

In the case of a non-complex air traffic services provider, the function of the safety manager could be combined with another function within the organisation provided that sufficient independence is guaranteed.

AMC1 ATS.OR.200(a)(1)(iv) Safety management system
COORDINATION OF EMERGENCY RESPONSE PLANNING FOR ATS PROVIDERS — COMPLEX ATS PROVIDERS

(a) An air traffic services provider should develop, coordinate and maintain a plan for its response to an emergency. It should:

(1) reflect the nature and complexity of the activities performed by the air traffic services provider;

(2) ensure an orderly and safe transition from normal to emergency operations;

(3) ensure safe continuation of operations or return to normal operations as soon as practicable; and

(4) ensure coordination with the emergency response plans of other organisations, where appropriate.

(b) For emergencies occurring at the aerodrome or in its surroundings, the plan should be aligned with the aerodrome emergency response plan and be coordinated with the aerodrome operator.

GM1 ATS.OR.200(a)(1)(iv) Safety management system
TYPES OF EMERGENCIES

At least the following types of emergencies may be considered:

(a) aircraft emergencies;

(b) natural phenomena (e.g. extreme weather conditions);

(c) acts of terrorism;

(d) loss of the ability to communicate with the aircraft; and

(e) loss of the air traffic services unit.

GM2 ATS.OR.200(a)(1)(iv) Safety management system
COORDINATION OF THE EMERGENCY RESPONSE PLANNING (ERP) FOR ATS PROVIDERS — COMPLEX ATS PROVIDERS

For aerodrome-related emergencies, please refer to GM4 ADR.OPS.B.005(a) 'Aerodrome Emergency Planning'.

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AMC1 ATS.OR.200(a)(1)(v) Safety management system
SAFETY MANAGEMENT MANUAL (SMM) — COMPLEX ATS PROVIDERS

The safety management manual should be the key instrument for communicating the approach to safety for the air traffic services provider. The safety management manual (SMM) should document all aspects of safety management, including but not limited to the:

(a) scope of the safety management system;

(b) safety policy and objectives;

(c) safety accountability of the accountable manager;

(d) safety responsibilities of key safety personnel;

(e) documentation control procedures;

(f) hazard identification and safety risk management schemes;

(g) safety performance monitoring;

(h) incident investigation and reporting;

(i) emergency response planning;

(j) management of change (including organisational changes with regard to safety responsibilities and changes to functional systems); and

(k) safety promotion.

AMC2 ATS.OR.200(a)(1)(v) Safety management system
SAFETY RECORDS — COMPLEX ATS PROVIDERS

Safety records that should be maintained and retained include but are not limited to:

(a) certificates;

(b) limited certificates;

(c) declarations;

(d) safety policy;

(e) safety accountabilities/responsibilities;

(f) safety occurrences;

(g) emergency response plan;

(h) SMS documentation;

(i) training and competence;

(j) occurrence reports;

(k) safety risk assessments including safety assessment of changes to the functional system;

(l) determination of either complex or non-complex organisation; and

(m) approved alternative means of compliance.

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GM1 ATS.OR.200(a)(1)(v) Safety management system
SAFETY MANAGEMENT MANUAL (SMM) — COMPLEX ATS PROVIDERS

The SMM may be contained in (one of) the manual(s) of the air traffic services provider.

AMC1 ATS.OR.200(a)(2)(ii) Safety management system — ATC service provider
INCLUSION OF HUMAN FACTORS IN THE SAFETY MANAGEMENT SYSTEM

The air traffic control service provider should ensure that any operational risk arising from air traffic controllers' stress, fatigue and problematic use of psychoactive substances is managed by its safety management system.

GM1 ATS.OR.200(a)(3)(i) Safety management system
SAFETY ASSURANCE — COMPLEX ATS PROVIDERS

(a) Leading indicators

(1) Metrics that measure inputs to the safety system (either within an organisation, a sector or across the total aviation system) to manage and improve safety performance.

(2) Leading indicators measure the specific features of the aviation safety system designed to support continuous improvement and to give an indication of likely future safety performance. They are designed to help identify whether the providers and regulators are taking actions and/or have processes in place that are effective in lowering the risk.

(b) Lagging indicators

Metrics that measure the outcome of the service delivery by measuring events that have already occurred and that impact safety performance. There are two subsets of lagging indicators:

(1) Outcome Indicators: These include only the occurrences that one aims to prevent, for example fatal or catastrophic accidents. Depending on the system, the severity of the occurrences that are included as outcome indicators can be adjusted to include all accidents and serious incidents.

(2) Precursor Indicators: These indicators do not manifest themselves in accidents or serious incidents. They indicate less severe system failures or 'near misses', and are used to assess how frequently the system comes close to severe failure. Because they are typically more numerous than outcome indicators, they can be used for trend monitoring.

(c) Safety management system

In the case of a complex air traffic services provider, SMS should include all of these measures. Risk management efforts, however, should be targeted at leading indicators and precursor events. The reason for doing this is to reduce the number of accidents and serious incidents.

(d) Differing levels of safety performance monitoring

(1) Measurements of safety in terms of undesirable events, such as accidents and incidents, are examples of 'lagging indicators', which can capture safety performance a posteriori. Such indicators give valuable signals to all involved in air traffic services — providers, regulators, and recipients — of the levels of safety being experienced and of the ability of the organisations concerned to take appropriate mitigation action.

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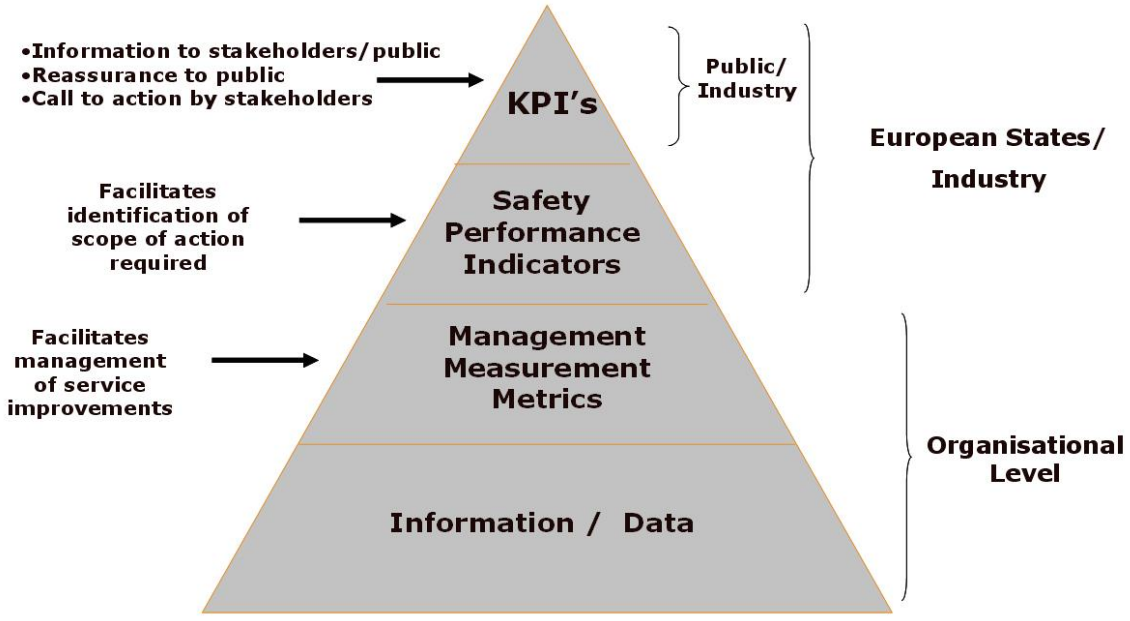
However, other types of measurement — 'leading indicators' — can give a wider perspective of the safety 'health' of the functional system, and focus on systemic issues, such as safety maturity and SMS performance.

(2) A holistic approach to performance monitoring is an essential input to decision-making with regard to safety. It is important to ensure that good safety performance is attributable to good performance of the safety management system, not simply to lack of incidents or accidents. It is also essential that the metrics chosen match the requirements of the stakeholders and decision-makers involved in safety improvement.

(3) As shown in the diagram, stakeholders in the wider aviation industry and the general public require relatively small numbers of safety indicators (safety performance indicators or key performance indicators) which can give an instant 'feel' for the overall position regarding safety performance. Conversely, those involved in the management of services concerned need a more detailed set of metrics on which to base decisions regarding the management of the services and facilities being reviewed.



Monitoring Metrics

AMC1 ATS.OR.200(a)(3)(iii) Safety management system
CONTINUOUS IMPROVEMENT OF THE SMS — COMPLEX ATS PROVIDERS

An air traffic services provider should continuously improve the effectiveness of its SMS by:

(a) developing and maintaining a formal process to identify the causes of substandard performance of the SMS;

(b) establishing (a) mechanism(s) to determine the implications of substandard performance of the SMS;

(c) establishing one or more mechanisms to eliminate or mitigate the causes of substandard performance of the SMS; and

(d) developing and maintaining a process for the proactive evaluation of facilities, equipment, documentation, processes and procedures (through internal audits, surveys, etc.).

GM1 ATS.OR.200(a)(3)(iii) Safety management system

CONTINUOUS IMPROVEMENT OF THE SMS — COMPLEX ATS PROVIDERS

(a) Substandard performance of the SMS can manifest itself in two ways. Firstly, where the SMS processes themselves do not fit their purpose (e.g. through not adequately enabling the air traffic services provider to identify, manage and mitigate hazards and their associated risks) resulting in the safety performance of the service being impacted in a negative way. Secondly, where the SMS processes fit their purpose, but are not applied correctly or adequately by the personnel whose safety accountabilities and responsibilities are discharged through the application of the SMS. Personnel who have safety accountabilities and responsibilities are considered an essential part of the effectiveness of the SMS and viewed as part of the SMS.

(b) Therefore, by detecting substandard performance of the SMS, the air traffic services provider can take action to improve the SMS processes themselves or to improve the application of the SMS processes by those with safety accountabilities and responsibilities resulting in an improvement to the safety performance.

(c) Continuous improvement of the effectiveness of the safety management processes can be achieved through:

(1) proactive and reactive evaluations of facilities, equipment, documentation, processes and procedures through safety audits and surveys; and

(2) reactive evaluations in order to verify the effectiveness of the system for control and mitigation of risks.

(d) In the same way that continuous improvement is sought through safety performance monitoring and measurement (see GM1 ATM/ANS.OR.B.005(a)(3) and GM1 ATS.OR.200(a)(3)(i)) by the use of leading and lagging indicators, continuous improvement of the SMS provides the air traffic services provider with safety assurance for the service.

(e) As with safety performance monitoring, the continuous improvement of the SMS lends itself to a process that can be summarised as:

(1) Identify where there are potential weaknesses or opportunities for improvement;

(2) Identify what goes right and disseminate as best practice;

(3) Identify what can be done to tackle weaknesses or lead to improvement;

(4) Set performance standards for the actions identified;

(5) Monitor performance against the standards;

(6) Take corrective actions to improve performance; and

(7) Repeat the process by using the continuous improvement model below:

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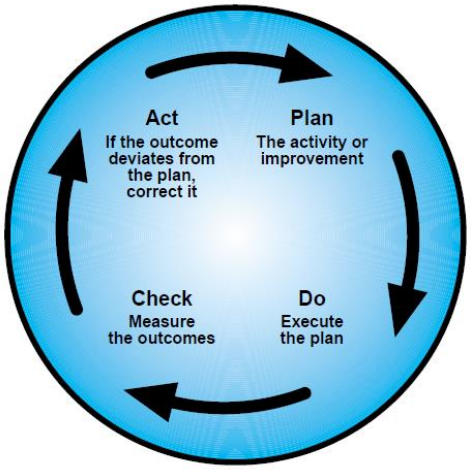

(f) Taking into account that SMS is being required to manage safety, it can be assumed that by continuously improving the effectiveness of the SMS, ATS providers should be able to better manage and mitigate, and ultimately control the safety risks associated with the provisions of their services.

GM1 ATS.OR.200(a)(4)(i) Safety management system.
TRAINING — COMPLEX ATS PROVIDERS

(a) Training

(1) All personnel should receive safety training as appropriate for their safety responsibilities.

(2) Adequate records of all safety training provided should be kept.

(b) Communication

(1) The ATS provider should establish communication about safety matters that:

(a) ensures that all personnel are aware of the safety management activities as appropriate for their safety responsibilities;

(b) conveys critical information, especially relating to assessed risks and analysed hazards;

(c) explains why particular actions are taken; and

(d) explains why safety procedures are introduced or changed.

(2) Regular meetings with personnel where information, actions and procedures are discussed, may be used to communicate safety matters.

(c) The safety training programme may consist of self-instruction via a medium (newsletters, flight safety magazines), classroom training, e-learning or similar training provided by training organisations.

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Section 3 — Specific human factors requirements for air traffic control service providers

AMC1 ATS.OR.305(a) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers
POLICY AND PROCEDURES

Within the context of the policy, the air traffic control service providers should:

(a) provide training and/or educational material to air traffic controllers relating to:

(1) the effects of psychoactive substances on individuals and subsequently on air traffic control service provision;

(2) established procedures within its organisation regarding this issue; and

(3) their individual responsibilities with regard to legislation and policies on psychoactive substances.

(b) make available appropriate support for air traffic controllers who are dependent on psychoactive substances;

(c) encourage air traffic controllers who think that they may have such a problem to seek and accept help made available by their air traffic control service provider;

(d) ensure that air traffic controllers are treated in a consistent, just and equitable manner as regards the problematic use of psychoactive substances.

GM1 ATS.OR.305(a) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers
POLICY

(a) Guidance for the development and implementation of the policy is contained in ICAO Doc 9654 'Manual on Prevention of Problematic Use of Substances in the Aviation Workplace', First Edition - 1995, and in particular:

(1) Attachment A (pages 27-34) as regards elements for the definition and the implementation of policy and programme;

(2) Chapter 3 (pages 9-12) as regards the identification, treatment, and rehabilitation of staff, with related supporting material, available in attachment C (pages 61-68); and

(3) Attachment D (pages 69-75) as regards the employment consequences of problematic use of substances.

TRAINING AND EDUCATION PROGRAMMES

(b) Guidance for the development and implementation of training and education programmes is contained in ICAO Doc 9654 'Manual on Prevention of Problematic Use of Substances in the Aviation Workplace', First Edition - 1995, in particular:

(1) Chapter 2 (pages 6-7) as regards the education of the workforce and educational material, with related supporting material available in Attachment A (page 35-48); and

(2) Attachment B (pages 49-59) and Attachment F (pages 87-94), where extracts from the ICAO Manual of Civil Aviation Medicine are reported.

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GM2 ATS.OR.305(a) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers

The air traffic control service provider may employ third-party assistance. Such assistance should be made freely available to air traffic controllers who are dependent on psychoactive substances.

AMC1 ATS.OR.305(b) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers
PROCEDURE FOR THE DETECTION OF CASES OF PROBLEMATIC USE OF PSYCHOACTIVE SUBSTANCES

The objective, transparent and non-discriminatory procedure should specify:

(a) the mechanisms and responsibilities for its initiation;

(b) its applicability in terms of timing and locations;

(c) the person(s)/body responsible for testing the individual;

(d) the testing process;

(e) thresholds for psychoactive substances;

(f) the process to be followed in case of detection of problematic use of psychoactive substances by an air traffic controller; and

(g) the appeal process.

GM1 ATS.OR.305(b) Responsibilities of air traffic control service providers with regard to the problematic use of psychoactive substances by air traffic controllers
PROCEDURE FOR THE DETECTION OF CASES OF PROBLEMATIC USE OF PSYCHOACTIVE SUBSTANCES

Guidance for the development and implementation of the procedure for detection of cases of psychoactive substances is contained in ICAO Doc 9654 'Manual on Prevention of problematic use of Substances in the Aviation Workplace', First Edition - 1995, particularly in Chapter 5 (pages 15-23) and attachment E (pages 77-85) as regards biochemical testing programmes, with related supporting material.

GM1 ATS.OR.310 Stress

(a) Introduction

(1) The job of an air traffic controller is generally considered to be responsible and demanding, and at times can lead to the experience of high levels of stress. The combination of skills and knowledge required to complete air traffic control tasks is wide. Visual spatial skills, perception, information processing, image and pattern recognition, prioritising, logical problem solving, application of rules and procedures and decision-making form core skills to which we can add interpersonal communication, teamwork and technical vocabulary usage.

(2) Air traffic control also requires to constantly adapt to an ever changing traffic picture and work environment within restricted time constraints. This has the potential to lead to considerable work pressure. In contrast, there may be times when traffic flows are low and controllers experience relatively low levels of activity. For some controllers, this may bring its own kind of stress due to the increased efforts required to maintain vigilance under light traffic load.

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(3) Thus, the work of an air traffic controller has the potential to induce high levels of stress; however, the stress experienced by controllers is always unique to the individual and their interaction with their environment.

(4) 'Stress' is a term that is in common use within everyday language and can mean different things to different people depending on the context in which it is used. In lay terms, stress is often used to describe an external pressure experienced by an individual whilst at the same time encompassing the subjective experience of this pressure. Usually the term is used in a negative way. In this sense, the lay use of the term 'stress' encompasses both the cause and the effect, and this can lead to confusion as to its meaning.

(b) Technical definitions of stress

(1) Even in its technical use, the word 'stress' is sometimes used when the term 'stressor' (or pressure) would be more appropriate, referring to the cause of a stress experience. Stressors can be internal (cognitive or physical) or external (environmental) to the individual and may be defined as any activity, event or other stimulus that causes the individual to experience stress.

(2) It is helpful to clarify the way the term 'stress' and other technical terms are used. For the purposes of this guidance material, stress is defined following the Transactional Model of Stress. This views stress as the outcomes experienced by an individual when faced with a potentially stressful event. The experience of the event as negatively stressful (distress), neutral or positive (eustress) is based on the individual's perception of their ability to manage the event. Under this definition, stress is a manifestation in the individual of usually negative effects, which can lead to a decrease in performance and negative health effects.

(3) A stressor can also act to improve performance when it is a stimulus to increase arousal and improves the outputs of an individual in the short to medium term. Too much arousal paradoxically leads to an inverse effect and subsequent detriment in performance.

(4) Acute stress is, as its name suggests, episodic and occurring for short periods of time. In most cases, the cause of the stress is eliminated by the air traffic controller taking action to manage the situation leading to stress. High levels of acute stress may lead to hyper-arousal and may leave an air traffic controller feeling exhausted. It is important to identify work situations that lead to this acute stress and plan for this within the work schedule.

(5) Chronic stress differs from acute stress only in that it is ongoing and even low levels of continuous chronic stress can lead to performance degradation and serious health implications, if it is not addressed. Chronic stress is insidious in its nature and a sufferer may become so accustomed to the sensations that they are unaware of the long-term negative effects. Chronic stress commonly leads to a sense of inability to cope.

(6) Both acute and chronic stresses have the potential to lead individuals into hyper-aroused states which may result in panic where task and skill performance, planning, reasoning and judgement are significantly impaired. In such instances, a well-practised but incorrect action, for that particular circumstance, may be performed when an alternative and more appropriate response is required.

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(7) Chronic stress may result in a condition known as burnout. Burnout is generally identified by the following characteristics: disaffection with the job leading to a decrease in motivation with an associated decrease, perceived or otherwise, in performance.

(c) Sources of stress

Broadly speaking, the stress experienced by an air traffic controller at work is a function of their underlying background levels of stress, related to lifestyle, health and well-being, personality, organisational/work environment, levels of satisfaction with life generally, and the acute stress imposed by and operational conditions at any given time. There are three major sources of stress: environmental, work-related, and personal.

(1) Environmental/physical stressors

(i) 'Physical stressors are underlying conditions that can either be internal to the body (e.g. pain, hunger, lack of sleep, exhaustion), or external environmental factors (e.g. noise pollution, overcrowding, excess heat). The common factor among all of these stressors is that they all create a physically uncomfortable environment that can cause stress. Stress is not solely dependent on the intensity of a stimulus, but also on the duration of exposure. For example, a low-pitched but persistent noise can cause as much stress as a sudden loud noise.'[8].

(ii) In the air traffic control room, some common environmental/physical stressors could be:

(A) uncomfortable temperature;

(B) cramped workspace;

(C) air quality;

(D) lighting conditions; and

(E) intrusive noise or vibration.

(2) Work-related stressors

(i) Stress in the workplace can come from a variety of sources besides physical stimuli. Some of these include:

(A) continuing high levels of workload near or above the maximum traffic handling capacity of an air traffic controller;

(B) a heterogeneous traffic mix where aircraft have varying levels of equipment and considerable variability in pilot skills;

(C) unsuitable or unreliable equipment;

(D) inappropriate, vague procedures;

(E) complex equipment which is insufficiently understood or mistrusted;

(F) supervision of trainees or less experienced colleagues;

[8] Source Skybrary: http://www.skybrary.aero

(G) workload and task breakdown not being matched to the level of technical skill of the controller, lack of support or too much support (interference);

(H) role ambiguity, where it is unclear where the responsibilities lie;

(I) interpersonal conflict with colleagues, other professionals;

(J) poor management relations (social dialogue), working conditions, e.g. rostering; and

(K) abnormal or emergency situations.

(ii) Incidents, including emergencies and accidents, that lead controllers to feel that they are not coping may lead to the experience of critical incident stress; this, in turn, may impair performance in varying degrees.

(3) Personal stressors

(i) Personal stressors include the range of events that occur throughout people's lives but external to the workplace. The belief that such stressors can be left at home, however, is a myth, and these personal stressors accompany air traffic controllers to work every day.

(ii) Personal issues such as health, personal life, living situation and major life events (deaths, births, marriages, and moving house) add to the background level of stress that individuals have to cope with. Where these are excessive, they can interfere with work due to the distraction they cause and the mental effort they require to resolve them.

(iii) Stress is also considered to have a contagious quality, which happens when a stressed person or stressed persons create stressful situations for those around them.

(d) Signs of stress in the individual

Signs of stress are many and varied. Some of the more commonly observed are shown below:

(1) Physiological

(i) Cardiovascular: increased pulse rate, elevated blood pressure, chest pains;

(ii) Respiratory: shortness of breath, tightness of chest, hyperventilation, dizziness;

(iii) Gastrointestinal: loss of appetite, gas pain, abdominal cramps, indigestion, diarrhoea, nausea;

(iv) Sweaty palms;

(v) Aching neck, jaw and back muscles;

(vi) Trembling;

(vii) Sleep disturbance, tiredness;

(viii) Itching;

(ix) Getting easily startled;

(x) Susceptibility to minor illnesses; and

(xi) Other: headaches, muscular tension, general weakness, psychosomatic symptoms.

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(2) Psychological

(i) Emotional: anger, guilt, mood swings, low self-esteem, depression and anxiety;

(ii) Concentration problems, forgetfulness;

(iii) Pessimism;

(iv) Difficulty in making decisions;

(v) Irritability;

(vi) Loss of interest;

(vii) Loss of self-control; and

(viii) Loss of confidence.

(3) Behavioural

(i) Self-medication, drugs or alcohol;

(ii) Excess fatigue;

(iii) Sleep disruption;

(iv) Social withdrawal;

(v) Absenteeism;

(vi) Staff turnover rates; and

(vii) Job performance decrements.

(e) Impact of stress on air traffic controllers' performance of air traffic control tasks

Any source of stress has the potential to create unique subjective experiences in different individuals, and these may be positive or negative experiences or something in between.

(f) Negative experiences of stress

There is a number of ways in which stress experienced by air traffic controllers can be manifested in the performance of air traffic control tasks. Some of these are listed in Table 1, but, in general terms, performance of tasks decreases due to the detrimental effects that high levels of stress can have on perception, awareness, decision-making and judgement. In the longer term, health and well-being may also be compromised, leading to decreased performance of air traffic controllers.

Table 1 below shows that the effects of stress on air traffic controller performance can have potentially very significant implications for the safety performance of an operation.

Difficulty in concentrating and reduced vigilance — easily distracted.
Errors, omissions, mistakes, incorrect actions, poor judgment and memory.
Tendency to cut corners, skip items and look for the easiest way out.
Either slowness (due to lack of interest) or hyperactivity (due to adrenaline).
Focussing on easily manageable details while ignoring serious threats.

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Tendency to pass responsibility on to others.
Fixation on single issues or even a mental block.
Unwillingness to make decisions — decisions are postponed or take longer to be made.
Fewer plans and backup plans are made.
Increase in risk-taking, leading to an increase in the number of violations, especially when frustrated with failures.
Excessively hurried actions — due to adrenaline and alertness level, there is a tendency to act very quickly even when there is no time pressure. Hurried actions increase the chance of errors.
In cases of significantly high stress, a controller will often: (1) return to old procedures that may no longer be applicable, appropriate or safe; (2) use of non-standard phraseology when communicating; (3) return to the use of one's native language; and/or (4) look for items in a place where they used to be, but are no longer located.

Table 1: Effects of stress on physical and mental performance of air traffic control tasks

(g) Mitigation of stress in the individual and the organisation

Air traffic control service providers have a duty to take care of their employees and the customers of their services. They should aim at mitigating the negative effects of stress. This is best achieved by ensuring that a range of preventative and counter measures are in place. These include:

(1) adoption of a stress policy and/or a critical incident stress management policy within the organisation;

(2) completing regular risk assessment of sources of occupational stress and its effects on individuals and operations;

(3) employee stress level monitoring;

(4) adopting stress intervention/mitigation/prevention practices and, where the organisation identifies a source of stress, use of a stress team/committee;

(5) stress management training for all levels of employees;

(6) education and prevention programmes on stress; and

(7) staff support mechanisms (e.g. peer counselling, professional support from health practitioners, CISM);

(8) adequate rostering allowing time to evacuate stress; and

(9) promoting sports or relaxation activities.

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GM1 ATS.OR.310(a) Stress
CRITICAL INCIDENT STRESS MANAGEMENT

The purpose of critical incident stress management (CISM) programmes is to prepare an organisation for the potential aftermath of an incident. These programmes come in a number of different forms, but have the added benefit of providing education on the effects of stress, how stress affects performance and stress management, even when the incident is relatively minor and perhaps personal to the individual.

Guidance for the implementation of a CISM programme may be found in the EUROCONTROL document: 'Human Factors — Critical Incident Stress Management: User Implementation Guidelines', edition 2.0 of 24 October 2008.

GM1 ATS.OR.310(b) Stress
SOURCES OF OCCUPATIONAL STRESS

Sources of occupational stress are of environmental and work-related nature and may be but are not limited to:

(a) traffic demand;

(b) operating procedures;

(c) interaction with colleagues and managers;

(d) working time;

(e) working tools;

(f) work environment, such as air temperature and quality, lighting conditions, noise, cramped workspace;

(g) working organisation; and

(h) critical incident.

GM1 ATS.OR.310(c) Stress
TRAINING AND EDUCATION PROGRAMMES

Scientific material proposed as guidance for training and education programmes on stress may be found in the EUROCONTROL document 'Human Factors Module — Stress', edition 1.0 of 15 March 1996.

AMC1 ATS.OR.315 Fatigue
[Note: This is a placeholder for AMC material elaborating on the following subjects:

(a) Specification of the key points to be addressed by the policy, and/or how to develop such a policy;

(b) Provision of a template for the procedures mentioned in ATS.OR.320(b) with key points to be addressed;

(c) Provision of key points to be considered when developing education and information programmes on fatigue prevention; and

(d) Provision of examples and what would be considered as staff support mechanisms and facilities to mitigate fatigue.**]**

GM1 ATS.OR.315 Fatigue

(a) Introduction

In a very general way, fatigue can be considered as a physiological and psychological state reflecting a need for recovery.

A more refined definition of fatigue is: 'a physiological state of reduced mental or physical performance capability resulting from sleep loss or extended wakefulness and/or physical activity that can impair operational air traffic controllers' alertness and ability to safely perform their tasks'.

The recovery process reflects the two kinds of manifestations of fatigue:

(1) Events associated with drowsiness or tendency to sleepiness. These events are generated mainly by three processes:

(i) Process C, regulated by the circadian clock, which induces a time variation of arousal with a reduction mainly between midnight and 6 a.m.;

(ii) Process S, or sleep pressure, which increases with the length of sleep deprivation; and

(iii) Process W, which corresponds to a state of sleep inertia (transient state of sleepiness after waking up) and dissipates gradually.

The recovery process associated with drowsiness corresponds to the onset of sleep. These processes are affected by many internal factors (individual 'morning' or 'evening' type, 'small' or 'big sleeper', personal concerns) and by the external environment (ambient temperature, noise).

(2) Events like mental, physical and muscle fatigue, associated with the amplitude of work shift and workload. The recovery is achieved by stopping the activity.

In most situations, these two forms of fatigue coexist.

(b) Acute fatigue versus chronic fatigue

Another distinction should also be made in the manner of installation of and recovery from fatigue over time:

(1) Acute fatigue, on a 24-hour scale, results from the deprivation of all or part of sleep. Depending on the extent of sleep debt, recovery occurs in one or more nights; and

(2) Chronic fatigue, across a week or a month. One recovers slowly and requires more rest for several days.

Recent studies suggest that chronic fatigue can have similar effects on cognitive performance as is the case with acute fatigue. Repeated deprivation of sleep over several days leads to the same performance degradation as that of deprivation of a whole night sleep (Van Dongen et al., 2003).

It is essential to remember that fatigue, in most cases (apart from fatigue-related diseases), is a normal physiological phenomenon that is reversible and reflects a need for recovery (such as hunger, which reflects the need to eat). However, deprivation of sleep or shifts of circadian rhythms repeated over several years are likely to lead to pathological conditions under the remit of occupational medicine.

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(c) Sleep

Sleep is vital for recovery from fatigue. Two aspects of sleep are important: the amount of sleep and the quality of sleep.

Two main physiological processes interact to regulate sleep:

(1) the homeostatic sleep process is evident in the pressure for slow-wave sleep that builds up across waking and discharges across sleep; and

(2) the circadian body clock regulates the timing of Rapid Eye Movement (REM) sleep and dictates the preference for sleep at night.

(d) Sleep apnoea syndrome

Sleep apnoea syndrome may be primary (central) or obstructive, the latter most commonly affecting overweight males, especially between the ages of 40 and 60. The syndrome results from frequent periods of apnoea during sleep, associated with loud snoring. Sleep recordings reveal apnoeic episodes in REM and non-REM sleep.

There may be an absence of respiratory effort with cessation of diaphragmatic movement. The upper airway can remain open even without airflow (central apnoea) or there may be excessive respiratory effort due to airways obstruction. Chronically disturbed nocturnal sleep and hypoxaemia cause excessive daytime sleepiness.

This leads to inappropriate and unrefreshing naps, an obvious safety hazard for air traffic controllers, whose sleep may already be disturbed by shift working. Sleep apnoea syndrome evolves gradually and may not be fully described by the individual affected. It should be considered with any presence of sleepiness which is not improved by a period of undisturbed sleep. Investigation should include respiratory studies and sleep recordings. It can be treated, but a diagnosis will require the air traffic controllers to be assessed as temporarily unfit until all aspects of treatment and recovery can be assessed by a specialist acceptable to the competent authority.

(e) Shift work and circadian cycles

Shift work may require a person to be awake during the time in the circadian body clock cycle where they would normally be asleep.

The ability of the circadian clock to ‘lock on’ to the 24-hour day/night cycle makes it resist adaptation to any pattern other than sleep at night.

The fact that the circadian body clock does not adapt fully to altered sleep/wake patterns has two main consequences:

(1) duty days that overlap usual sleep times (particularly all-night shifts) tend to cause sleep restriction; and

(2) air traffic controllers who are working between midnight and 5.59 a.m. can be expected to be sleepy and have to make additional effort to maintain their performance.

The further sleep is displaced from the optimum part of the circadian body clock cycle, the more difficult it becomes for air traffic controllers to get adequate sleep. The frequency of recovery breaks

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(e.g. two consecutive nights of unrestricted sleep) needs to reflect the rate of accumulation of sleep debt.

GM2 ATS.OR.315 Fatigue
FATIGUE AND SAFETY

(a) Fatigue presents a safety risk because of performance degradation (increased response times, degradation of situational awareness, deterioration in mood, reduction of communication within the team).

(b) In the second half of the 20th century, scientific evidence implicating other causes of fatigue in addition to time-on-task, particularly in 24/7 operations, began accumulating. The most significant new understanding concerns:

(1) the vital importance of adequate sleep (not just rest) for restoring and maintaining all aspects of waking function; and

(2) daily rhythms in the ability to perform mental and physical work, and in sleep propensity (the ability to fall asleep and stay asleep), that are driven by the daily cycle of the circadian rhythms.

(c) Although fatigue constitutes a risk to safety in the sense of safety management systems, it does differ in some respects from other risks. Briefly, five particular properties must be considered to ensure that the fatigue risk is adequately controlled:

(1) Sources of fatigue are both occupational and extra-occupational;

(2) Occupational sources of fatigue are multidimensional and relate just as much to work hours as to the nature and context of the activity;

(3) There are significant individual differences in susceptibility to fatigue and ability to manage fatigue;

(4) The link between fatigue and the safety level is not linear: fatigue management strategies change according to the level of fatigue; and

(5) Bearing in mind the interactions among team members, it would also seem relevant to analyse the fatigue risk for the team as a whole.

(d) Several scientific studies suggest that this relationship is not completely linear: an increase in the level of fatigue does not systematically and proportionally increase risk. Folkard and Akerstedt (2004) postulate that low levels of fatigue could create a high level of confidence in the air traffic control service provider which then would tend to less monitor air traffic controllers' performance. People and teams assisted by the systems are likely to 'absorb' the impact of fatigue on performance.

(e) One critical element that seems to impact the relationship between fatigue and safety is the degree of awareness of air traffic controllers' own fatigue (Cabon et al., 2008). Indeed, when an individual is aware of his or her fatigue, he or she tends to develop strategies to either reduce his or her level of fatigue or to ensure that this level of fatigue does not degrade his or her performance.

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GM1 ATS.OR.315(b) Fatigue

[Note: This is a placeholder for a GM elaborating on fatigue detection mechanisms.]

GM1 ATS.OR.315(c) Fatigue
TRAINING AND EDUCATION PROGRAMMES

Scientific material proposed as guidance for training and education programmes on fatigue may be found in the document 'Fatigue and Sleep Management: Personal strategies for decreasing the effects of fatigue in air traffic control' (Brussels: Human Factors Management Business Division (DAS/HUM), EUROCONTROL, 2005)[9].

GM1 ATS.OR.320(b) Air traffic controllers' rostering system(s)
AIR TRAFFIC CONTROLLERS' INVOLVEMENT

Additional guidance concerning the involvement of air traffic controllers in the definition of rostering systems is available in EUROCONTROL Study on Shiftwork practices — ATM and related Industries, edition 1.0 of 14 April 2006.

SUBPART B — TECHNICAL REQUIREMENTS FOR THE PROVISION OF AIR TRAFFIC SERVICES (ATS.TR)

Section 1 — General requirements

GM1 ATS.TR.100(b) Working methods and operating procedures for the provision of ATS
SPECIAL AND ALTERNATIVE CONDITIONS AND OPERATING PRCEDURES FOR ATS PROVIDERS PROVIDING SERVICES TO FLIGHT TESTS

(a) While flight tests are regularly conducted in compliance with the standards and the regulation specified in ATS.TR.100 (a), some of them need to follow specific additional or alternative conditions and procedures approved by the competent authority, to meet the needs of flight tests carried out during the flight. This is also the case for flight tests involving more than one aircraft in the same flight test. These special provisions will not jeopardise the safety of the other airspace users and the population in the area overflown.

(b) In order to ensure safe operations within the provision of air traffic service for flight tests control, the air traffic controllers providing these services may need to have specific knowledge of flight tests and/or be briefed, depending on the specificities of the flight profiles.

(c) Air traffic controllers that provide air traffic services to flight tests (flight test ATCOs) may need to obtain their specific competence through a dedicated training as specified in the Implementing Rule for air traffic controllers.

(d) Air traffic services for flight test should be provided through dedicated and specific procedures. These procedures should address:

(1) Compatibility with other airspace users

(i) In order to ensure the compatibility of the flight test with other airspace users and to ensure safe operations and an acceptable rate of success of flight test, the air traffic

[9] This document is available at: http://www.skybrary.aero/bookshelf/books/220.pdf

services provider should ensure proper coordination at all levels, including strategic, pre-tactical and real-time coordination.

(ii) An air traffic services unit providing services to flight test is responsible for ensuring compatibility of their activities with other airspace users.

(2) Flight Plan

The air traffic services unit should obtain all the necessary details related to flight tests (e.g. from the design organisation or the entity wishing to carry out the flight test).

(3) Flight tests with limited manoeuvrability

During certain phases of the flight test, the capability to normally perform manoeuvres may only be possible after a necessary period of time (e.g. for the flight crew to get into a configuration that allows the execution of these manoeuvres).

The air traffic services provider should obtain the necessary information about the phases of flight and the duration if known.

For the conduct of these flights, the use of a temporarily reserved area is preferred. If unable, after prior coordination with the relevant air traffic services units neighbouring the flight tests, the use of a transponder should be mandated.

This real-time information does not relieve the air traffic services unit responsible for providing services to the flight tests from the obligation to ensure traffic separation and assure compatibility with all airspace users.

(e) The above-mentioned procedures are not exhaustive and additional provisions may be necessary to meet the needs of flight tests. The paramount principle is anyhow to make provisions without contradicting the standards and the regulation specified in ATS.TR.100(a).

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ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL TO ANNEX V — SPECIFIC REQUIREMENTS FOR THE PROVISION OF METEOROLOGICAL SERVICES (Part-MET)

SUBPART A — ADDITIONAL ORGANISATION REQUIREMENTS FOR THE PROVISION OF METEOROLOGICAL SERVICES (MET.OR)

Section 1 — General requirements

GM1 MET.OR.100 Meteorological data and information
DATA AND INFORMATION RELIABILITY

Owing to the variability of meteorological elements in space and time, to limitations of observing and forecasting techniques and to limitations caused by the definitions of some of the elements, the specific value of any of the meteorological elements given in an observation or forecast report provides the best approximation to the actual conditions at the time of observation or the most probable value which the meteorological element is likely to assume during the period of the forecast. Similarly, when the time of occurrence or change of a meteorological element is given in a forecast, this time indicates the most probable time.

GM1 MET.OR.110 Meteorological information exchange requirements
GENERAL

Operational meteorological information is disseminated to international OPMET databanks and the centres for the operation of aeronautical fixed service satellite distribution systems.

GM2 MET.OR.110 Meteorological information exchange requirements
OPMET DATABANK

The list of relevant meteorological exchange requirements for OPMET can be found in the FASID tables in ICAO Doc 7754 (EUR ANP)

GM3 MET.OR.110(a) Meteorological information exchange requirements
AREA FORECASTS FOR LOW-LEVEL FLIGHTS

Area forecasts for low-level flights prepared in support of the issuance of AIRMET information are exchanged between aerodrome meteorological offices and/or meteorological watch offices responsible for the issuance of flight documentation for low-level flights in the flight information regions concerned.

GM1 MET.OR.120 Notification of discrepancies to the World Area Forecast Centre (WAFC)
GUIDANCE ON REPORTING SIGNIFICANT DISCREPANCIES

Guidance on reporting significant discrepancies is provided in the Manual of Aeronautical Meteorological Practice (ICAO Doc 8896).

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Section 2 — Specific requirements

Chapter 1 — Requirements for aeronautical meteorological stations

AMC1 MET.OR.200(a)(1) Meteorological reports and other information
ROUTINE OBSERVATIONS

Meteorological stations should make routine observations throughout the 24 hours each day or as determined by the competent authority.

GM1 MET.OR.200(a)(1) Meteorological reports and other information
NO DISSEMINATION OF LOCAL ROUTINE AND SPECIAL REPORTS

By agreement between the aeronautical meteorological station and the appropriate ATS unit, local routine and local special reports may not be disseminated in respect of:

(a) any element for which there is in the local air traffic services unit a display corresponding to the one in the meteorological station, and where arrangements are in force for the use of this display to update information included in local routine and special reports; and

(b) runway visual range, when all changes of one or more steps on the reporting scale in use are being reported to the local air traffic services unit by an observer on the aerodrome.

AMC1 MET.OR.200(a)(2) Meteorological reports and other information
METAR AT AERODROMES NOT CONTINUOUSLY OPERATIONAL

At aerodromes that are not operational throughout the 24 hours, the issuance of a METAR should commence at least 3 hours prior to the aerodrome resuming operations, or as agreed between the Member State and the operator, to meet pre-flight and in-flight planning requirements for flights due to arrive at the aerodrome as soon as it is opened for use.

GM1 MET.OR.200(a) Meteorological reports and other information
TYPES OF AERONAUTICAL METEOROLOGICAL STATIONS

An aeronautical meteorological station may be a separate station or may be combined with a synoptic station.

METEOROLOGICAL INSTRUMENTS

Aeronautical meteorological stations may include sensors installed outside the aerodrome.

AMC1 MET.OR.200(c) Meteorological reports and other information
CONTENT OF THE VOLCANIC ACTIVITY REPORT

The report of occurrence of pre-eruption volcanic activity, volcanic eruptions and volcanic ash clouds should be made in the form of a volcanic activity report comprising the following meteorological information in the order indicated:

(a) message type, VOLCANIC ACTIVITY REPORT;

(b) station identifier, location indicator or name of station;

(c) date/time of message;

(d) location of volcano and name, if known; and

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(e) concise description of the event including, as appropriate, level of intensity of volcanic activity, occurrence of an eruption and its date and time and the existence of a volcanic ash cloud in the area together with direction of ash cloud movement and height.

AMC1 MET.OR.210 Observing meteorological elements
DISPLAY

Where automated equipment forms part of an integrated semi-automatic observing system, displays of data which are made available to the local ATS units should be a subset of and displayed parallel to those available in the aeronautical meteorological stations or meteorological offices. In those displays, each meteorological element should be annotated to identify, as appropriate, the locations for which the element is representative.

AMC2 MET.OR.210 Observing meteorological elements
FORMAT OF METEOROLOGICAL OBSERVATIONS

(a) Meteorological observations for regular and alternate aerodromes should be collected, processed and stored in a form suitable for the preparation of aerodrome climatological information.

(b) Aeronautical climatological information should be exchanged on request between meteorological services providers.

Chapter 2 — Requirements for aerodrome meteorological offices

GM1 MET.OR.215(a) Forecasts and other information
PREPARATION OF FORECASTS

The extent of the aerodrome meteorological office responsibilities to prepare forecasts may relate to the local availability and use of en-route and aerodrome forecast material received from other offices.

AMC1 MET.OR.215(c) Forecasts and other information
FORMAT OF FORECASTS

The length of the forecast messages and the number of changes indicated in the forecast should be kept to a minimum.

GM1 MET.OR.215(c) Forecasts and other information
AUTOMATIC CANCELLATION

The issue of a new forecast by an aerodrome meteorological office, such as a routine aerodrome forecast, automatically cancels any forecast of the same type previously issued for the same place and for the same period of validity or part thereof.

GM2 MET.OR.215(c) Forecasts and other information
TAF CONTINUOUS REVIEW GUIDANCE

Guidance on methods to keep Terminal Aerodrome Forecasts (TAF) under continuous review is given in Chapter 3 of the Manual of Aeronautical Meteorological Practice (ICAO Doc 8896).

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GM1 MET.OR.215(d) Forecasts and other information
BRIEFING AND CONSULTATION

(a) Briefing should be understood as being preparatory meteorological information on existing and/or expected meteorological conditions.

(b) Consultation should be understood as discussion, including answers to questions, with a meteorologist or another qualified person of existing and/or expected meteorological conditions relating to flight operations.

GM2 MET.OR.215(d) Forecasts and other information
BRIEFING, CONSULTATION AND DISPLAY

The purpose of briefing and consultation is to provide the latest available information on existing and expected meteorological conditions along the route to be flown and at the aerodrome of intended landing, and on alternate aerodromes and other aerodromes as relevant, in order to either explain or amplify the information contained in the flight documentation.

GM2 MET.OR.215(d) Forecasts and other information
SCOPE OF THE PRE-FLIGHT PLANNING

The service for pre-flight planning should be confined to flights originating within the territory of the State concerned.

GM3 MET.OR.215(d) Forecasts and other information
FLIGHT DOCUMENTATION

'Flight documentation' for the purpose of meteorology is understood as being documents, including charts or forms, containing meteorological information for a flight.

AMC1 MET.OR.215(e) Forecasts and other information
CLIMATOLOGICAL TABLES

The aerodrome meteorological office should make available such climatological tables within a time period as agreed between the competent authority and the relevant user.

AMC1 MET.OR.215(f) Forecasts and other information
NOTAM/ASHTAM

For the preparation of NOTAM or ASHTAM, the relevant aeronautical information service unit should be provided with meteorological information:

(a) about the establishment, withdrawal and significant changes in operation of aeronautical meteorological services sufficiently in advance of the effective date to permit issuance of NOTAM in compliance with Annex 15, 5.1.1 and 5.1.1.1; and

(b) necessary for the preparation of aeronautical information circulars, including, in particular, meteorological information on expected important changes in aeronautical meteorological procedures, services and facilities provided.

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AMC1 MET.OR.215(g) Forecasts and other information
METEOROLOGICAL INFORMATION FOR SEARCH AND RESCUE

To facilitate search and rescue operations, the aerodrome meteorological office or meteorological watch office should provide:

(a) complete and detailed meteorological information on the current and forecast meteorological conditions in the search area;

(b) current and forecast conditions en-route, covering flights by search aircraft from and returning to the aerodrome from which the search is being conducted; and

(c) on request from the rescue coordination centre, meteorological information required by ships undertaking search and rescue operations.

AMC1 MET.OR.215(k) Forecasts and other information
METEOROLOGICAL DATA TYPE

On request by the operator, the meteorological information supplied for flight planning should include data for the determination of the lowest usable flight level.

GM1 MET.OR.220(a) Aerodrome forecasts
DISSEMINATION OF TAF

TAF and amendments thereto are disseminated to international OPMET databanks and the centres designated for the operation of aeronautical fixed service satellite distribution systems.

GM1 MET.OR.225 Forecasts for landing
RANGE OF LANDING FORECASTS

Landing forecasts are intended to meet the requirements of local users and of aircraft within about one hour's flying time from the aerodrome.

GM2 MET.OR.225 Forecasts for landing (TREND)
TREND FORECAST

A TREND forecast is understood as being a concise statement of the expected significant changes in the meteorological conditions at that aerodrome to be appended to a local routine or local special report, or a METAR.

AMC1 MET.OR.235(b) Aerodrome warnings and wind shear warnings and alerts
WIND SHEAR FOLLOW-UP

Wind shear alerts should be updated at least every minute. They should be cancelled as soon as the headwind/tailwind change falls below 15 kt (7.5 m/s).

GM1 MET.OR.235(d) Aerodrome warnings and wind shear warnings and alerts
WIND SHEAR ALERTS

Wind shear alerts are expected to complement wind shear warnings and together are intended to enhance situational awareness of wind shear.

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GM2 MET.OR.235(d) Aerodrome warnings and wind shear warnings and alerts
EXAMPLES OF WIND SHEAR DETECTION EQUIPMENT

Examples of wind shear detection equipment are ground-based, wind shear detection equipment: a system of surface wind and/or pressure sensors located in an array monitoring a specific runway or runways and associated approach and departure paths.

GM1 MET.OR.235(e) Aerodrome warnings and wind shear warnings and alerts
CANCELLATION OF WARNINGS

The criteria for the cancellation of a wind shear warning are defined locally for each aerodrome, as agreed between the aerodrome meteorological office, the appropriate ATS units and the operators concerned.

GM1 MET.OR.240(a)(1) Meteorological information for use by operator or flight crew
DISPLAY

Forecasts of upper-air humidity and geopotential altitude of flight levels are used only in automatic flight planning and need not be displayed.

GM2 MET.OR.240(a)(4) Meteorological information for use by operator or flight crew
INDEPENDENT METEOROLOGICAL INFORMATION

Special air-reports supplied to operators and flight crew members will be those not already used in the preparation of SIGMET.

Chapter 3 — Requirements for meteorological watch offices

AMC1 MET.OR.245(a) Watch and other information
BOUNDARIES

The boundaries of the area over which meteorological watch is to be maintained by a meteorological watch office should be coincident with the boundaries of a flight information region or a control area or a combination of flight information regions and/or control areas.

GM1 MET.OR.245(e) Watch and other information
INFORMATION RECEIVED ON THE RELEASE OF RADIOACTIVE MATERIALS

The meteorological information is provided by regional specialised meteorological centres (RSMCs) of the World Meteorological Organization (WMO) for the provision of transport model products for radiological environmental emergency response, at the request of the Member State in which the radioactive material was released into the atmosphere or the International Atomic Energy Agency (IAEA). The meteorological information is sent by the RSMC to a single contact point of the provider of meteorological service in each Member State. This contact point has the responsibility for redistributing the RSMC products within the Member State concerned. Furthermore, the meteorological information is provided by the IAEA to RSMCs co-located with the London Volcanic Ash Advisory Centre (VAAC), designated as the focal point, which in turn notifies the Area Control Centres (ACCs) concerned about the release.

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AMC1 MET.OR.250(a) SIGMET messages.
MULTIPLE FLIGHT INFORMATION REGIONS (FIR) OR CONTROL AREA (CTA)

Meteorological watch offices whose area of responsibility encompasses more than one FIR and/or CTA should provide separate SIGMET messages for each FIR and/or CTA.

GM1 MET.OR.250(a) SIGMET messages
DISSEMINATION

SIGMET messages are disseminated to meteorological watch offices and WAFCs and to other meteorological offices. SIGMET messages for volcanic ash are also disseminated to VAACs.

GM2 MET.OR.250(a) SIGMET messages
DISSEMINATION

SIGMET messages are disseminated to international OPMET databanks and the centres designated for the operation of aeronautical fixed service satellite distribution systems.

AMC1 MET.OR.250(b) SIGMET messages
FORMAT

In addition to the issuance of SIGMET information in abbreviated plain language, SIGMET information should be issued in digital form.

AMC1 MET.OR.250(d) SIGMET messages
SOURCE OF SIGMET MESSAGES

SIGMET messages concerning volcanic ash clouds and tropical cyclones should be based on advisory information provided by VAACs and Tropical Cyclone Advisory Centres (TCACs), respectively.

GM1 MET.OR.255(a) AIRMET messages
DISSEMINATION

(a) AIRMET messages are disseminated to meteorological watch offices in adjacent flight information regions and to other meteorological watch offices or aerodrome meteorological offices, as agreed by the competent authorities concerned.

(b) AIRMET messages are transmitted to international operational meteorological databanks and the centres for the operation of aeronautical fixed service satellite distribution systems.

Chapter 4 — Requirements for Volcanic Ash Advisory Centres (VAAC)

GM1 MET.OR.265(a) Volcanic Ash Advisory Centres responsibilities
DISTRIBUTION OF METEOROLOGICAL DATA

The AFTN address to be used by the VAACs is given in the Handbook on the International Airways Volcano Watch (IAVW) (Doc 9766) which is available on the ICAO IAVWOPSG website.

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Chapter 6 — Requirements for World Area Forecast Centres (WAFC)

GM1 MET.OR.275(a)(1) World Area Forecasts Centre responsibilities
GENERAL

Gridded global forecasts of cumulonimbus clouds, icing and turbulence are currently of an experimental nature, labelled as 'trial forecasts' and only distributed through the Internet-based file transfer protocol (FTP) services.

SUBPART B — TECHNICAL REQUIREMENTS FOR THE PROVISION OF METEOROLOGICAL SERVICES (MET.TR)

Section 1 — General requirements

GM1 MET.TR.115(a) Meteorological bulletins
ALPHANUMERICAL FORMAT

The format of the meteorological bulletins are understood to be those in alphanumerical format.

GM2 MET.TR.115(a) Meteorological bulletins
COMPOSITION AND FILLING TIMES OF BULLETINS

(a) Whenever possible, exchanges of operational meteorological information should be made in consolidated bulletins of the same types of meteorological information.

(b) Meteorological bulletins required for scheduled transmissions should be filed regularly and at the prescribed scheduled times.

GM3 MET.TR.115(a) Meteorological bulletins
HEADING

Detailed specifications on format and contents of the heading are given in the WMO Publication No 386, Manual on the Global Telecommunication System, Volume I, and in the ICAO Manual of Aeronautical Meteorological Practice (Doc 8896).

GM1 MET.TR.115(a)(2) Meteorological bulletins
LOCATION INDICATOR

ICAO location indicators are listed in Location Indicators (Doc 7910).

Section 2 — Specific requirements

Chapter 1 — Technical requirements for aeronautical meteorological stations

GM1 MET.TR.200(a)(2) Meteorological reports and other information
LOCATION INDICATORS

The location indicators and their significations are published in Location Indicators (Doc 7910).

AMC1 MET.TR.200(a)(4) Meteorological reports and other information
AUTOMATED REPORTING

Local routine and special reports and METAR from automatic observing systems should be identified with the word 'AUTO'.

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AMC1 MET.TR.200(a)(12) Meteorological reports and other information
SUPPLEMENTARY INFORMATION — WEATHER PHENOMENA — SEMI-AUTOMATIC OBSERVING SYSTEM

(a) In local routine and local special reports and in METAR when reported by a semi-automatic observing system, the following recent weather phenomena should be reported, up to a maximum of three groups, in the supplementary information:

(1) freezing precipitation;

(2) moderate or heavy precipitation, including showers thereof;

(3) blowing snow;

(4) dust storm, sandstorm;

(5) thunderstorm;

(6) funnel cloud, tornado or water spout; and

(7) volcanic ash.

(b) In local routine and special reports when reported by a semi-automatic observing system, the following significant meteorological conditions, or combinations thereof, should be reported in the supplementary information:

(1) cumulonimbus clouds (CB);

(2) thunderstorm (TS);

(3) moderate or severe turbulence (MOD TURB, SEV TURB);

(4) wind shear (WS);

(5) hail (GR);

(6) severe squall line (SEV SQL);

(7) moderate or severe icing (MOD ICE, SEV ICE);

(8) freezing precipitation (FZDZ, FZRA);

(9) severe mountain waves (SEV MTW);

(10) dust storm, sandstorm (DS, SS);

(11) blowing snow (BLSN); and

(12) funnel cloud (tornado or water spout) (FC).

The location of the condition should be indicated. Where necessary, additional information should be included using abbreviated plain language.

AMC2 MET.TR.200(a)(12) Meteorological reports and other information
SUPPLEMENTARY INFORMATION — WEATHER PHENOMENA — AUTOMATIC OBSERVING SYSTEM

In local routine and special reports and in METAR reported by an automatic observing system, the following recent weather phenomena should be reported, up to a maximum of three groups, in the supplementary information:

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(a) freezing precipitation;

(b) moderate or heavy precipitation, including showers thereof;

(c) thunderstorm; and

(d) unknown precipitation (UP).

AMC3 MET.TR.200(a)(12) Meteorological reports and other information
SUPPLEMENTARY INFORMATION — WIND SHEAR

Information on wind shear should be included as supplementary information in local routine and special reports and in METAR, where local circumstances so warrant.

AMC4 MET.TR.200(a)(12) Meteorological reports and other information
SUPPLEMENTARY INFORMATION — SEA-SURFACE TEMPERATURE AND STATE OF THE SEA AND OF THE RUNWAY

In METAR, the following should be included in the supplementary information:

(a) information on sea-surface temperature and the state of the sea or the significant wave height from aeronautical meteorological stations established on offshore structures in support of helicopter operations; and

(b) information on the state of the runway provided by the appropriate airport authority.

AMC5 MET.TR.200(a)(12) Meteorological reports and other information
SUPPLEMENTARY INFORMATION — SIGNIFICANT METEOROLOGICAL CONDITIONS

(a) Observations made at aerodromes should include the available supplementary information concerning significant meteorological conditions, particularly those in the approach and climb-out areas.

(b) Where practicable, the information should identify the location of the meteorological condition.

GM1 to AMC1 & AMC2 MET.TR.200(a)(12) Meteorological reports and other information
SUPPLEMENTARY INFORMATION — RECENT WEATHER PHENOMENA

'Recent weather phenomena' is understood as being the weather phenomena observed at the aerodrome during the period since the last issued routine report or last hour, whichever is the shorter, but not at the time of observation.

GM2 to AMC3 MET.TR.200(a)(12) Meteorological reports and other information
SUPPLEMENTARY INFORMATION — LOCAL CIRCUMSTANCES

Local circumstances include but are not necessarily limited to wind shear of non-transitory nature such as might be associated with low-level temperature inversions or local topography.

AMC1 MET.TR.200(b) Meteorological reports and other information
TEMPLATE FOR THE LOCAL ROUTINE AND LOCAL SPECIAL REPORTS

Local routine and special reports should be issued in abbreviated plain language, in accordance with the below template.

Template for the local routine (MET REPORT) and local special (SPECIAL) reports

Key:

M = inclusion mandatory, part of every message;

C = inclusion conditional, dependent on meteorological conditions;

O = inclusion optional.

Element as specified in Chapter 4	*Detailed content*	*Template(s)*			*Examples*
Identification of the type of report (M)	Type of report	MET REPORT *or* SPECIAL			MET REPORT SPECIAL
Location indicator (M)	ICAO location indicator (M)	nnnn			YUDO[1]
Time of the observation (M)	Day and actual time of the observation in UTC	nnnnnnZ			221630Z
Identification of an automated report (C)	Automated report identifier (C)	AUTO			AUTO
Surface wind (M)	Name of the element (M)	WIND			WIND 240/4MPS (WIND 240/8KT)
	Runway (O)[2]	RWY nn[L] *or* RWY nn[C] *or* RWY nn[R]			WIND RWY 18 TDZ 190/6MPS (WIND RWY 18 TDZ 190/12KT)
	Runway section (O)[3]	TDZ			
	Wind direction (M)	nnn/	VRB BTN nnn/ AND nnn/ *or* VRB	C A L M	WIND VRB1MPS WIND CALM (WIND VRB2KT) WIND VRB BTN 350/ AND 050/1MPS (WIND VRB BTN 350/ AND 050/2KT)
	Wind speed (M)	[ABV]n[n][n]MPS (*or* [ABV]n[n]KT)			WIND 270/ABV49MPS (WIND 270/ABV99KT)
	Significant speed variations (C)[4]	MAX[ABV]nn[n] MNMn[n]			WIND 120/3MPS MAX9 MNM2 (WIND 120/6KT MAX18 MNM4)

Element as specified in Chapter 4	*Detailed content*	*Template(s)*			*Examples*
	Significant directional variations (C)[5]	VRB BTN nnn/ AND nnn/	—		WIND 020/5MPS VRB BTN 350/ AND 070/ (WIND 020/10KT VRB BTN 350/ AND 070/)
	Runway section (O)[3]	MID			WIND RWY 14R MID 140/6MPS (WIND RWY 14R MID 140/12KT)
	Wind direction (O)[3]	nnn/	VRB BTN nnn/ AND nnn/ *or* VRB	C A L M	
	Wind speed (O)[3]	[ABV]n[n][n]MPS (*or* [ABV]n[n]KT)			
	Significant speed variations (C)[4]	MAX[ABV]nn[n] MNMn[n]			
	Significant directional variations (C)[5]	VRB BTN nnn/ AND nnn/	—		
	Runway section (O)[3]	END			WIND RWY 27 TDZ 240/8MPS MAX14 MNM5 END 250/7MPS (WIND RWY 27 TDZ 240/16KT MAX28 MNM10 END 250/14KT)
	Wind direction (O)[3]	nnn/	VRB BTN nnn/ AND nnn/ *or* VRB	C A L M	
	Wind speed (O)[3]	[ABV]n[n][n]MPS (*or* [ABV]n[n]KT)			
	Significant speed variations (C)[4]	MAX[ABV]nn[n] MNMn[n]			
	Significant directional variations (C)[5]	VRB BTN nnn/ AND nnn/	—		

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Element as specified in Chapter 4	*Detailed content*	*Template(s)*		*Examples*
Visibility (M)	Name of the element (M)	VIS	C A V O K	VIS 350M CAVOK VIS 7KM VIS 10KM
	Runway (O)[2]	RWY nn[L] *or* RWY nn[C] *or* RWY nn[R]		VIS RWY 09 TDZ 800M END 1200M
	Runway section (O)[3]	TDZ		
	Visibility (M)	n[n][n][n]M or n[n]KM		
	Runway section (O)[3]	MID		
	Visibility (O)[3]	n[n][n][n]M *or* n[n]KM		
	Runway section (O)[3]	END		VIS RWY 18C TDZ 6KM RWY 27 TDZ 4000M
	Visibility (O)[3]	n[n][n][n]M *or* n[n]KM		
Runway visual range (C)[6]	Name of the element (M)	RVR		RVR RWY 32 400M RVR RWY 20 1600M
	Runway (C)[7]	RWY nn[L] *or* RWY nn[C] *or* RWY nn[R]		
	Runway section (C)[8]	TDZ		
	RVR (M)	[ABV *or* BLW] nn[n][n]M		RVR RWY 10L BLW 50M RVR RWY 14 ABV 2000M RVR RWY 10 BLW 150M RVR RWY 12 ABV 1200M
	Runway section (C)[8]	MID		RVR RWY 12 TDZ 1100M MID ABV 1400M
	RVR (C)[8]	[ABV *or* BLW] nn[n][n]M		
	Runway section (C)[8]	END		RVR RWY 16 TDZ 600M MID 500M END 400M
	RVR (C)[8]	[ABV *or* BLW] nn[n][n]M		RVR RWY 26 500M RWY 20 800M

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Element as specified in Chapter 4	*Detailed content*	*Template(s)*			*Examples*
Present weather (C)[9, 10]	Intensity of present weather (C)[9]	FBL *or* MOD *or* HVY	—		
	Characteristics and type of present weather (C)[9,11]	DZ *or* RA *or* SN *or* SG *or* PL *or* DS *or* SS *or* FZDZ *or* FZUP[12] *or* FC[13] *or* FZRA *or* SHGR *or* SHGS *or* SHRA *or* SHSN *or* SHUP[12] *or* TSGR *or* TSGS *or* TSRA *or* TSSN *or* TSUP[12] *or* UP[12]	FG *or* BR *or* SA *or* DU *or* HZ *or* FU *or* VA *or* SQ *or* PO *or* FC *or* TS *or* BCFG *or* BLDU *or* BLSA *or* BLSN *or* DRDU *or* DRSA *or* DRSN *or* FZFG *or* MIFG *or* PRFG *or* //[12]		MOD RA HVY TSRA HVY DZ FBL SN HZ FG VA MIFG HVY TSRASN FBL SNRA FBL DZ FG HVY SHSN BLSN HVY TSUP //

Element as specified in Chapter 4	*Detailed content*	*Template(s)*				*Examples*
Cloud (M)[14]	Name of the element (M)	CLD				
	Runway (O)[2]	RWY nn[L] *or* RWY nn[C] *or* RWY nn[R]				CLD NSC
	Cloud amount (M) *or* vertical visibility (O)[9]	FEW *or* SCT *or* BKN *or* OVC *or* ///[12]	OBSC	NSC *or* NCD[12]		CLD SCT 300M OVC 600M (CLD SCT 1000FT OVC 2000FT) CLD OBSC VER VIS 150M (CLD OBSC VER VIS 500FT)
	Cloud type (C)[9]	CB *or* TCU *or* ///[12]	—			CLD BKN TCU 270M (CLD BKN TCU 900FT)
	Height of cloud base *or* the value of vertical visibility (C)[9]	n[n][n][n]M (*or* n[n][n][n]FT) *or* ///M (*or* ///[12]/FT)	[VER VIS n[n][n]M (*or* VER VIS n[n][n][n]FT)] *or* VER VIS ///M (*or* VER VIS ///[12]/FT)[1]			CLD RWY 08R BKN 60M RWY 26 BKN 90M (CLD RWY 08R BKN 200FT RWY 26 BKN 300FT) CLD /// CB ///M (CLD /// CB ///FT) CLD /// CB 400M (CLD /// CB 1200FT) CLD NCD
Air temperature (M)	Name of the element (M)	T				T17 TMS08
	Air temperature (M)	[MS]nn				
Dew-point temperature (M)	Name of the element (M)	DP				DP15 DPMS18
	Dew-point temperature (M)	[MS]nn				
Pressure values (M)	Name of the element (M)	QNH				QNH 0995HPA

Element as specified in Chapter 4	*Detailed content*	*Template(s)*		*Examples*
	QNH (M)	nnnnHPA		QNH 1009HPA
	Name of the element (O)	QFE		QNH 1022HPA QFE 1001HPA
	QFE (O)	[RWY nn[L] *or* RWY nn[C] *or* RWY nn[R]] nnnnHPA [RWY nn[L] *or* RWY nn[C] *or* RWY nn[R] nnnnHPA]		QNH 0987HPA QFE RWY 18 0956HPA RWY 24 0955HPA
Supplementary information (C)[9]	Significant meteorological phenomena (C)[9]	CB *or* TS *or* MOD TURB *or* SEV TURB *or* WS *or* GR *or* SEV SQL *or* MOD ICE *or* SEV ICE *or* FZDZ *or* FZRA *or* SEV MTW *or* SS *or* DS *or* BLSN *or* FC[15]		FC IN APCH WS IN APCH 60M-WIND 360/13MPS WS RWY 12
	Location of the phenomena (C)[9]	IN APCH [n[n][n][n]M-WIND nnn/n[n]MPS] *or* IN CLIMB-OUT [n[n][n][n]M-WIND nnn/n[n]MPS] (IN APCH [n[n][n][n]FT-WIND nnn/n[n]KT] *or* IN CLIMB-OUT [n[n][n][n]FT-WIND nnn/n[n]KT]) *or* RWY nn[L] *or* RWY nn[C] *or* RWY nn[R]		
	Recent weather (C)[9, 10]	REFZDZ *or* REFZRA *or* REDZ *or* RE[SH]RA *or* RERASN *or* RE[SH]SN *or* RESG *or* RESHGR *or* RESHGS *or* REBLSN *or* RESS *or* REDS *or* RETSRA *or* RETSSN *or* RETSGR *or* RETSGS *or* REFC *or* REPL or REUP[12] *or* REFZUP[12] *or* RETSUP[12] *or* RESHUP[12] *or* REVA *or* RETS		REFZRA CB IN CLIMB-OUT RETSRA
Trend forecast (O)[16]	Name of the element (M)	TREND		
	Change indicator (M)[17]	NOSIG	BECMG *or* TEMPO	TREND NOSIG TREND BECMG FEW 600M (TREND BECMG FEW 2000FT)
	Period of change (C)[9]		FMnnnn *and/or* TLnnnn *or* ATnnnn	
	Wind (C)[9]		nnn/[ABV]n[n][n]MPS [MAX[ABV]nn[n]] (*or* nnn/[ABV]n[n]KT [MAX[ABV]nn])	TREND TEMPO 250/18 MPS MAX25 (TREND TEMPO 250/36KT MAX50)

	Visibility (C)[9]		VIS n[n][n][n]M *or* VIS n[n]KM			C A V O K	TREND BECMG AT1800 VIS 10KM NSW TREND BECMG TL1700 VIS 800M FG TREND BECMG FM1030 TL1130 CAVOK
	Weather phenomenon: intensity (C)[9]		FBL *or* MOD *or* HVY	—	NSW		TREND TEMPO TL1200 VIS 600M BECMG AT1230 VIS 8KM NSW CLD NSC
	Weather phenomenon: characteristics and type (C)[9, 10, 11]		DZ *or* RA *or* SN *or* SG *or* PL *or* DS *or* SS *or* FZDZ *or* FZRA *or* SHGR *or* SHGS *or* SHRA *or* SHSN *or* TSGR *or* TSGS *or* TSRA *or* TSSN	FG *or* BR *or* SA *or* DU *or* HZ *or* FU *or* VA *or* SQ *or* PO *or* FC *or* TS *or* BCFG *or* BLDU *or* BLSA *or* BLSN *or* DRDU *or* DRSA *or* DRSN *or* FZFG *or* MIFG *or* PRFG			TREND TEMPO FM0300 TL0430 MOD FZRA TREND BECMG FM1900 VIS 500M HVY SNRA TREND BECMG FM1100 MOD SN TEMPO FM1130 BLSN
	Name of the element (C)[9]		CLD				
	Cloud amount and vertical visibility (C)[9,14]		FEW *or* SCT *or* BKN *or* OVC	OBSC	NSC		TREND BECMG AT1130 CLD OVC 300M (TREND BECMG AT1130 CLD OVC 1000FT)
	Cloud type (C)[9,14]		CB *or* TCU	—			TREND TEMPO TL1530 HVY SHRA CLD BKN CB 360M

	Height of cloud base *or* the value of vertical visibility (C)[9,14]		n[n][n][n]M (*or* n[n][n][n]FT)	[VER VIS n[n][n]M (*or* VER VIS n[n][n][n]FT)]			(TREND TEMPO TL1530 HVY SHRA CLD BKN CB 1200FT)

GM1 MET.TR.200(b) Meteorological reports and other information

RANGES AND RESOLUTIONS — LOCAL ROUTINE AND LOCAL SPECIAL REPORTS

(a) The ranges and resolutions for the numerical elements included in the local routine and special reports are shown below.

Ranges and resolutions for the numerical elements included in local reports

Element elements included in the local routine and special reports		Range	Resolution
Runway:		01–36	1
Wind direction:	°true	010–360	10
Wind speed:	MPS	1– 99*	1
	KT	1– 199*	1
Visibility:	M	0– 750	50
	M	800– 4 900	100
	KM	5– 9	1
	KM	10–	0 (fixed value: 10 KM)
Runway visual range:	M	0– 375	25
	M	400–750	50
	M	800–2 000	100
Vertical visibility:	M	0–75	15
	M	90–600	30
	FT	0–250	50
	FT	300–2 000	100
Clouds: height of cloud base:	M	0–75	15
	M	90–3 000	30

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	FT	0–250	50
	FT	300–10 000	100
Air temperature; Dew-point temperature:	°C	–80 – +60	1
QNH; QFE:	hPa	0500–1 100	1

* There is no aeronautical requirement to report surface wind speeds of 100 kt (50 m/s) or more; however, provision has been made for reporting wind speeds up to 199 kt (99 m/s) for non-aeronautical purposes, as necessary.

** Under circumstances as specified in 4.5.4.3; otherwise a resolution of 100 ft (30 m) is to be used.

(b) The explanations for the abbreviations can be found in the Procedures for Air Navigation Services — ICAO Abbreviations and Codes (PANS-ABC, Doc 8400).

GM1 MET.TR.200(b) & (c) Meteorological reports and other information

EXAMPLE OF METAR AND LOCAL ROUTINE REPORT

(a) Local routine report (same location and weather conditions as METAR):

MET REPORT YUDO 221630Z WIND 240/4KT VIS 600M RVR RWY 12 TDZ 1000M MOD DZ FG CLD SCT 1000FT OVC 2000FT T17 DP16 QNH 1018HPA TREND BECMG TL1700 VIS 800M FG BECMG AT1800 VIS 10KM NSW

(b) METAR for YUDO (Donlon/International)*:

METAR YUDO 221630Z 24004KT 0600 R12/1000U DZ FG SCT010 OVC020 17/16 Q1018 BECMG TL1700 0800 FG ECMG AT 1800 9999 NSW

Meaning of both reports:

Routine report for Donlon/International* issued on the 22nd of the month at 16.30 UTC; surface wind direction 240 degrees; wind speed 4 knots; visibility (along the runway(s) in the local routine report; prevailing visibility in METAR) 600 metres; runway visual range representative of the touchdown zone for runway 12 is 1 000 metres and the runway visual range values have shown an upward tendency during previous 10 minutes (Runway visual range tendency to be included in METAR only); and moderate drizzle and fog; scattered cloud at 1 000 feet; overcast at 2 000 feet; air temperature 17 degrees Celsius; dew-point temperature 16 degrees Celsius; QNH 1 018 hectopascals; trend during next 2 hours, visibility (along the runway(s) in the local routine report; prevailing visibility in METAR) becoming 800 metres in fog by 17.00 UTC; at 18.00 UTC visibility (along the runway(s) in the local routine report; prevailing visibility in METAR) becoming 10 kilometres or more and nil significant weather.

* Fictitious location

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GM2 MET.TR.200(b)(1) Meteorological reports and other information
EXAMPLE OF LOCAL SPECIAL REPORT

Local special report:

SPECIAL YUDO 151115Z WIND 050/25KT MAX37 MNM10 VIS 1200M RVR RWY 05 ABV 1800M HVY TSRA CLD BKN CB 500FT T25 DP22 QNH 1018HPA TREND TEMPO TL1200 VIS 600M BECMG AT1200 VIS 8KM NSW NSC

Meaning:

Special report for Donlon/International* issued on the 15th of the month at 11.15 UTC; surface wind direction 050 degrees; wind speed 25 knots gusting between 10 and 37 knots; visibility 1 200 metres along the runway; Runway visual range above 1 800 metres at the threshold on runway 05; thunderstorm with heavy rain; broken cumulonimbus cloud at 500 feet; air temperature 25 degrees Celsius; dew-point temperature 22 degrees Celsius; QNH 1 008 hectopascals; trend during next 2 hours, visibility along the runway temporarily 600 metres from 1 115 to 1 200, becoming at 12.00 UTC visibility along the runway 8 kilometres, thunderstorm ceases and nil significant weather and nil significant cloud.

** Fictitious location*

GM1 MET.TR.200(c)(1) Meteorological reports and other information
FORMAT OF METAR

The METAR code form is contained in the WMO Publication No 306, Manual on Codes, Volume I.1, Part A — Alphanumeric Codes.

AMC1 MET.TR.200(c)(2) Meteorological reports and other information
METAR — DIGITAL FORM

METAR should be disseminated, under bilateral agreements between Member States, in digital form.

GM1 MET.TR.200(c)(2) Meteorological reports and other information
METAR — DIGITAL FORM

(a) When METAR is disseminated in digital form, this is in addition to the METAR code form.

(b) Guidance on the information exchange model, GML, and the metadata profile is provided in the Manual on the Digital Exchange of Aeronautical Meteorological Information (Doc 10003).

GM1 MET.TR.200(e)(5) Meteorological reports and other information
NOISE ABATEMENT PROCEDURES

Noise abatement procedures are those in accordance with 7.2.6 of the PANS-ATM (Doc 4444).

GM1 MET.TR.205(a)(3)(iii)(A) Reporting of meteorological elements
NOISE ABATEMENT PROCEDURE

The noise abatement procedures are those in accordance with 7.2.6 of the PANS-ATM (Doc 4444).

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AMC1 MET.TR.205(b)(1) Reporting of meteorological elements
VISIBILITY — VALUES

In local routine and special reports, when instrumented systems are used for the measurement of visibility:

(a) if the visibility is observed from more than one location along the runway, the values representative of the touchdown zone should be reported first, followed, as necessary, by the values representative of the mid-point and stop-end of the runway, and the locations for which these values are representative should be indicated; and

(b) when there is more than one runway in use and the visibility is observed related to these runways, the available visibility values for each runway should be reported, and the runways to which the values refer should be indicated.

AMC2 MET.TR.205(b)(1) Reporting of meteorological elements
VISIBILITY

In METAR, visibility should be reported as prevailing visibility. When the visibility is not the same in different directions and:

(a) when the lowest visibility is different from the prevailing visibility, and (1) less than 1 500 m or 2) less than 50 % of the prevailing visibility, and less than 5 000 m, the lowest visibility observed should also be reported and, when possible, its general direction in relation to the aerodrome reference point indicated by reference to one of the eight points of the compass;

(b) if the lowest visibility is observed in more than one direction, then the most operationally significant direction should be reported; and

(c) when the visibility is fluctuating rapidly, and the prevailing visibility cannot be determined, only the lowest visibility should be reported, with no indication of direction.

AMC1 MET.TR.205(c)(1) Reporting of meteorological elements
RUNWAY VISUAL RANGE (RVR) — THRESHOLD LIMIT

(a) 50 m should be considered the lower limit, and 2 000 m the upper limit for RVR.

(b) Beyond these limits, local routine and special reports and METAR should merely indicate that the RVR is less than 50 or more than 2 000 m.

AMC1 MET.TR.205(c)(3) Reporting of meteorological elements
RUNWAY VISUAL RANGE (RVR) — VALUES FOR METAR

(a) When instrumented systems are used for the assessment of RVR, the variations in RVR during the 10-minute period immediately preceding the observation should be included if the RVR values during the 10-minute period have shown a distinct tendency, such that the mean during the first 5 minutes varies by 100 m or more from the mean during the second 5 minutes of the period.

(b) When the variation of the RVR values shows an upward or downward tendency, this should be indicated by the abbreviation ‘U’ or ‘D’, respectively. In cases when actual fluctuations during the 10-minute period show no distinct tendency, this should be indicated using the abbreviation ‘N’.

(c) When indications of tendency are not available, no abbreviations should be included.

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AMC1 MET.TR.205(c) Reporting of meteorological elements
RUNWAY VISUAL RANGE (RVR) — TOUCHDOWN ZONE VALUES

In METAR:

(a) only the value representative of the touchdown zone should be reported and no indication of location on the runway should be included; and

(b) where there is more than one runway available for landing, touchdown zone RVR values should be included for all such runways, up to a maximum of four, and the runways to which the values refer should be indicated.

AMC1 MET.TR.205(c)(4)(iii) Reporting of meteorological elements
RUNWAY VISUAL RANGE (RVR) — VALUES REPRESENTATION

(a) RVR assessments should be representative of:

(1) the touchdown zone and the mid-point of the runway intended for Category II instrument approach and landing operations; and

(2) the touchdown zone, mid-point and stop-end of the runway intended for Category III instrument approach and landing operations.

(b) Where RVR is determined by human observers, it should be reported to the appropriate local ATS units, whenever there is a change in the value to be reported in accordance with the reporting scale.

(c) The transmission of such reports should normally be completed within 15 seconds after the termination of the observation.

AMC1 MET.TR.205(d) Reporting of meteorological elements
PRESENT WEATHER PHENOMENA — AUTOMATIC OBSERVING SYSTEM

In local routine and special reports and in METAR reported by an automatic observing system, the following types of present weather phenomena should be reported, using their respective abbreviations and relevant criteria, as appropriate:

(a) Precipitation:

(1) drizzle (DZ);

(2) rain (RA); and

(3) snow (SN).

(b) Obscurations (hydrometeors);

(c) Fog (FG): reported when visibility is less than 1 000 m, except when qualified by ‘MI’, ‘BC’, ‘PR’ or ‘VC’;

(d) Mist (BR): reported when visibility is at least 1 000 m, but not more than 5 000 m;

(e) Obscurations (lithometeors). Haze (HZ) should be used when the obscuration consists predominantly of lithometeors and the visibility is 5 000 m or less;

(f) Unidentified precipitation (UP); and

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(g) Temporary failure of system/sensor: the present weather should be replaced by '//' when it cannot be observed due to a temporary failure of the system/sensor.

AMC2 MET.TR.205(d) Reporting of meteorological elements

PRESENT WEATHER PHENOMENA — SEMI-AUTOMATIC OBSERVING SYSTEM

In local routine and special reports and in METAR reported by a semi-automatic observing system, the following types of present weather phenomena should be reported, using their respective abbreviations and relevant criteria, as appropriate:

(a) Precipitation:

(1) drizzle (DZ);

(2) rain (RA);

(3) snow (SN);

(4) snow grains (SG);

(5) ice pellets (PL);

(6) hail (GR): reported when the diameter of the largest hailstones is 5 mm or more;

(7) small hail and/or snow pellets (GS): reported when the diameter of the largest hailstones is less than 5 mm.

(b) Obscurations (hydrometeors):

(1) fog (FG): reported when visibility is less than 1 000 m, except when qualified by 'MI', 'BC', 'PR' or 'VC'.

(2) mist (BR): reported when visibility is at least 1 000 m, but not more than 5 000 m;

(c) Obscurations (lithometeors)

The following should be used only when the obscuration consists predominantly of lithometeors and the visibility is 5 000 m or less, except 'SA' when qualified by 'DR' and volcanic ash:

(1) sand (SA);

(2) dust (widespread) (DU);

(3) haze (HZ);

(4) smoke (FU); and

(5) volcanic ash (VA).

(d) Other phenomena:

(1) dust/sand whirls (dust devils) (PO);

(2) squall (SQ);

(3) funnel cloud (tornado or waterspout) (FC);

(4) dust storm (DS);

(5) sandstorm (SS).

AMC3 MET.TR.205(d) Reporting of meteorological elements
PRESENT WEATHER PHENOMENA — UNIDENTIFIED PRECIPITATION (UP)

In automated local routine and special reports and in METAR, in addition to drizzle (DZ), rain (RA) and snow (SN), the abbreviation 'UP' should be used for unidentified precipitation when the type of precipitation cannot be identified by the automatic observing system.

AMC1 MET.TR.205(d)(3) Reporting of meteorological elements
PRESENT WEATHER PHENOMENA — ADDITIONAL CHARACTERISTICS

In local routine and special reports and in METAR, only when reported by a semi-automatic observing system, the following characteristics of present weather phenomena, as necessary, should be reported using their respective abbreviations and relevant criteria, as appropriate:

(a) Shower (SH): used to report showers. Showers observed in the vicinity of the aerodrome should be reported as 'VCSH' without qualification regarding type or intensity of precipitation.

(b) Blowing (BL): used with types of present weather phenomena raised by the wind to a height of 6 ft (2 m) or more above the ground.

(c) Low drifting (DR): used with types of present weather phenomena raised by the wind to less than 6 ft (2 m) above ground level.

(d) Shallow (MI): less than 6 ft (2 m) above ground level.

(e) Patches (BC): fog patches randomly covering the aerodrome.

(f) Partial (PR): a substantial part of the aerodrome covered by fog while the remainder is clear.

AMC2 MET.TR.205(d)(3) Reporting of meteorological elements
PRESENT WEATHER PHENOMENA — INTENSITY

In local routine and special reports and METAR, the relevant intensity or, as appropriate, the proximity to the aerodrome of the reported present weather phenomena should be indicated as follows:

	(local routine and special reports)	(METAR)
Light	FBL	–
Moderate	MOD	(no indication)
Heavy	HVY	+

— Used with types of present weather phenomena. Light intensity should be indicated only for precipitation.

Vicinity (VC)

— Between approximately 8 and 16 km of the aerodrome reference point and used only in METAR with present weather when not reported under AMC1 MET.TR.205(d)(3) and MET.TR.205(d)(3).

GM1 MET.TR.205(d)(3)(i) Reporting of meteorological elements
PRESENT WEATHER PHENOMENA — TS LIGHTNING DETECTION EQUIPMENT

(a) At aerodromes with human observers, lightning detection equipment may supplement human observations.

(b) For aerodromes with automatic observing systems, guidance on the use of lightning detection equipment intended for thunderstorm reporting is given in the Manual on Automatic Meteorological Observing Systems at Aerodromes (Doc 9837).

AMC1 MET.TR.205(e)(1) Reporting of meteorological elements
CLOUD — HEIGHT OF CLOUD BASE

In local routine and special reports and in METAR:

(a) the cloud amount should be reported using the abbreviations 'FEW' (1 to 2 oktas), 'SCT' (3 to 4 oktas), 'BKN' (5 to7 oktas) or 'OVC' (8 oktas);

(b) cumulonimbus clouds and towering cumulus clouds should be indicated as 'CB' and 'TCU', respectively;

(c) the vertical visibility should be reported in steps of 100 ft (30 m) up to 2 000 ft (600 m);

(d) if there are no clouds of operational significance and no restriction on vertical visibility and the abbreviation 'CAVOK' is not appropriate, the abbreviation 'NSC' should be used;

(e) when several layers or masses of cloud of operational significance are observed, their amount and height of cloud base should be reported in increasing order of the height of cloud base, and in accordance with the following criteria:

  (1) the lowest layer or mass, regardless of the amount to be reported as FEW, SCT, BKN or OVC, as appropriate;

  (2) the next layer or mass, covering more than 2/8 to be reported as SCT, BKN or OVC, as appropriate;

  (3) the next higher layer or mass, covering more than 4/8 to be reported as BKN or OVC, as appropriate; and

  (4) cumulonimbus and/or towering cumulus clouds, whenever observed and not reported in (1) to (3).

(f) when the cloud base is diffuse or ragged or fluctuating rapidly, the minimum height of cloud base or cloud fragments, should be reported; and

(g) when an individual layer (mass) of cloud is composed of cumulonimbus and towering cumulus clouds with a common cloud base, the type of cloud should be reported as cumulonimbus only.

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AMC2 MET.TR.205(e)(1) Reporting of meteorological elements
CLOUD — AUTOMATIC OBSERVING SYSTEM

When an automatic observing system is used to report local routine and special reports and METAR:

(a) when the cloud type cannot be observed, the cloud type in each cloud group should be replaced by '///';

(b) when no clouds are detected, it should be indicated by using the abbreviation 'NCD';

(c) when cumulonimbus clouds or towering cumulus clouds are detected and the cloud amount and/or the height of cloud base cannot be observed, the cloud amount and/or the height of cloud base should be replaced by '///'; and

(d) when the sky is obscured and the value of the vertical visibility cannot be determined due to a temporary failure of the system/sensor, the vertical visibility should be replaced by '///'.

AMC1 MET.TR.205(e)(3) Reporting of meteorological elements
CLOUD — HEIGHT OF CLOUD BASE

At aerodromes where low-visibility procedures are established for approach and landing, as agreed between the meteorological station and the appropriate ATS unit, in local routine and special reports, the height of cloud base should be reported in steps of 50 ft up to and including 300 ft (90 m) and in steps of 100 ft (30 m) between 300 ft (90 m) and 10 000 ft (3 000 m), and the vertical visibility in steps of 50 ft (15 m) up to and including 300 ft (90 m) and in steps of 100 ft (30 m) between 300 ft (90 m) and 2 000 ft (600 m).

AMC1 MET.TR.210 Observing meteorological elements
HUMAN OBSERVATION

Observers at an aerodrome should be located, in so far as is practicable, so as to provide data which is representative of the area for which the observations are required.

GM1 MET.TR.210 Observing meteorological elements
HUMAN OBSERVATION

When a semi-automatic observing system is used, the observer should be located, in so far as is practicable, so as to supply data which is representative of the area for which the observations are required.

GM2 MET.TR.210 Observing meteorological elements
OPERATIONALLY DESIRABLE ACCURACY OF OBSERVATION

Element to be observed	*Operationally desirable accuracy of measurement or observation**
Mean surface wind	*Direction: ± 10°* *Speed: ± 0.5 m/s (1 kt) up to 5 m/s (10 kt)* *± 10 % above 5 m/s (10 kt)*

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Variations from the mean surface wind	*± 1 m/s (2 kt), in terms of longitudinal and lateral components*
Visibility	*± 50 m up to 600 m* *± 10 % between 600 m and 1 500 m* *± 20 % above 1 500 m*
Runway visual range	*± 10 m up to 400 m* *± 25 m between 400 m and 800 m* *± 10 % above 800 m*
Cloud amount	*± 1 okta*
Cloud height	*± 10 m (33 ft) up to 100 m (330 ft)* *± 10 % above 100 m (330 ft)*
Air temperature and dew-point temperature	*± 1°C*
Pressure value (QNH, QFE)	*± 0.5 hPa*

* The operationally desirable accuracy is not intended as an operational requirement; it is to be understood as a goal that has been expressed by the operators.

AMC1 MET.TR.210(a) Observing meteorological elements
SURFACE WIND OBSERVATIONS

(a) When local routine and special reports are used for departing or arriving aircraft, the surface wind observations for these reports should be representative of conditions along the runway or the touchdown zone respectively.

(b) For METAR, the surface wind observations should be representative of the conditions above the whole runway where there is only one runway and the whole runway complex where there is more than one runway.

GM1 MET.TR.210(a) Observing meteorological elements
SURFACE WIND OBSERVATIONS FOR TAKE-OFF AND LANDING

Since, in practice, the surface wind cannot be measured directly on the runway, surface wind observations for take-off and landing are expected to be the best practicable indication of the winds which an aircraft will encounter during take-off and landing.

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AMC1 MET.TR.210(a)(1) Observing meteorological elements
SURFACE WIND — SITING

(a) Reported surface wind should be representative of a wind at a height of 30 ± 3 ft (10 ± 1 m) above the ground.

(b) Representative surface wind observations should be obtained by the use of sensors appropriately sited.

(c) Sensors for surface wind observations for local routine and special reports should be sited to give the best practicable indication of conditions along the runway and touchdown zones.

(d) At aerodromes where topography or prevalent weather conditions cause significant differences in surface wind at various sections of the runway, additional sensors should be provided.

GM1 MET.TR.210(a)(1) Observing meteorological elements
SURFACE WIND — SITING

Specifications concerning the siting of equipment and installations on operational areas, aiming at reducing the hazard to aircraft to a minimum, are contained in the EASA CS ADR-DSN.T.915 'Siting of equipment and installations on operational areas'.

AMC1 MET.TR.210(a)(2) Observing meteorological elements
SURFACE WIND — DISPLAY

The mean values of, and significant variations in, the surface wind direction and speed for each sensor should be derived and displayed by automated equipment.

AMC1 MET.TR.210(a)(3) Observing meteorological elements
SURFACE WIND — AVERAGING

The averaging period for measuring variations from the mean wind speed (gusts) reported in accordance with MET.TR.205(a)(3)(iii) should be 3 seconds for local routine and special reports and for METAR, and for wind displays used for depicting variations from the mean wind speed (gusts) in ATS units.

GM1 MET.TR.210(a)(3)(ii) Observing meteorological elements
SURFACE WIND — AVERAGING — MARKED DISCONTINUITY

A marked discontinuity occurs when there is an abrupt and sustained change in wind direction of 30° or more, with a wind speed of 10 kt (5 m/s) before or after the change, or a change in wind speed of 10 kt (5 m/s) or more, lasting at least 2 minutes.

AMC1 MET.TR.210(b)(1) Observing meteorological elements
VISIBILITY — GENERAL

(a) When instrumented systems are used for the measurement of visibility, their output should be updated at least every 60 seconds to permit provision of current representative values.

(b) When instrumented systems are used for the measurement of visibility, it should be measured at a height of approximately 7.5 ft (2.5 m) above the runway.

(c) When local routine and special reports are used for departing aircraft, the visibility observations for these reports should be representative of the conditions along the runway.

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(d) When local routine and special reports are used for arriving aircraft, the visibility observations for these reports should be representative of the touchdown zone of the runway.

(e) For METAR, the visibility observations should be representative of the aerodrome.

AMC1 MET.TR.210(b)(2) Observing meteorological elements
VISIBILITY — SITING

(a) When instrumented systems are used for the measurement of visibility, representative visibility observations should be obtained by the use of sensors appropriately sited.

(b) Sensors for visibility observations for local routine and special reports should be sited to give the best practicable indications of visibility along the runway and touchdown zone.

AMC1 MET.TR.210(b)(4) Observing meteorological elements
VISIBILITY — AVERAGING

The averaging period for visibility should be 1 minute for local routine and special reports and for visibility displays in ATS units.

GM1 MET.TR.210(b)(4)(ii) Observing meteorological elements
VISIBILITY — AVERAGING — MARKED DISCONTINUITY

A marked discontinuity occurs when there is an abrupt and sustained change in visibility, lasting at least 2 minutes, which reaches or passes through one or more of the following values: 800, 1 500 or 3 000 or 5 000 m.

AMC1 MET.TR.210(c) Observing meteorological elements
RUNWAY VISUAL RANGE (RVR) — ASSESSMENT

RVR should be assessed:

(a) at a height of approximately 7.5 ft (2.5 m) above the runway for instrument systems or at a height of approximately 15 ft (5 m) above the runway by a human observer;

(b) at a lateral distance from the runway centre line of not more than 120 m.

GM1 MET.TR.210(c) Observing meteorological elements
RUNWAY VISUAL RANGE (RVR) - ASSESSMENT

A detailed understanding of the assessment of RVR is described in ICAO Doc 9328 Manual on 'RVR — Observing and reporting practices'.

AMC1 MET.TR.210(c)(1) Observing meteorological elements
RUNWAY VISUAL RANGE (RVR) — SITING

(a) The site for observations to be representative of the touchdown zone should be located about 300 m along the runway from the threshold.

(b) The sites for observations to be representative of the mid-point and stop-end of the runway should be located at a distance of 1 000 to 1 500 m along the runway from the threshold and at a distance of about 300 m from the other end of the runway.

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(c) The exact position of these sites and, if necessary, additional sites should be decided after considering aeronautical, meteorological and climatological factors such as long runways, swamps and other fog-prone areas.

AMC1 MET.TR.210(c)(2) Observing meteorological elements
RUNWAY VISUAL RANGE (RVR) — RUNWAY LIGHT INTENSITY

(a) Instrument systems should consider the runway light intensity.

(b) When instrumented systems are used for the assessment of RVR, computations should be made separately for each available runway.

(c) RVR should not be computed for a light intensity of 3 % or less of the maximum light intensity available on a runway.

(d) For local routine and special reports, the light intensity to be used for the computation should be:

(1) for a runway with the lights switched on, the light intensity actually in use on that runway; and

(2) for a runway with lights switched off (or at the lowest setting pending the resumption of operations), the optimum light intensity that would be appropriate for operational use in the prevailing conditions.

(e) In METAR, the RVR should be based on the maximum light intensity available on the runway.

GM1 MET.TR.210(c)(2) Observing meteorological elements
RUNWAY VISUAL RANGE (RVR) — USE OF INSTRUMENTED SYSTEMS

(a) Since accuracy can vary from one instrument design to another, performance characteristics are to be checked before selecting an instrument for assessing the runway visual range.

(b) The calibration of a forward-scatter meter has to be traceable and verifiable to a transmissometer standard, whose accuracy has been verified over the intended operational range.

(c) Guidance on the use of transmissometers and forward-scatter meters in instrumented Runway Visual Range systems is given in the Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328).

GM1 MET.TR.210(c)(4)(ii)(B) Observing meteorological elements
RUNWAY VISUAL RANGE (RVR) — AVERAGING

A marked discontinuity occurs when there is an abrupt and sustained change in RVR, lasting at least 2 minutes, which reaches or passes through the values 800, 550, 300 and 175 m.

AMC1 MET.TR.210(d)(1) Observing meteorological elements
PRESENT WEATHER — GENERAL

(a) For local routine and special reports, the present weather information should be representative of the conditions at the aerodrome.

(b) For METAR, the present weather information should be representative of the conditions at the aerodrome and, for certain specified present weather phenomena, in its vicinity.

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AMC1 MET.TR.210(d)(2) Observing meteorological elements
PRESENT WEATHER — SITING

When instrumented systems are used for observing present weather phenomena listed under AMC2 MET.TR.205(d), MET.TR.205(d)(3) and AMC1 MET.TR.205(d)(3), representative information should be obtained by the use of sensors appropriately sited.

AMC1 MET.TR.210(e) Observing meteorological elements
CLOUDS — GENERAL

(a) Cloud observations for local routine and special reports should be representative of the runway threshold(s) in use.

(b) Cloud observations for METAR should be representative of the aerodrome and its vicinity.

AMC1 MET.TR.210(e)(2) Observing meteorological elements
CLOUDS — SITING

(a) When instrumented systems are used for the measurement of the cloud amount and the height of cloud base, representative observations should be obtained by the use of sensors appropriately sited.

(b) For local routine and special reports, in the case of aerodromes with precision approach runways, sensors for the cloud amount and the height of cloud base should be sited to give the best practicable indications of the cloud amount and the height of cloud base and at the middle marker site of the instrument landing system or, at aerodromes where a middle marker beacon is not used, at a distance of 3 000 to 4 000 ft (900 to 1 200 m) from the landing threshold at the approach end of the runway.

GM1 MET.TR.210(e)(2) Observing meteorological elements
CLOUDS — SITING

Specifications concerning the middle marker site of an instrument landing system are given in Annex 10, Volume I, Chapter 3, and in Attachment C, Table C-5.

AMC1 MET.TR.210(f) Observing meteorological elements
AIR TEMPERATURE AND DEW-POINT TEMPERATURE — GENERAL

Observations of air temperature and dew-point temperature for local routine and special reports and METAR should be representative of the whole runway complex.

AMC1 MET.TR.210(g)(3) Observing meteorological elements
ATMOSPHERIC PRESSURE — REFERENCE LEVEL

(a) The reference level for the computation of QFE should be the aerodrome elevation.

(b) For non-precision approach runways, whose thresholds are 7 ft (2 m) or more below the aerodrome elevation, and for precision approach runways, the QFE, if required, should refer to the relevant threshold elevation.

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Chapter 2 — Technical requirements for aerodrome meteorological offices

AMC1 MET.TR.215(a) Forecasts and other information
MEANS BY WHICH METEOROLOGICAL INFORMATION CAN BE PROVIDED

Meteorological information provided to operators and flight crew members should be provided by means of one or more of the following:

(a) written or printed material, including specified charts and forms;

(b) data in digital form;

(c) briefing;

(d) consultation;

(e) display; or

(f) an automated pre-flight information system providing self-briefing and flight documentation facilities while retaining access by operators and aircrew members to consultation, as necessary, with the aerodrome meteorological office.

AMC2 MET.TR.215(a) Forecasts and other information
SPECIFIC INFORMATION FOR HELICOPTER OPERATIONS

(a) Meteorological information for pre-flight planning and in-flight replanning by operators of helicopters flying to offshore structures should include data covering the layers from sea level to flight level 100.

(b) Particular mention should be made of the expected surface visibility, the amount, type, where available, base and tops of cloud below flight level 100, sea state and sea-surface temperature, mean sea-level pressure, and the occurrence and expected occurrence of turbulence and icing.

AMC1 MET.TR.215(a) Forecasts and other information
AUTOMATED PRE-FLIGHT INFORMATION SYSTEMS

Automated pre-flight information systems for the supply of meteorological information for self-briefing, pre-flight planning and flight documentation should:

(a) provide for the continuous and timely updating of the system database and monitoring of the validity and integrity of the meteorological information stored;

(b) permit access to the system by operators and flight crew members and also by other aeronautical users concerned through suitable telecommunications means;

(c) use access and interrogation procedures based on abbreviated plain language and, as appropriate, ICAO location indicators, and aeronautical meteorological code data-type designators prescribed by WMO, or based on a menu-driven user interface, or other appropriate mechanisms as agreed between the meteorological authority and the operators concerned; and

(d) provide for rapid response to a user request for information.

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GM1 MET.TR.215(a) Forecasts and other information
AUTOMATED PRE-FLIGHT INFORMATION SYSTEMS

(a) ICAO abbreviations and codes and location indicators are given respectively in the Procedures for Air Navigation Services — ICAO Abbreviations and Codes (PANS-ABC, Doc 8400) and Location Indicators (Doc 7910).

(b) Aeronautical meteorological code data-type designators are given in the WMO Publication No 386, Manual on the Global Telecommunication System.

GM1 MET.TR.215(b) Forecasts and other information
METEOROLOGICAL INFORMATION TO RESCUE COORDINATION CENTRES

(a) The elements which are not distributed routinely are:

(1) state of ground, and in particular any snow cover or flooding;

(2) sea-surface temperature, state of the sea, ice cover (if any) and ocean currents, if relevant to the search area; and

(3) sea-level pressure data.

(b) On request from the rescue coordination centre, the designated aerodrome meteorological office or meteorological watch office should arrange to obtain details of the flight documentation which was supplied to the missing aircraft, together with any amendments to the forecast which were transmitted to the aircraft in flight.

GM2 MET.TR.215(b) Forecasts and other information
METEOROLOGICAL INFORMATION TO RESCUE COORDINATION CENTRES

Information to be supplied to rescue coordination centres includes:

(a) significant en-route weather phenomena;

(b) cloud amount and type, particularly cumulonimbus; height indications of bases and tops;

(c) visibility and phenomena reducing visibility;

(d) surface wind and upper wind;

(e) state of ground, in particular, any snow cover or flooding;

(f) sea-surface temperature, state of the sea, ice cover if any and ocean currents, if relevant to the search area; and

(g) sea-level pressure data.

AMC1 MET.TR.215(d)(5) Forecasts and other information
HEIGHT INDICATIONS

All references to en-route meteorological conditions, such as height indications of upper winds, turbulence or bases and tops of clouds, should be expressed in flight levels.

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GM1 MET.TR.215(d)(5) Forecasts and other information
HEIGHT INDICATIONS

Height indications referred to en-route meteorological conditions may also be expressed in pressure, altitude or, for low-level flights, in height above ground level.

AMC1 MET.TR.215(e) Forecasts and other information
FLIGHT DOCUMENTATION

(a) Where the forecasts are supplied in chart form, flight documentation for low-level flights, including those in accordance with the visual flight rules, operating up to flight level 100 or up to flight level 150 in mountainous areas or higher, where necessary, should contain the following as appropriate to the flight:

(1) information from relevant SIGMET and AIRMET messages;

(2) upper wind and upper-air temperature charts; and

(3) significant weather charts.

(b) Where the forecasts are not supplied in chart form, flight documentation for low-level flights, including those in accordance with the visual flight rules, operating up to flight level 100 or up to flight level 150 in mountainous areas or higher, where necessary, should contain the following information as appropriate to the flight: SIGMET and AIRMET information.

AMC1 MET.TR.215(e)(1) & (2) Forecasts and other information
CHARTS FORM

When the flight documentation related to forecasts of upper wind and upper-air temperature and SIGWX phenomena is presented in the form of charts, it should be in accordance with the below model charts.

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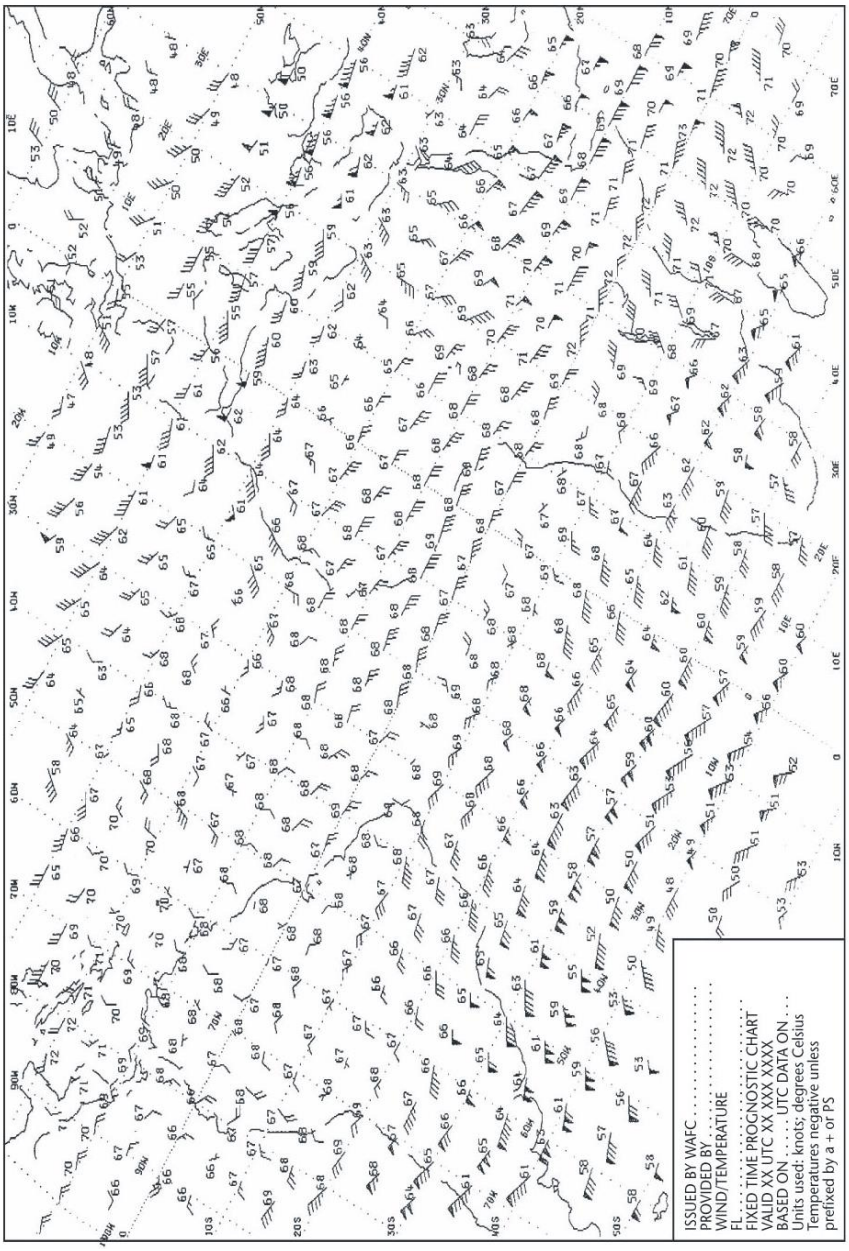
UPPER WIND AND TEMPERATURE CHART FOR STANDARD ISOBARIC SURFACE (MODEL IS)

Example 1. Arrows, feathers and pennants (Mercator projection)



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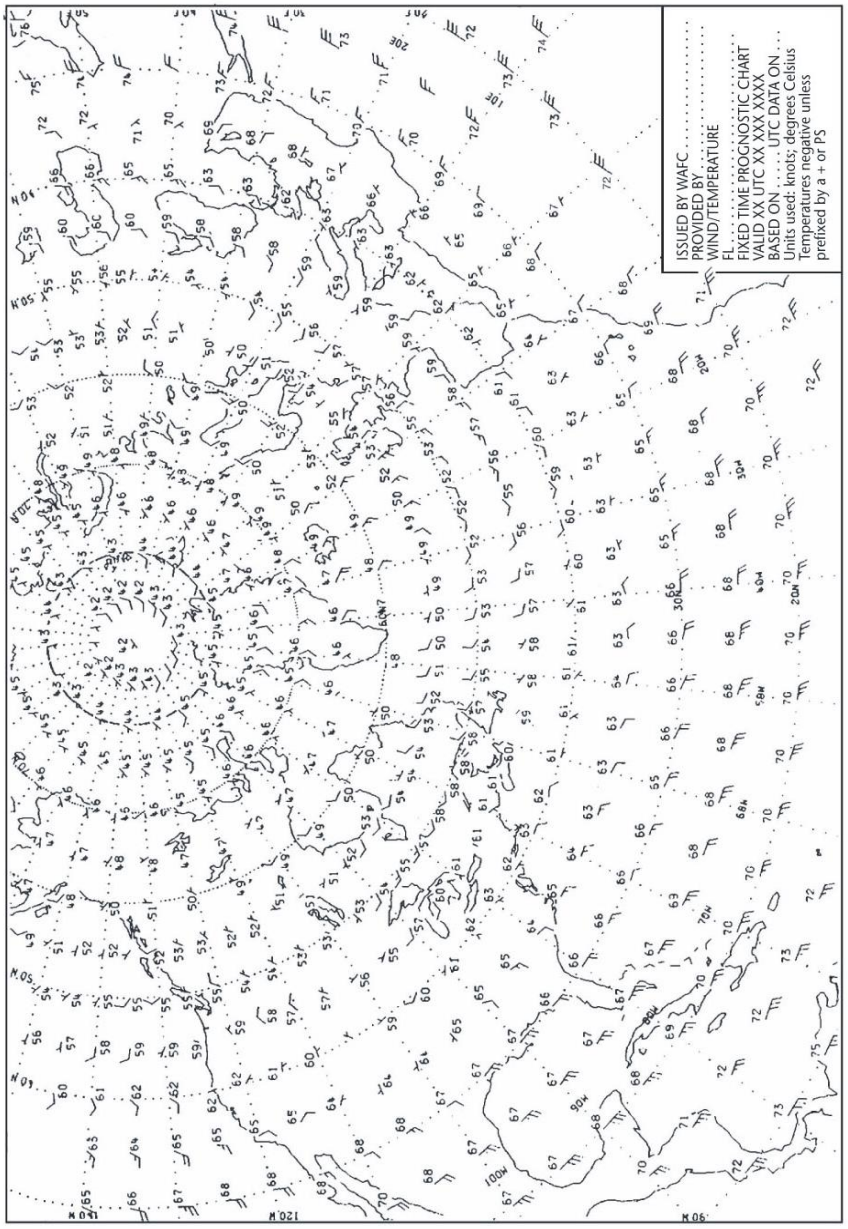
UPPER WIND AND TEMPERATURE CHART FOR STANDARD ISOBARIC SURFACE
MODEL IS
Example 2. Arrows, feathers and pennants (Polar stereographic projection)



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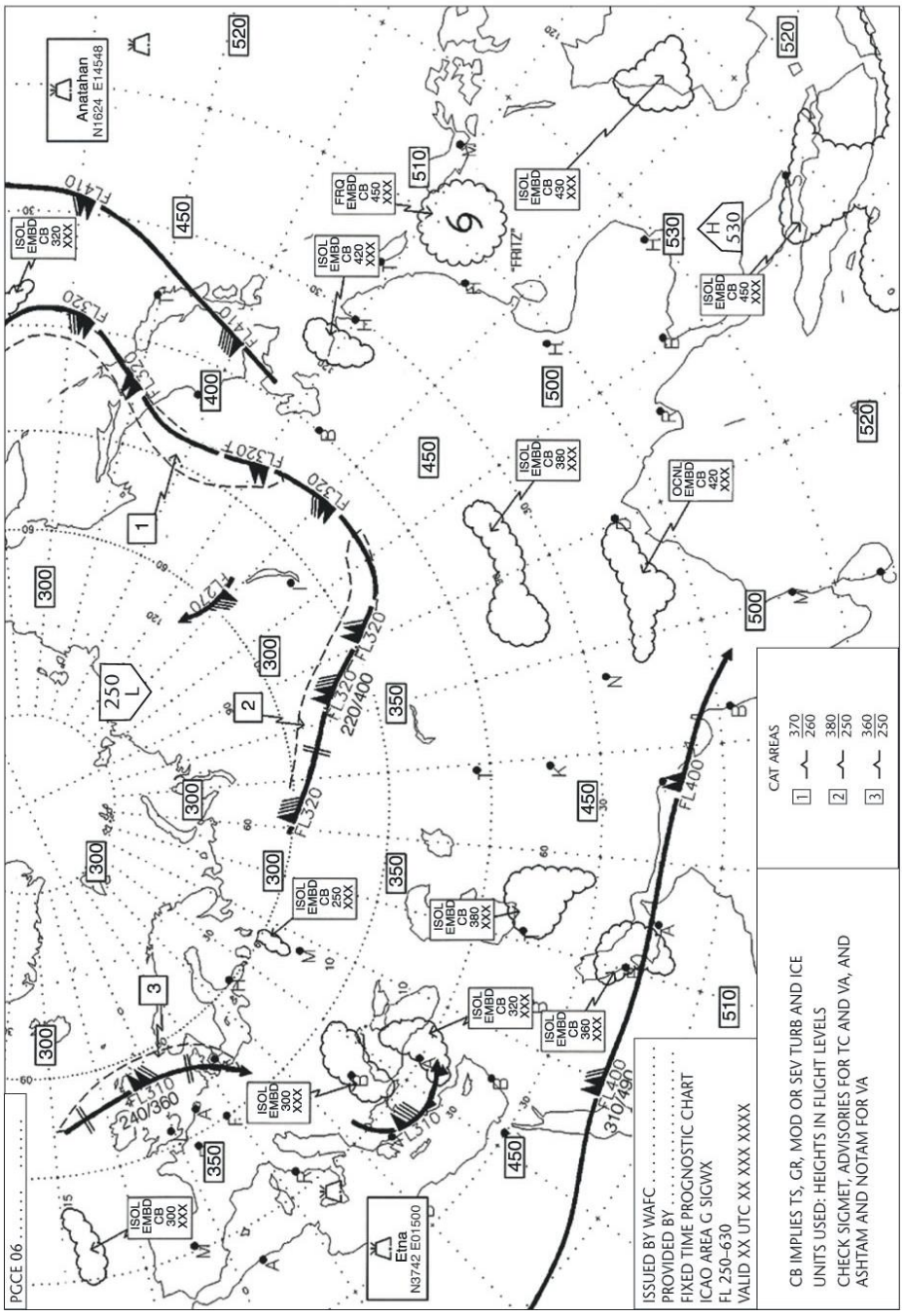
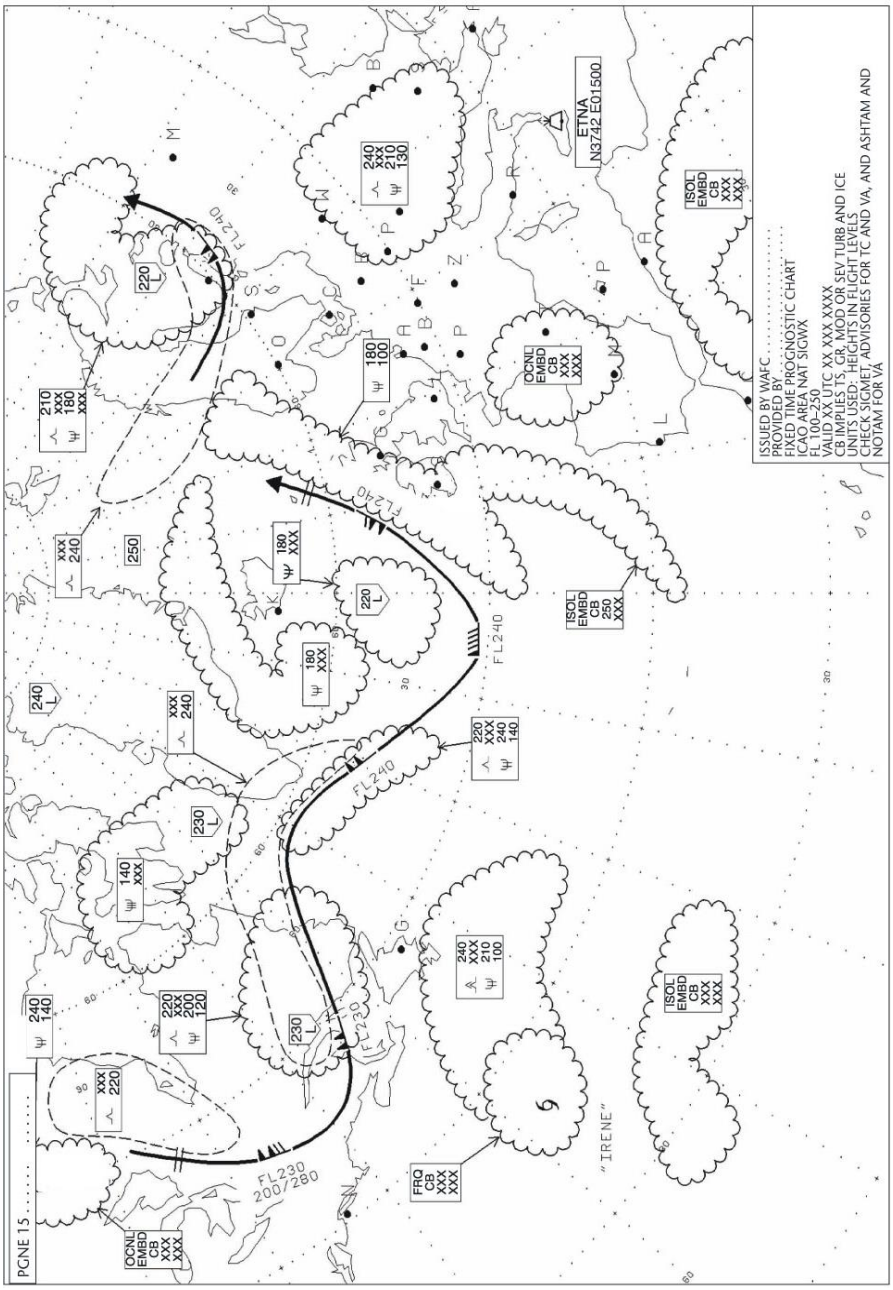
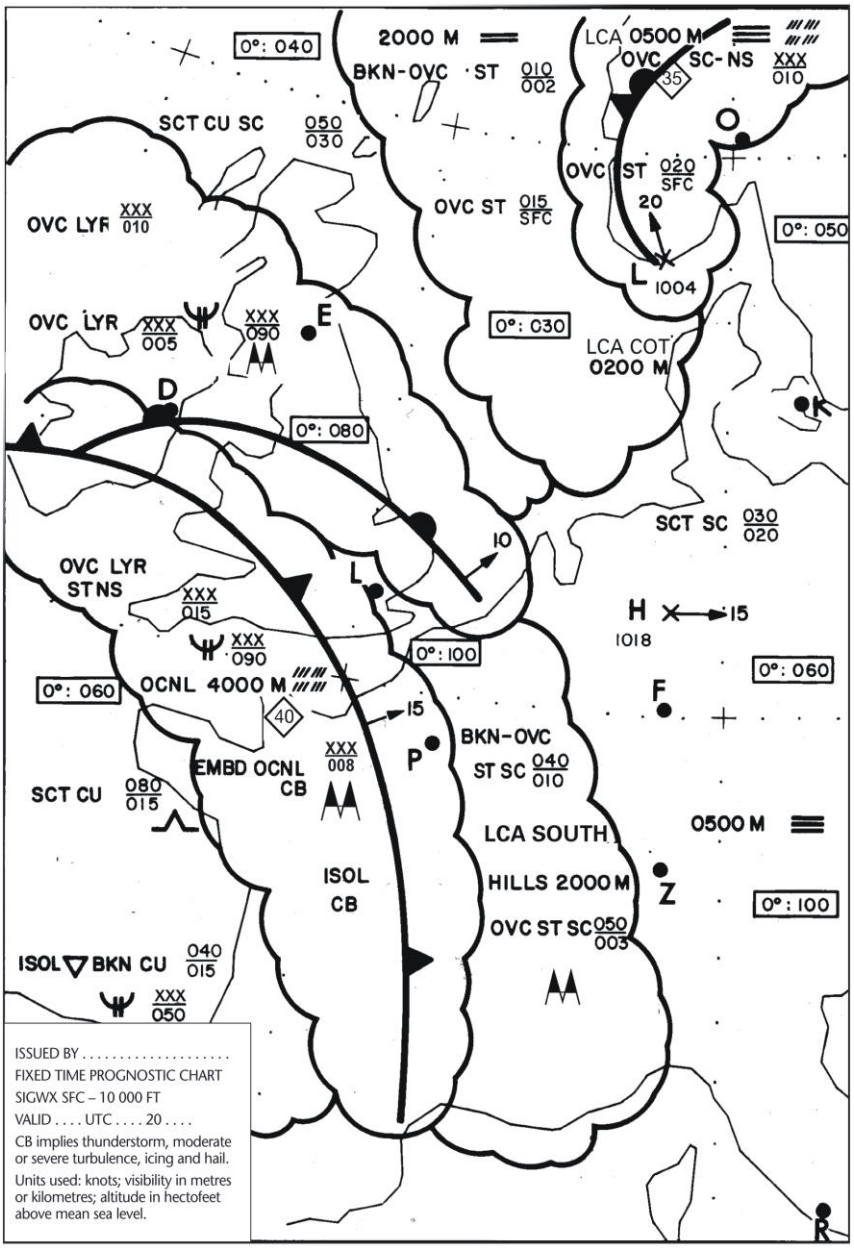
SIGNIFICANT WEATHER CHART (HIGH LEVEL)
MODEL SWH
Example. Polar stereographic projection (showing the jet stream vertical extent)



SIGNIFICANT WEATHER CHART (MEDIUM LEVEL)
MODEL SWM



SIGNIFICANT WEATHER CHART (LOW LEVEL)
MODEL SWL
Example 1



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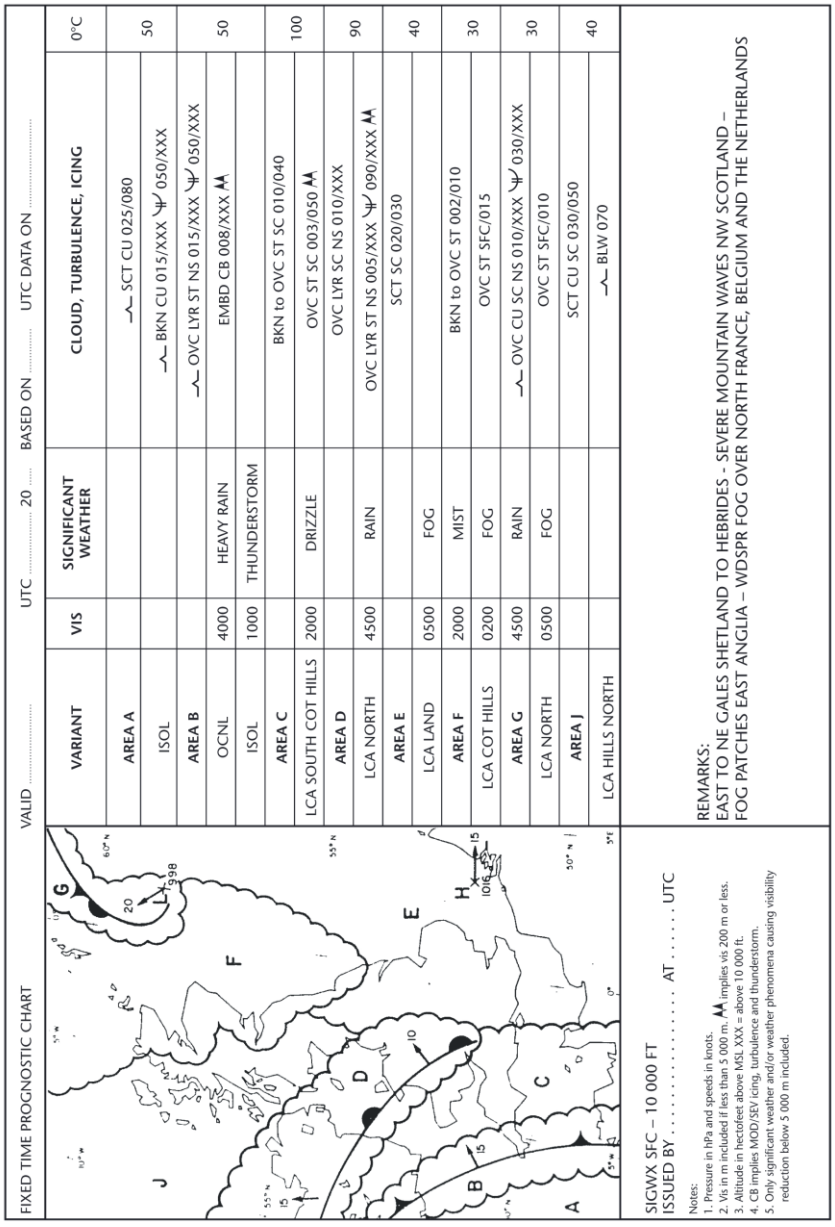
SIGNIFICANT WEATHER CHART (LOW LEVEL)
MODEL SWL
Example 2



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AMC2 MET.TR.215(e)(1) & (2) Forecasts and other information
FORMAT OF FLIGHT DOCUMENTATION

The location indicators and the abbreviations used should be explained in the flight documentation.

AMC1 MET.TR.215(f) Forecasts and other information
CHARACTERISTICS OF CHARTS

Charts included in flight documentation should have a high standard of clarity and legibility and should have the following physical characteristics:

(a) For convenience, the largest size of charts should be about 42 × 30 cm (standard A3 size) and the smallest size should be about 21 × 30 cm (standard A4 size). The choice between these sizes should depend on the route lengths and the amount of detail that needs to be given in the charts as agreed between the meteorological authorities and the users;

(b) Major geographical features, such as coastlines, major rivers and lakes, should be depicted in a way that makes them easily recognisable;

(c) For charts prepared by computer, meteorological data should take preference over basic chart information, the former cancelling the latter wherever they overlap;

(d) Major aerodromes should be shown as a dot and identified by the first letter of the name of the city the aerodrome serves as given in Table AOP of the EUR air navigation plan;

(e) A geographical grid should be shown with meridians and parallels represented by dotted lines at each 10°-latitude and longitude; dots should be spaced one degree apart;

(f) Latitude and longitude values should be indicated at various points throughout the charts; and

(g) Labels on the charts for flight documentation should be clear and simple and should present the name of the world area forecast centre or, for non-WAFS products, the originating centre, the type of chart, date and valid time and, if necessary, the types of units used in an unambiguous way.

AMC2 MET.TR.215(f) Forecasts and other information
SET OF CHARTS TO BE PROVIDED

(a) The minimum number of charts for flights between flight level 250 and flight level 630 should include a high-level SIGWX chart (flight level 250 to flight level 630) and a forecast 250 hPa wind and temperature chart.

(b) The actual charts provided for pre-flight and in-flight planning and for flight documentation should be agreed between the meteorological providers and the users concerned.

GM1 MET.TR.215(f) Forecasts and other information
CHARTS — SHORT-HAUL FLIGHTS

For short-haul flights, charts should be prepared covering limited areas at a scale of $1:15 \times 10^6$ as required.

GM1 MET.TR.215(g) Forecasts and other information
CONCATENATED ROUTE-SPECIFIC FORECASTS

(a) The flight documentation related to concatenated route-specific upper wind and upper-air temperature forecasts should be provided when agreed between the meteorological service provider and the operator concerned.

(b) Guidance on the design, formulation and use of concatenated charts is given in the Manual of Aeronautical Meteorological Practice (Doc 8896).

AMC1 MET.TR.215(i) Forecasts and other information
CLIMATOLOGICAL INFORMATION — PERIOD OF OBSERVATION

Aeronautical climatological information should be based on observations made over a period of at least five years. The period should be indicated in the information supplied.

AMC2 MET.TR.215(i) Forecasts and other information
CLIMATOLOGICAL DATA RELATED TO SITES FOR NEW AERODROMES

Climatological data related to sites for new aerodromes and to additional runways at existing aerodromes should be collected starting as early as possible before the commissioning of those aerodromes or runways.

AMC3 MET.TR.215(i) Forecasts and other information
PURPOSE OF CLIMATOLOGICAL SUMMARIES

Aerodrome climatological summaries should follow the procedures prescribed by the World Meteorological Organization and should be made available in a form to meet a specific user request.

AMC4 MET.TR.215(i) Forecasts and other information
CLIMATOLOGICAL TABLE — GENERAL

An aerodrome climatological table should indicate:

(a) mean values and variations therefrom, including maximum and minimum values, of meteorological elements; and/or

(b) the frequency of occurrence of present weather phenomena affecting flight operations at the aerodrome; and/or

(c) the frequency of occurrence of specified values of one, or of a combination of two or more, elements.

AMC5 MET.TR.215(i) Forecasts and other information
CLIMATOLOGICAL TABLE — GENERAL

Aerodrome climatological tables should include information required for the preparation of aerodrome climatological summaries.

AMC6 MET.TR.215(i) Forecasts and other information
CLIMATOLOGICAL SUMMARIES — GENERAL

Aerodrome climatological summaries should cover:

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(a) frequencies of the occurrence of runway visual range/visibility and/or height of base of the lowest cloud layer of BKN or OVC extent below specified values at specified times;

(b) frequencies of visibility below specified values at specified times;

(c) frequencies of the height of base of the lowest cloud layer of BKN or OVC extent below specified values at specified times;

(d) frequencies of occurrence of concurrent wind direction and speed within specified ranges;

(e) frequencies of surface temperature in specified ranges of 5°C at specified times; and

(f) mean values and variations therefrom, including maximum and minimum values of meteorological elements required for operational planning purposes, including take-off performance calculations.

GM1 MET.TR.215(i) Forecasts and other information
CLIMATOLOGICAL INFORMATION — GENERAL

In cases where it is impracticable to meet the requirements for aeronautical climatological information on a national basis, the collection, processing and storage of observational data may be effected through computer facilities available for international use, and the responsibility for the preparation of the required aeronautical climatological information may be delegated by agreement between the competent authorities concerned.

GM2 MET.TR.215(i) Forecasts and other information
MODELS OF CLIMATOLOGICAL SUMMARIES

Models of climatological summaries related to (a) to (e) of AMC6 MET.TR.215(i) are given in the WMO Publication No 49, Technical Regulations, Volume II, C.3.2.

GM3 MET.TR.215(i) Forecasts and other information
CLIMATOLOGICAL DATA REQUIRED FOR AERODROME PLANNING PURPOSES

Climatological data required for aerodrome planning purposes are set out in GM1 ADR-DSN.B.025 ‘Data to be used’.

GM1 MET.TR.220 Aerodrome forecasts
EXAMPLE OF TAF

TAF for YUDO (Donlon/International)*:

TAF YUDO 160000Z 1606/1624 13005MPS 9000 BKN020 BECMG 1606/1608 SCT015CB BKN020 TEMPO 1608/1612 17006G12MPS 1000 TSRA SCT010CB BKN020 FM161230 15004MPS 9999 BKN020

Meaning of the forecast:

TAF for Donlon/International* issued on the 16th of the month at 00.00 UTC valid from 06.00 UTC to 24.00 UTC on the 16th of the month; surface wind direction 130 degrees; wind speed 5 knots; visibility 9 kilometres, broken cloud at 2 000 feet; becoming between 06.00 UTC and 08.00 UTC on the 16th of the month, broken cloud at 800 feet; temporarily between 08.00 UTC and 12.00 UTC on the 16th of the month surface wind direction 170 degrees; wind speed 15 knots gusting to 25 knots; visibility 1 000 metres in a thunderstorm with moderate rain, scattered cumulonimbus cloud at 300 metres and broken cloud at 2 000 feet; from 12.30 UTC on the 16th of the month, surface wind direction 150 degrees;

wind speed 4 knots; visibility 10 kilometres or more; and broken cloud at 2 000 feet.

** Fictitious location*

GM2 MET.TR.220 Aerodrome forecasts
EXAMPLE OF CANCELLATION OF TAF

Cancellation of TAF for YUDO (Donlon/International):*

TAF AMD YUDO 161500Z 1606/1624 CNL

Meaning of the forecast:

Amended TAF for Donlon/International* issued on the 16th of the month at 15.00 UTC cancelling the previously issued TAF valid from 06.00 UTC to 24.00 UTC on the 16th of the month.

** Fictitious location*

GM3 MET.TR.220 Aerodrome forecasts
ACCURACY OF TAF

Guidance on operationally desirable accuracy of TAF is given below:

Element to be forecast	*Operationally desirable accuracy of forecasts*	*Minimum percentage of cases within range*
	TAF	
Wind direction	± 20°	80 % of cases
Wind speed	± 2.5 m/s (5 kt)	80 % of cases
Visibility	± 200 m up to 800 m ± 30 % between 800 m and 10 km	80 % of cases
Precipitation	Occurrence or non-occurrence	80 % of cases
Cloud amount	One category below 450 m (1 500 ft) Occurrence or non-occurrence of BKN or OVC between 450 m (1 500 ft) and 3 000 m (10 000 ft)	70 % of cases
Cloud height	± 30 m (100 ft) up to 300 m (1 000 ft) ± 30 % between 300 m (1 000 ft) and 3 000 m (10 000 ft)	70 % of cases
Air temperature	± 1°C	70 % of cases

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GM1 MET.TR.220(a)(8) Aerodrome forecasts
VISIBILITY

The visibility included in TAF refers to the forecast prevailing visibility.

GM1 MET.TR.220(b) Aerodrome forecasts
TAF CODE FORM

The TAF code form is contained in the WMO Publication No 306, Manual on Codes, Volume I.1, Part A — Alphanumeric Codes.

AMC1 MET.TR.220(c) Aerodrome forecasts
PERIOD OF VALIDITY

(a) The periods of validity for 9-hour TAF should commence at 00, 03, 06, 09, 12, 15, 18 and 21 UTC and for 24- and 30-hour TAF at 00, 06, 12 and 18 UTC or 03, 09, 15, and 21 UTC.

(b) The 24- and 30-hour TAF periods of validity should be determined based on the types of operations, as agreed between the aerodrome meteorological office and the operators concerned.

At aerodromes with limited hours of operation, the beginning of the period of validity of a TAF should commence at least 1 hour prior to the aerodrome resuming operations, or more as agreed between the aerodrome meteorological office and the operators concerned, to meet planning requirements for flights that arrive at the aerodromes as soon as it is opened for use.

(c) Routine TAF valid for 9 hours should be issued every 3 hours, and those valid for 24 or 30 hours should be issued every 6 hours.

GM1 MET.TR.220(d) Aerodrome forecasts
FORMAT OF TAF

Guidance on the information exchange model, XML/GML and the metadata profile is provided in the Manual on the Digital Exchange of Aeronautical Meteorological Information (Doc 10003).

AMC1 MET.TR.220(f) Aerodrome forecasts
CRITERIA USED FOR THE INCLUSION OF CHANGE GROUPS IN TAF

The criteria used for the inclusion of change groups in TAF or amendments to TAF should be based on the following:

(a) when the mean surface wind direction is forecasted to change by 60° or more, the mean speed before and/or after the change being 10 kt (5 m/s) or more;

(b) when the mean surface wind speed is forecasted to change by 10 kt (5 m/s) or more;

(c) when the variation from the mean surface wind speed (gusts) is forecasted to change by 10 kt (5 m/s) or more, the mean speed before and/or after the change being 15 kt (7.5 m/s) or more;

(d) when the surface wind is forecasted to change through values of operational significance;

(e) when the visibility is forecasted to improve and change to or pass through one or more of the following values, or when the visibility is forecasted to deteriorate and pass through one or more of the following values:

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(1) 150, 350, 600, 800, 1 500 or 3 000 m; and

(2) 5 000 m in cases where significant numbers of flights are operated in accordance with the visual flight rules;

(f) when any of the following weather phenomena, or combinations thereof, are forecasted to begin or end:

(1) low drifting dust, sand or snow;

(2) blowing dust, sand or snow;

(3) squall; and

(4) funnel cloud (tornado or waterspout);

(g) when the height of base of the lowest layer or mass of cloud of BKN or OVC extent is forecasted to lift and change to or pass through one or more of the following values, or when the height of the lowest layer or mass of cloud of BKN or OVC extent is forecasted to lower and pass through one or more of the following values:

(1) 100, 200, 500 or 1 000 ft (30, 60, 150 or 300 m); or

(2) 1 500 ft (450 m) in cases where significant numbers of flights are operated in accordance with the visual flight rules;

(h) when the amount of a layer or mass of cloud below 1 500 ft (450 m) is forecasted to change:

(1) from NSC, FEW or SCT to BKN or OVC; or

(2) from BKN or OVC to NSC, FEW or SCT;

(i) when the vertical visibility is forecasted to improve and change to or pass through one or more of the following values, or when the vertical visibility is forecasted to deteriorate and pass through one or more of the following values: 100, 200, 500 or 1 000 ft (30, 60, 150 or 300 m); and

(j) any other criteria based on local aerodrome operating minima, as agreed between the aerodrome meteorological office and the operators.

GM1 MET.TR.220(f)(1) Aerodrome forecasts
USE OF CHANGE AND TIME INDICATORS IN TAF

Guidance on the use of change and time indicators in TAF is given below:

Change or time indicator		*Time period*	*Meaning*
FM		ndndnhnhnmnm	Used to indicate a significant change in most weather elements occurring at ndnd day, nhnh hours and nmnm minutes (UTC); all the elements given before 'FM' are to be included following 'FM' (i.e. they are all superseded by those following the abbreviation).

BECMG		nd1nd1nh1nh1/nd2nd2nh2nh2	The change is forecast to commence at nd1nd1 day and nh1nh1 hours (UTC) and be completed by nd2nd2 day and nh2nh2 hours (UTC); only those elements for which a change is forecast are to be given following 'BECMG'; the time period nd1nd1nh1nh1/nd2nd2nh2nh2 should normally be less than 2 hours and in any case should not exceed 4 hours.	
TEMPO		nd1nd1nh1nh1/nd2nd2nh2nh2	Temporary fluctuations are forecast to commence at nd1nd1 day and nh1nh1 hours (UTC) and cease by nd2nd2 day and nh2nh2 hours (UTC); only those elements for which fluctuations are forecast are to be given following 'TEMPO'; temporary fluctuations should not last more than one hour in each instance, and in the aggregate, cover less than half of the period nd1nd1nh1nh1/nd2nd2nh2nh2.	
PROBnn	—	nd1nd1nh1nh1/nd2nd2nh2nh2	probability of occurrence (in %) of an alternative value of a forecast element or elements; nn = 30 or nn = 40 only; to be placed after the element(s) concerned	—
	TEMPO	nd1nd1nh1nh1/nd2nd2nh2nh2		probability of occurrence of temporary fluctuations

AMC1 MET.TR.220(g) Aerodrome forecasts
USE OF PROBABILITY INDICATORS

The number of change and probability groups should be kept to a minimum.

GM1 MET.TR.220(g) Aerodrome forecasts
USE OF PROBABILITY INDICATORS

(a) A probability of an alternative value or change of less than 30 % should not be considered sufficiently significant to be indicated.

(b) A probability of an alternative value or change of 50 % or more should not be considered a probability but, instead, should be indicated, as necessary, by use of the change indicators 'BECMG'

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or 'TEMPO' or by subdivision of the validity period using the abbreviation 'FM'. The probability group should neither be used to qualify the change indicator 'BECMG' nor the time indicator 'FM'.

AMC1 MET.TR.225(c)(1)(iii) Forecasts for landing
THRESHOLD VALUES

The threshold values should be established by the aerodrome meteorological office in consultation with the appropriate ATS units and operators concerned, taking into account changes in the wind which would:

(a) require a change in runway(s) in use; and

(b) indicate that the runway tailwind and crosswind components will change through values representing the main operating limits for typical aircraft operating at the aerodrome.

AMC1 MET.TR.225(c)(7)(ii) Forecasts for landing
USE OF CHANGE GROUPS — BECMG

(a) When the change is forecast to begin and end wholly within the trend forecast period, the beginning and end of the change should be indicated by using the abbreviations 'FM' and 'TL', respectively, with their associated time groups.

(b) When the change is forecast to commence at the beginning of the trend forecast period but be completed before the end of that period, the abbreviation 'FM' and its associated time group should be omitted and only 'TL' and its associated time group should be used.

(c) When the change is forecast to begin during the trend forecast period and be completed at the end of that period, the abbreviation 'TL' and its associated time group should be omitted and only 'FM' and its associated time group should be used.

(d) When the change is forecast to occur at a specified time during the trend forecast period, the abbreviation 'AT' followed by its associated time group should be used.

(e) When the change is forecast to commence at the beginning of the trend forecast period and be completed by the end of that period, or when the change is forecast to occur within the trend forecast period but the time is uncertain, the abbreviations 'FM', 'TL' or 'AT' and their associated time groups should be omitted and the change indicator 'BECMG' should be used alone.

GM1 MET.TR.225(c)(7)(ii) Forecasts for landing
USE OF CHANGE INDICATORS IN TREND FORECASTS

Guidance on the use of change indicators in trend forecasts is given in the table below:

<table>
<tr><th>Change indicator</th><th>Time indicator and period</th><th colspan="2">Meaning</th></tr>
<tr><td>NOSIG</td><td>—</td><td colspan="2">no significant changes are forecast</td></tr>
<tr><td rowspan="2">BECMG</td><td>FMn1n1n1n1
TLn2n2n2n2</td><td rowspan="2">the change is forecast to</td><td>commence at n1n1n1n1 UTC and be completed by n2n2n2n2 UTC</td></tr>
<tr><td>TLnnnn</td><td>commence at the beginning of the trend forecast period and be completed by nnnn</td></tr>
</table>

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			UTC
	FMnnnn		commence at nnnn UTC and be completed by the end of the trend forecast period
	ATnnnn		occur at nnnn UTC (specified time)
	—		commence at the beginning of the trend forecast period and be completed by the end of the trend forecast period; or the time is uncertain
TEMPO	FMn1n1n1n1 TLn2n2n2n2	temporary fluctuations are forecast to	commence at n1n1n1n1 UTC and cease by n2n2n2n2 UTC
	TLnnnn		commence at the beginning of the trend forecast period and cease by nnnn UTC
	FMnnnn		commence at nnnn UTC and cease by the end of the trend forecast period
	—		commence at the beginning of the trend forecast period and cease by the end of the trend forecast period

AMC1 MET.TR.225(c)(7)(iii) Forecasts for landing
USE OF CHANGE GROUPS — TEMPO

(a) When the change is forecast to begin and end wholly within the trend forecast period, the beginning and end of the change should be indicated by using the abbreviations 'FM' and 'TL' respectively, with their associated time groups.

(b) When the change is forecast to commence at the beginning of the trend forecast period but be completed before the end of that period, the abbreviation 'FM' and its associated time group should be omitted and only 'TL' and its associated time group should be used.

(c) When the change is forecast to begin during the trend forecast period and be completed at the end of that period, the abbreviation 'TL' and its associated time group should be omitted and only 'FM' and its associated time group should be used.

(d) When the change is forecast to occur at a specified time during the trend forecast period, the abbreviation 'AT' followed by its associated time group should be used.

(e) When the change is forecast to commence at the beginning of the trend forecast period and be completed by the end of that period, or when the change is forecast to occur within the trend forecast period but the time is uncertain, the abbreviations 'FM', 'TL' or 'AT' and their associated time groups should be omitted and the change indicator 'BECMG' should be used alone.

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AMC1 MET.TR.230(a) Forecasts for take-off
AMENDMENTS TO FORECASTS

(a) The criteria for the issuance of amendments to forecasts for take-off for surface wind direction and speed, temperature and pressure, and any other elements agreed locally should be agreed between the aerodrome meteorological office and the operators concerned.

(b) The criteria should be consistent with the corresponding criteria for special reports established for the aerodrome

AMC1 MET.TR.235 Aerodrome warnings and wind shear warnings and alerts
FORMAT OF AERODROME WARNINGS

(a) Aerodrome warnings may be issued in accordance with the template below or in another format where required by operators or aerodrome meteorological offices.

Template for aerodrome warnings

Key:

M = inclusion mandatory, part of every message;

C = inclusion conditional, included whenever applicable.

Element	*Detailed content*	*Templates*	*Examples*
Location indicator of the aerodrome (M)	Location indicator of the aerodrome	nnnn	YUCC
Identification of the type of message (M)	Type of message and sequence number	AD WRNG [n]n	AD WRNG 2
Validity period (M)	Day and time of validity period in UTC	VALID nnnnnn/nnnnnn	VALID 211230/211530
IF THE AERODROME WARNING IS TO BE CANCELLED, SEE DETAILS AT THE END OF THE TEMPLATE.			
Phenomenon (M)	Description of phenomenon causing the issuance of the aerodrome warning	TC nnnnnnnnnn *or* [HVY] TS *or* GR *or* [HVY] SN [nnCM] *or* [HVY] FZRA *or* [HVY] FZDZ *or* RIME *or* [HVY] SS *or* [HVY] DS *or* SA *or* DU *or* SFC WSPD nn[n]MPS MAX nn[n] (SFC WSPD nn[n]KT MAX nn[n]) *or*	TC ANDREW HVY SN 25CM SFC WSPD 20MPS MAX 30 VA TSUNAMI

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		SFC WIND nnn/nn[n]MPS MAX nn[n] (SFC WIND nnn/nn[n]KT MAX nn[n]) *or* SQ *or* FROST *or* TSUNAMI *or* VA[DEPO] *or* TOX CHEM *or* *Free text up to 32 characters*	
Observed or forecast phenomenon (M)	Indication whether the information is observed and expected to continue, *or* forecast	OBS [AT nnnnZ] *or* FCST	OBS AT 1200Z OBS
Changes in intensity (C)	Expected changes in intensity	INTSF *or* WKN *or* NC	WKN

OR

Cancellation of aerodrome warning	Cancellation of aerodrome warning referring to its identification	CNL AD WRNG [n]n nnnnnn/nnnnnn	CNL AD WRNG 2 211230/211530

(b) When the above template is used, the sequence number referred to in the template should correspond to the number of aerodrome warnings issued for the aerodrome since 00.01 UTC on the day concerned.

GM1 MET.TR.235 Aerodrome warnings and wind shear warnings and alerts
RANGES AND RESOLUTIONS — AERODROME WARNINGS

(a) The ranges and resolutions for the numerical elements included in aerodrome warnings are shown below:

Ranges and resolutions for the numerical elements included in volcanic ash and tropical cyclone advisory messages, SIGMET/AIRMET messages and aerodrome and wind shear warnings

Elements		*Range*	*Resolution*
Summit elevation:	M	000–8 100	1
	FT	000–27 000	1
Advisory number:	for VA (index)*	000–2 000	1
	for TC (index)*	00–99	1
Maximum surface wind:	MPS	00–99	1

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	KT	00–199	1
Central pressure:	hPa	850–1 050	1
Surface wind speed:	MPS	15–49	1
	KT	30–99	1
Surface visibility:	M	0000–0750	50
	M	0800–5 000	100
Cloud: height of base:	M	000–300	30
	FT	000–1 000	100
Cloud: height of top:	M	000–2 970	30
	M	3 000–20 000	300
	FT	000–9 900	100
	FT	10 000–60 000	1 000
Latitudes:	° (degrees)	00–90	1
	(minutes)	00–60	1
Longitudes:	° (degrees)	000–180	1
	(minutes)	00–60	1
Flight levels:		000–650	10
Movement:	KMH	0–300	10
	KT	0–150	5
* Non-dimensional			

(b) The explanations for the abbreviations can be found in the Procedures for Air Navigation Services — ICAO Abbreviations and Codes (PANS ABC, Doc 8400).

AMC2 MET.TR.235(a) Aerodrome warnings and wind shear warnings and alerts
FORMAT OF AERODROME WARNINGS

(a) The additional text should be prepared in abbreviated plain language using approved ICAO abbreviations and numerical values. If no ICAO-approved abbreviations are available, English plain language text should be used.

(b) When quantitative criteria are necessary for the issuance of aerodrome warnings, the criteria should be established by agreement between the aerodrome meteorological office and the users of the warnings.

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AMC1 MET.TR.235(c) Aerodrome warnings and wind shear warnings and alerts
FORMAT OF WIND SHEAR WARNINGS

(a) The use of text additional to the abbreviations listed in the template in Table 6 of Appendix 1 should be kept to a minimum. The additional text should be prepared in abbreviated plain language using ICAO-approved abbreviations and numerical values.

(b) When an aircraft report is used to prepare a wind shear warning or to confirm a warning previously issued, the corresponding aircraft report, including the aircraft type, should be disseminated unchanged in accordance with the local arrangements to those concerned.

GM1 MET.TR.235(c) Aerodrome warnings and wind shear warnings and alerts
WIND SHEAR TYPES

Following reported encounters by both arriving and departing aircraft, two different wind shear warnings may exist: one for arriving aircraft and one for departing aircraft.

GM2 MET.TR.235(c) Aerodrome warnings and wind shear warnings and alerts
REPORTING THE INTENSITY OF WIND SHEAR

Specifications for reporting the intensity of wind shear are still under development. It is recognised, however, that pilots, when reporting wind shear, may use the qualifying terms ‘moderate’, ‘strong’ or ‘severe’, based to a large extent on their subjective assessment of the intensity of the wind shear encountered.

GM1 MET.TR.235(c) Aerodrome warnings and wind shear warnings and alerts
DETECTION OF WIND SHEAR

Wind shear conditions are normally associated with the following phenomena:

(a) thunderstorms, microbursts, funnel cloud, tornado or waterspout, and gust fronts;

(b) frontal surfaces;

(c) strong surface winds coupled with local topography;

(d) sea breeze fronts;

(e) mountain waves, including low-level rotors in the terminal area;

(f) low-level temperature inversions.

GM1 MET.TR.235(d) Aerodrome warnings and wind shear warnings and alerts
DISSEMINATION OF WIND SHEAR ALERTS

The wind shear alerts are disseminated from automated, ground-based, wind shear remote-sensing or detection equipment in accordance with local arrangements to those concerned.

Chapter 3 — Technical requirements for meteorological watch offices

AMC1 MET.TR.250(a) SIGMET messages
GRAPHICAL FORMAT

SIGMET, when issued in graphical format, should be as specified below:

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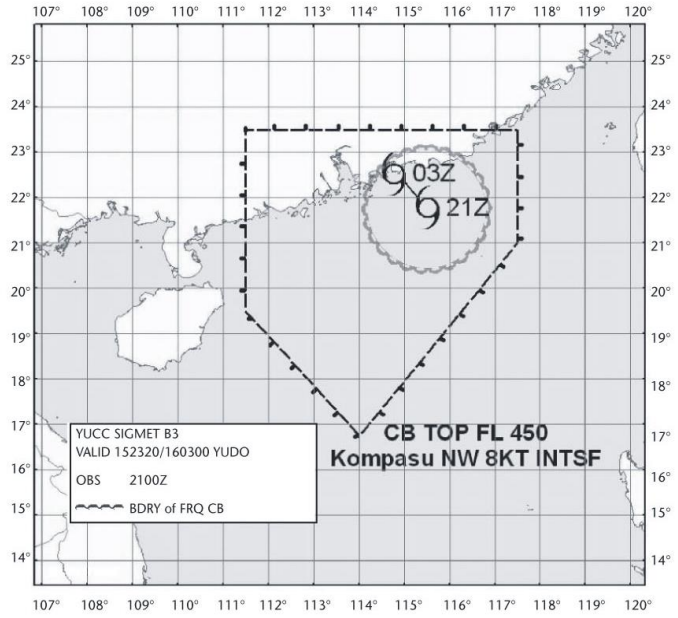
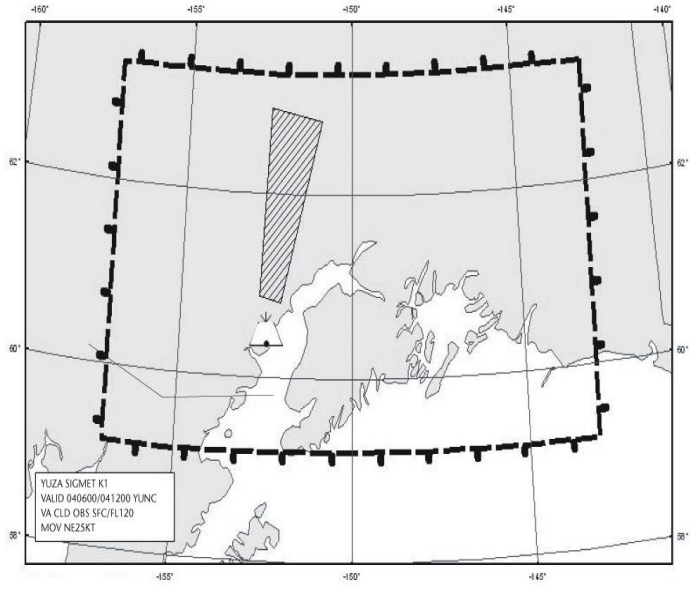
(a) **SIGMET FOR TROPICAL CYCLONE — MODEL STC**



Note: Fictitious FIR.

(b) **SIGMET FOR VOLCANIC ASH — MODEL SVA**



Fictitious FIR.

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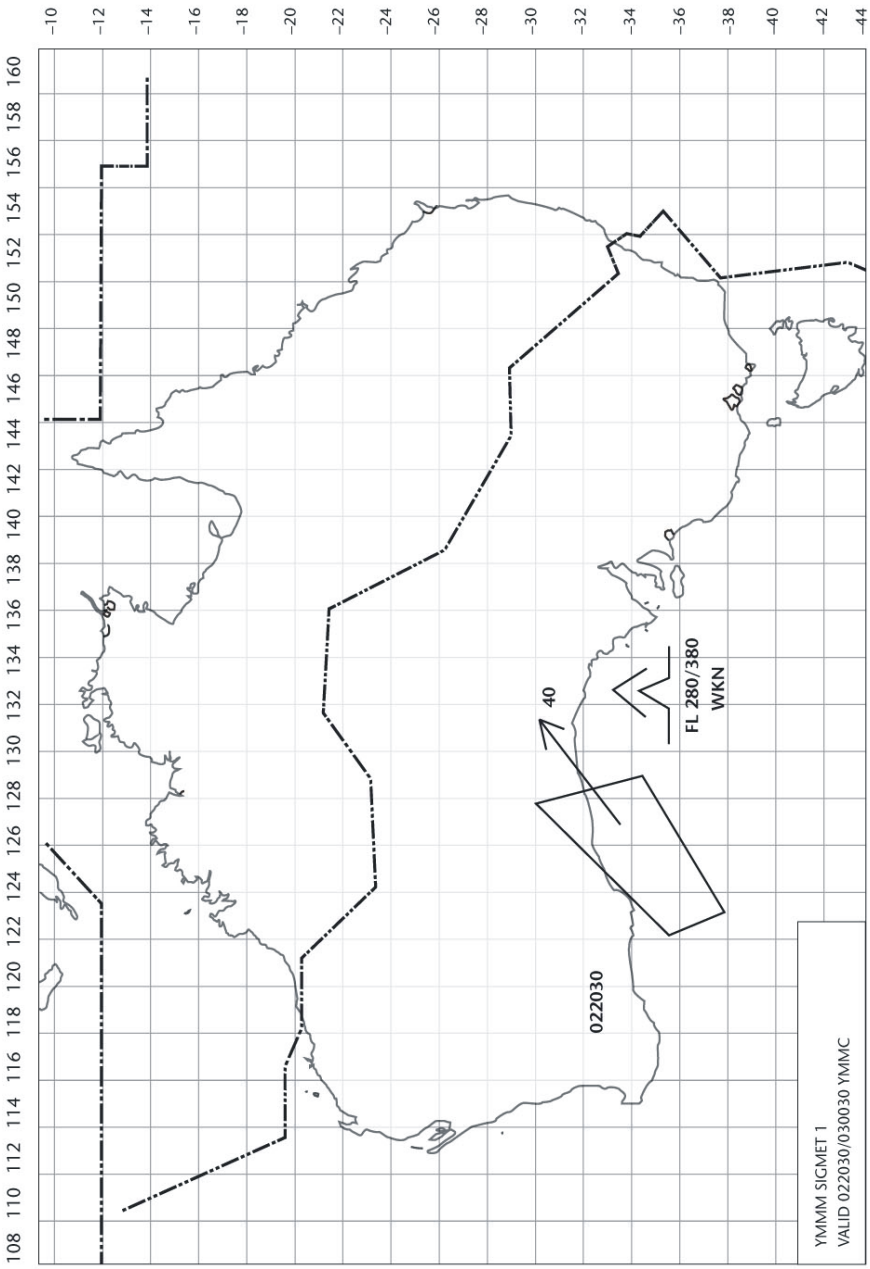
(c) SIGMET FOR PHENOMENA OTHER THAN TROPICAL CYCLONE AND VOLCANIC ASH — MODEL SGE



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AMC2 MET.TR.250(a) SIGMET messages
FLIGHT INFORMATION REGION

In cases where the airspace is divided into a flight information region (FIR) and an upper-flight information region (UIR), the SIGMET message should be identified by the location indicator of the ATS unit serving the FIR.

GM1 MET.TR.250(a) SIGMET messages
FLIGHT INFORMATION REGION

The SIGMET message applies to the whole airspace within the lateral limits of the FIR, i.e. to the FIR and to the UIR. The particular areas and/or flight levels affected by the meteorological phenomena causing the issuance of the SIGMET message are given in the text of the message.

GM2 MET.TR.250(a) SIGMET messages & MET.TR.255(a) AIRMET messages
EXAMPLE OF SIGMET AND AIRMET MESSAGES, AND THE CORRESPONDING CANCELLATIONS

SIGMET	**Cancellation of SIGMET**
YUDD SIGMET 2 VALID 101200/101600 YUSO – YUDD SHANLON FIR/UIR OBSC TS FCST S OF N54 AND E OF W012 TOP FL390 MOV E WKN FCST 1600Z S OF N54 AND E OF W010	YUDD SIGMET 3 VALID 101345/101600 YUSO – YUDD SHANLON FIR/UIR CNL SIGMET 2 101200/101600
AIRMET	**Cancellation of AIRMET**
YUDD AIRMET 1 VALID 151520/151800 YUSO – YUDD SHANLON FIR ISOL TS OBS N OF S50 TOP ABV FL100 STNR WKN	YUDD AIRMET 2 VALID 151650/151800 YUSO – YUDD SHANLON FIR CNL AIRMET 1 151520/151800

GM3 MET.TR.250(a) SIGMET messages
EXAMPLE OF SIGMET MESSAGE FOR TROPICAL CYCLONE

YUCC SIGMET 3 VALID 251600/252200 YUDO — YUCC AMSWELL FIR TC GLORIA OBS AT 1600Z N2706 W07306 CB TOP FL500 WI 150NM OF CENTRE MOV NW 10KT NC FCST 2200Z TC CENTRE N2740 W07345

Meaning:

The third SIGMET message issued for the AMSWELL* flight information region (identified by YUCC Amswell area control centre) by the Donlon/International* meteorological watch office (YUDO) since 00.01 UTC; the message is valid from 16.00 UTC to 22.00 UTC on the 25th of the month; tropical cyclone Gloria was observed at 16.00 UTC at 27 degrees 6 minutes north and 73 degrees 6 minutes west with cumulonimbus top at flight level 500 within 150 nautical miles of the centre; the tropical cyclone is expected to move northwestwards at 10 knots and not to undergo any changes in intensity; the forecast position of the centre of the tropical cyclone at 22.00 UTC is expected to be at 27 degrees 40 minutes north and 73 degrees 45 minutes west.

** Fictitious locations*

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GM4 MET.TR.250(a) SIGMET messages
EXAMPLE OF SIGMET MESSAGE FOR VOLCANIC ASH

YUDD SIGMET 2 VALID 211100/211700 YUSO – YUDD SHANLON FIR/UIR VA ERUPTION MT ASHVAL PSN S1500 E07348 VA CLD OBS AT 1100Z

APRX 220KM BY 35KM S1500 E07348 — S1530 E07642 FL310/450 MOV SE 35KT FCST 1700Z VA CLD

APRX S1506 E07500 — S1518 E08112 — S1712 E08330 — S1824 E07836

Meaning:

The second SIGMET message issued for the SHANLON* flight information region (identified by YUDD Shanlon area control centre/upper flight information region) by the Shanlon/International* meteorological watch office (YUSO) since 00.01 UTC; the message is valid from 11.00 UTC to 17.00 UTC on the 21st of the month; volcanic ash eruption of Mount Ashval* located at 15 degrees south and 73 degrees 48 minutes east; volcanic ash cloud observed at 11.00 UTC in an approximate area of 220 km by 35 km between 15 degrees south and 73 degrees 48 minutes east, and 15 degrees 30 minutes south and 76 degrees 42 minutes east; between flight levels 310 and 450, the volcanic ash cloud is expected to move south-eastwards at 35 knots; at 17.00 UTC the volcanic ash cloud is forecast to be located approximately in an area bounded by the following points: 15 degrees 6 minutes south and 75 degrees east, 15 degrees 18 minutes south and 81 degrees 12 minutes east, 17 degrees 12 minutes south and 83 degrees 30 minutes east, and 18 degrees 24 minutes south and 78 degrees 36 minutes east.

** Fictitious locations*

GM5 MET.TR.250(a) SIGMET messages
EXAMPLE OF SIGMET MESSAGE FOR RADIOACTIVE CLOUD

YUCC SIGMET 2 VALID 201200/201600 YUDO — YUCC AMSWELL FIR RDOACT CLD OBS AT 1155Z WI S5000 W14000 — S5000 W13800 — S5200 W13800 — S5200 W14000 — S5000 W14000 SFC/FL100 STNR WKN

Meaning:

The second SIGMET message issued for the AMSWELL* flight information region (identified by YUCC Amswell area control centre) by the Donlon/International* meteorological watch office (YUDO) since 00.01 UTC; the message is valid from 12.00 UTC to 16.00 UTC on the 20th of the month; radioactive cloud was observed at 11.55 UTC within an area bounded by 50 degrees 0 minutes south and 140 degrees 0 minutes west to 50 degrees 0 minutes south and 138 degrees 0 minutes west to 52 degrees 0 minutes south and138 degrees 0 minutes west to 52 degrees 0 minutes south and 140 degrees 0 minutes west to 50 degrees 0 minutes south and 140 degrees 0 minutes west and between the surface and flight level 100; the radioactive cloud is expected to remain stationary and to weaken in intensity.

** Fictitious locations*

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GM6 MET.TR.250(a) SIGMET messages
EXAMPLE OF SIGMET MESSAGE FOR SEVERE TURBULENCE

YUCC SIGMET 5 VALID 221215/221600 YUDO — YUCC AMSWELL FIR SEV TURB OBS AT 1210Z N2020 W07005 FL250 MOV E 20KT WKN FCST 1600Z S OF N2020 E OF W06950

Meaning:

The fifth SIGMET message issued for the AMSWELL* flight information region (identified by YUCC Amswell area control centre) by the Donlon/International* meteorological watch office (YUDO) since 0001 UTC; the message is valid from 12.15 UTC to 16.00 UTC on the 22nd of the month; severe turbulence was observed at 12.10 UTC 20 degrees 20 minutes north and 70 degrees 5 minutes west at flight level 250; the turbulence is expected to move eastwards at 20 knots and to weaken in intensity; forecast position at 16.00 UTC south of 20 degrees 20 minutes north and east of 69 degrees 50 minutes west.

** Fictitious locations*

AMC1 MET.TR.250(c) SIGMET messages
SEQUENCE NUMBER

The letters to be used as the first character for the sequence number to indicate the specified en-route weather phenomena which may affect the safety of aircraft operations should be:

SIGMET Type	**Specified en-route phenomena**	**Letter to be used in sequence number for specified en-route phenomena**
WC	Tropical cyclone	C
	For WC exchange test purposes	X
WV	Volcanic ash	A
	For WV exchange test purposes	Y
WS	Thunderstorm	T
	Turbulence	U
	Icing	I
	Freezing rain	F
	Mountain wave	M
	Dust storm	D
	Sandstorm	S
	Radioactive cloud	R
	For WS exchange test purposes	Z

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AMC2 MET.TR.250(c) SIGMET messages
SEQUENCE NUMBER

The two-character number to be used in the sequence number should correspond to the number of SIGMET messages, dependent on the phenomena as indicated by the first character, issued for the flight information region since 00.01 UTC on the day concerned.

AMC1 MET.TR.250(d) SIGMET messages & MET.TR.255(d) AIRMET messages
CRITERIA RELATED TO PHENOMENA

Sandstorm/dust storm should be considered:

(a) heavy whenever the visibility is below 200 m and the sky is obscured; and

(b) moderate whenever the visibility is:

(1) below 20 m and the sky is not obscured; or

(1) between 200 and 600 m.

GM1 MET.TR.250(d) SIGMET messages & MET.TR.255(c) AIRMET messages
CRITERIA RELATED TO PHENOMENA

(a) An area of thunderstorms and cumulonimbus clouds is considered:

(1) obscured (OBSC) if it is obscured by haze or smoke or cannot be readily seen due to darkness;

(2) embedded (EMBD) if it is embedded within cloud layers and cannot be readily recognised;

(3) isolated (ISOL) if it consists of individual features which affect, or are forecast to affect, an area with a maximum spatial coverage less than 50 % of the area concerned (at a fixed time or during the period of validity); and

(4) occasional (OCNL) if it consists of well-separated features which affect, or are forecast to affect, an area with a maximum spatial coverage between 50 and 75 % of the area concerned (at a fixed time or during the period of validity).

(b) An area of thunderstorms is considered frequent (FRQ) if within that area there is little or no separation between adjacent thunderstorms with a maximum spatial coverage greater than 75 % of the area affected, or forecast to be affected, by the phenomenon (at a fixed time or during the period of validity).

(c) Squall line (SQL) indicates a thunderstorm along a line with little or no space between individual clouds.

(d) Hail (GR) is used as a further description of the thunderstorm, as necessary.

(e) Severe and moderate turbulence (TURB) refers only to: low-level turbulence associated with strong surface winds; rotor streaming; or turbulence whether in cloud or not (CAT). Turbulence is not used in connection with convective clouds.

(f) Turbulence is considered:

(1) severe whenever the peak value of the cube root of EDR exceeds 0.7; and

(2) moderate whenever the peak value of the cube root of EDR is above 0.4 and below or equal to 0.7.

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(g) Severe and moderate icing (ICE) refers to icing in other than convective clouds. Freezing rain (FZRA) should refer to severe icing conditions caused by freezing rain.

(h) A mountain wave (MTW) is considered:

(1) severe whenever an accompanying downdraft of 600 ft/min (3.0 m/s) or more and/or severe turbulence is observed or forecast; and

(2) moderate whenever an accompanying downdraft of 350–600 ft/min (1.75–3.0 m/s) and/or moderate turbulence is observed or forecast.

AMC1 MET.TR.250(e) SIGMET messages
FORMAT

SIGMET messages should be issued in digital form, in addition to the abbreviated plain language.

GM1 MET.TR.250(e)(1) SIGMET messages
FORMAT

Guidance on the information exchange model, GML, and the metadata profile is provided in the Manual on the Digital Exchange of Aeronautical Meteorological Information (Doc 10003).

GM2 MET.TR.255(a) AIRMET messages
EXAMPLE OF AIRMET MESSAGE FOR MODERATE MOUNTAIN WAVE

YUCC AIRMET 2 VALID 221215/221600 YUDO — YUCC AMSWELL FIR MOD MTW OBS AT 1205Z N48 E010 FL080 STNR NC

Meaning:

The second AIRMET message issued for the AMSWELL* flight information region (identified by YUCC Amswell area control centre) by the Donlon/International* meteorological watch office (YUDO) since 00.01 UTC; the message is valid from 12.15 UTC to 16.00 UTC on the 22nd of the month; moderate mountain wave was observed at 12.05 UTC at 48 degrees north and 10 degrees east at flight level 080; the mountain wave is expected to remain stationary and not to undergo any changes in intensity.

** Fictitious locations*

GM1 MET.TR.255(b) AIRMET messages
FIR

The flight information region may be divided in sub-areas.

AMC1 MET.TR.260 Area forecasts for low-level flights
AMENDMENT OF LOW-LEVEL FORECASTS

(a) In case the AIRMET/low-level forecast concept is not fully implemented, the criteria for amendments should as a minimum include the weather phenomena hazardous to low-level flights, which constitute the criteria for the issuance of AIRMET.

(b) When low-level forecast is issued as an SIGWX chart or as a wind and temperature (W+T) chart, it should, as appropriate, include the cloud/visibility information in the form of visibility/cloud base

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category which should be provided for well-defined sub-areas and/or route segments. For each sub-area and/or route segment, the reference height to which the cloud base information refers should be specified.

(c) The graphical part of an SIGWX chart should depict the weather situation at the beginning of the validity period. Significant changes of initial weather parameters should be depicted together with time intervals determining the duration of expected changes.

Chapter 4 — Technical requirements for Volcanic Ash Advisory Centres

GM1 MET.TR.265(a) Volcanic Ash Advisory Centre responsibilities
EXAMPLE OF ADVISORY MESSAGE FOR VOLCANIC ASH

FVFE01 RJTD 230130
VA ADVISORY

DTG:	20080923/0130Z
VAAC:	TOKYO
VOLCANO:	KARYMSKY 1000-13
PSN:	N5403 E15927
AREA:	RUSSIA
SUMMIT ELEV:	1536M
ADVISORY NR:	2008/4
INFO SOURCE:	MTSAT-1R KVERT KEMSD
AVIATION COLOUR CODE:	RED
ERUPTION DETAILS:	ERUPTION AT 20080923/0000Z FL300 REPORTED
OBS VA DTG:	23/0100Z
OBS VA CLD:	FL250/300 N5400 E15930 — N5400 E16100 — N5300 E15945 MOV SE 20KT SFC/FL200 N5130 E16130 — N5130 E16230 — N5230 E16230 — N5230 E16130 MOV SE 15KT
FCST VA CLD +6 HR:	23/0700Z FL250/350 N5130 E16030 — N5130 E16230 — N5330 E16230 — N5330 E16030 SFC/FL180 N4830 E16330 — N4830 E16630 — N5130 E16630 — N5130 E16330
FCST VA CLD +12 HR:	23/1300Z SFC/FL270 N4830 E16130 — N4830 E16600 — N5300 E16600 — N5300 E16130
FCST VA CLD +18 HR:	23/1900Z NO VA EXP
RMK:	LATEST REP FM KVERT (0120Z) INDICATES ERUPTION HAS CEASED. TWO DISPERSING VA CLD ARE EVIDENT ON SATELLITE IMAGERY
NXT ADVISORY:	20080923/0730Z

GM1 MET.TR.265(b)(2) Volcanic Ash Advisory Centre responsibilities
BUFR CODE

The BUFR code form is contained in the WMO Publication No 306, Manual on Codes, Volume I.2, Part B — Binary Codes.

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Chapter 5 — Technical requirements for Tropical Cyclone Advisory Centres (TCACs)

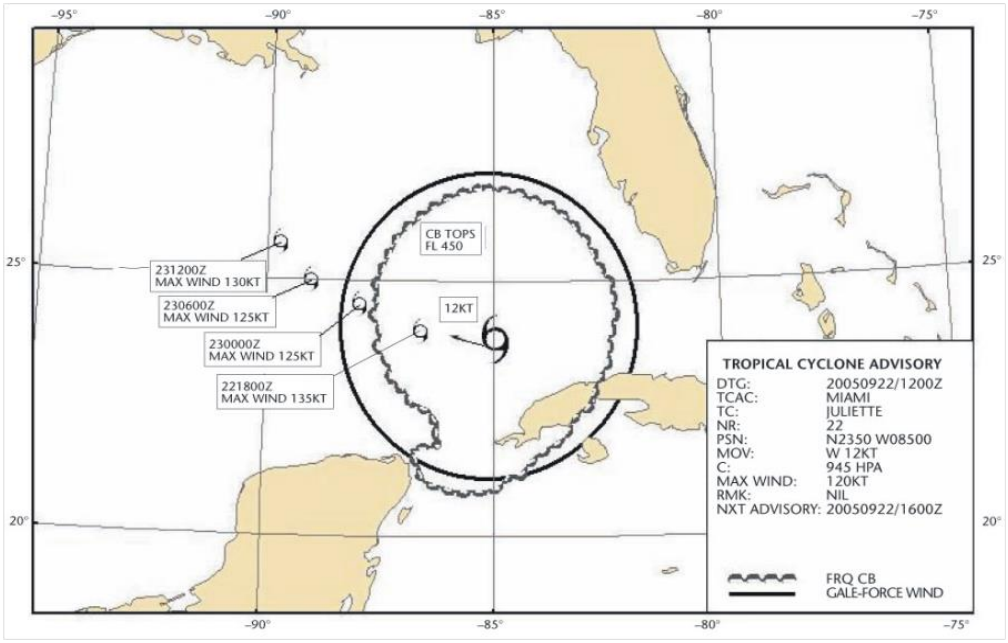
AMC1 MET.TR.270(b) Tropical Cyclone Advisory Centre responsibilities

FORMAT OF ADVISORY INFORMATION ON TROPICAL CYCLONES

The tropical cyclone advisory information listed in Table 8 of Appendix 1, when prepared in graphical format, should be as specified below and should be issued using:

(a) the portable network graphics (PNG) format; or

(b) the BUFR code form, when exchanged in binary format.



GM1 MET.TR.270(b) Tropical Cyclone Advisory Centre responsibilities

CODE FOR ADVISORY INFORMATION ON TROPICAL CYCLONES

The BUFR code form is contained in the WMO Publication No 306, Manual on Codes, Volume I.2, Part B — Binary Codes.

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GM2 MET.TR.270(b) Tropical Cyclone Advisory Centre responsibilities
EXAMPLE FOR ADVISORY MESSAGE FOR TROPICAL CYCLONES

TC ADVISORY	
DTG:	20040925/1600Z
TCAC:	YUFO
TC:	GLORIA
NR:	01
PSN:	N2706 W07306
MOV:	NW 12KT
C:	965HPA
MAX WIND:	73KT
FCST PSN +6 HR:	25/2200Z N2748 W07350
FCST MAX WIND +6 HR:	73KT
FCST PSN +12 HR:	26/0400Z N2830 W07430
FCST MAX WIND +12 HR:	73KT
FCST PSN +18 HR:	26/1000Z N2852 W07500
FCST MAX WIND +18 HR:	70KT
FCST PSN +24 HR:	26/1600Z N2912 W07530
FCST MAX WIND +24 HR:	60KT
RMK:	NIL
NXT MSG:	20040925/2000Z

Chapter 6 — Technical requirements for World Area Forecast Centres (WAFCs)

AMC1 MET.TR.275(a) World Area Forecast Centre responsibilities
GRIDDED GLOBAL FORECASTS

The telecommunications facilities used for the supply of world area forecast system products should:

(a) be the aeronautical fixed service or the public Internet;

(b) be continuous; and

(c) not have interruptions exceeding 10 minutes during any period of 6 hours.

GM1 MET.TR.275(a) World Area Forecast Centre responsibilities
GRIB CODE

The GRIB code form is contained in the WMO Publication No 306, Manual on Codes, Volume I.2, Part B — Binary Codes.

GM2 MET.TR.275(a) World Area Forecast Centre responsibilities
BUFR CODE

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GM1 MET.TR.275(b)(3) World Area Forecast Centre responsibilities
GRID POINT FORECASTS

(a) Layers centred at a flight level referred to in MET.TR.275(b)(3)(v) and (vii) have a depth of 100 hPa.

(b) Layers centred at a flight level referred to in MET.TR.275(b)(3)(vi) have a depth of 50 hPa.

AMC1 MET.TR.275(d) World Area Forecast Centre responsibilities
MEDIUM-LEVEL SIGWX FORECASTS

The medium-level SIGWX forecasts provided for flight levels between 100 and 250 for limited geographical areas should cover the areas as shown in in Table 2 of Appendix 1.

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ACCEPTABLE MEANS OF COMPLIANCE AND GUIDANCE MATERIAL TO ANNEX XIII — REQUIREMENTS FOR PERSONNEL TRAINING AND COMPETENCE ASSESSMENT (PART-PERS)

SUBPART A — AIR TRAFFIC SAFETY ELECTRONIC PERSONNEL

Section 1 — General

GM1 ATSEP.OR.100 Scope
GENERAL

Whilst it is acknowledged that 'power supply' and 'air conditioning' systems and equipment that can be critical elements of the aviation safety chain and that personnel should, therefore, be appropriately trained in those areas, it is not considered that this training should fall within the scope of the ATSEP training provisions. In general, ATSEP do not work on these systems, but rather control and manage the release of power and air conditioning systems, to and from operational service. In this situation, the person does not have, and is not expected to have, extensive knowledge of the aviation environment to provide the required service. Consequently, the vast majority of the Initial Training objectives would not be applicable to a power engineer.

GM1 ATSEP.OR.105 Training and competence assessment programme
GENERAL

The training and competence assessment programme should include:

(a) the training policy;

(b) the description of all training activities and the interrelations between different training activities;

(c) the description of the function/role of the phase/course supervisor, instructors and assessors;

(d) the description of the qualifications of instructional and competence assessment personnel;

(e) the target group of learners;

(f) the description of the minimum qualification of learners or required entry levels ('learner' is the generic term for a person performing a learning activity without any reference to his/her status (ab initio/student/trainee));

(g) the description of knowledge outcome and performance objectives;

(h) the record of supervisory, instructional and competence assessment personnel participating in a course;

(i) the training environment (e.g. infrastructure, equipment, etc.);

(j) the training methodology (e.g. classroom instruction, self-study, computer-based training (CBT), on-the-job training (OJT), etc.);

(k) the training material;

(l) the training schedule;

(m) the competence assessment method (e.g. pre-course, on-training evaluation, post-course, etc.);

(n) the record of individual learners training and competence assessment; and

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(o) the feedback mechanisms.

GM2 ATSEP.OR.105 Training and competence assessment programme
CHANGE OF ORGANISATION

When already qualified and experienced ATSEP move from one service provider to another, the receiving service provider may conduct an analysis and/or competence assessment of their previous training. Any identified training shortcomings, relative to their new duties assignments should be addressed through additional training.

AMC1 ATSEP.OR.115 Language proficiency
LANGUAGE LEVEL

Service providers should determine the level of language proficiency based on the particular ATSEP duties, the safety criticality of the system ATSEP will need to work on, and taking into account the language requirements related to operating instructions, manuals, and the need to communicate across operational boundaries that require a common language.

Section 2 — Training requirements

GM1 ATSEP.OR.200 Training requirements — General
ATSEP TRAINING PHASES

The following diagram illustrates the phases of ATSEP training:

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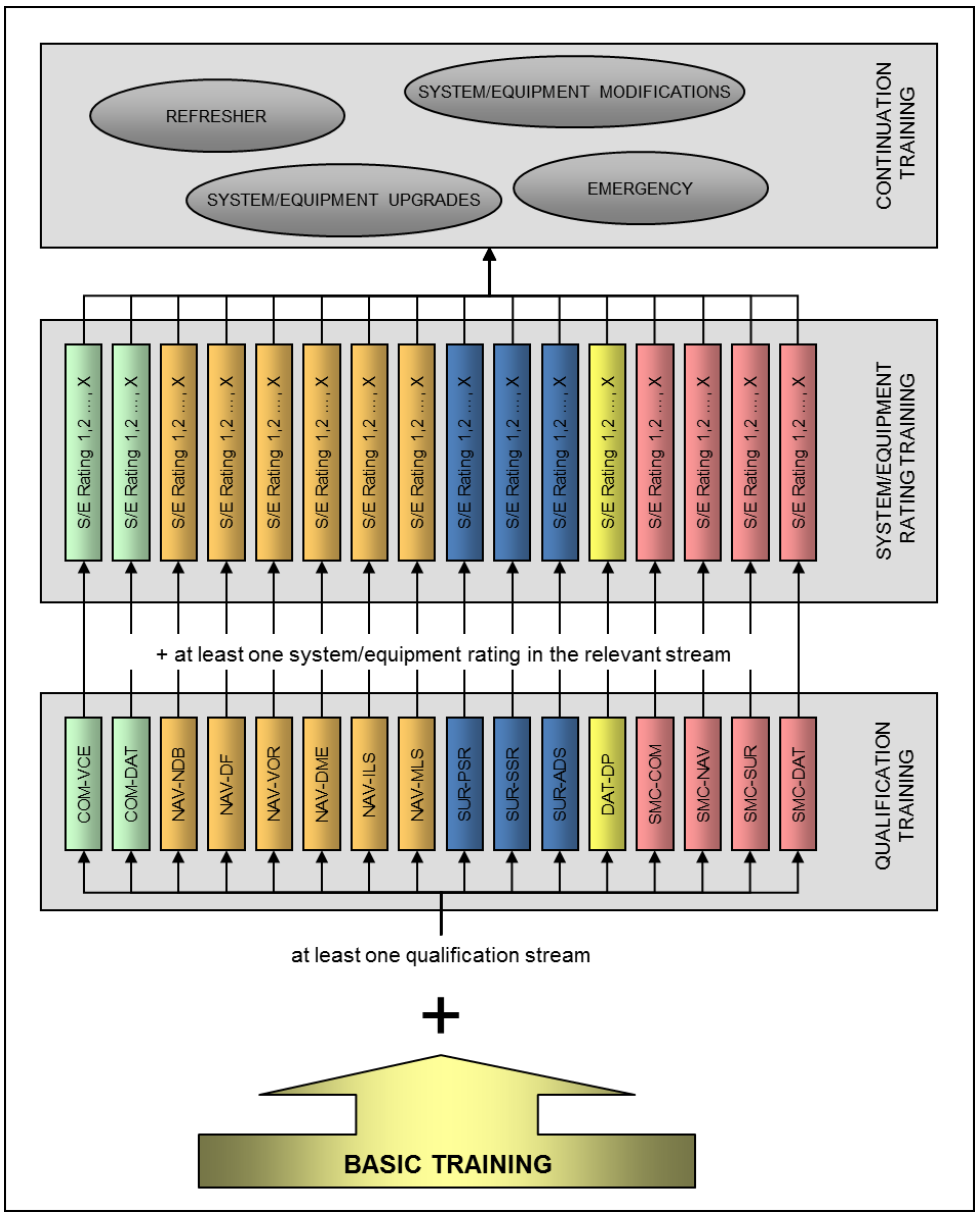

GM1 ATSEP.OR.200(a) Training requirements — General

BASIC TRAINING

For the purpose of this section, 'basic training' is understood as being training designed to impart fundamental knowledge of the service provider's operational environment.

QUALIFICATION TRAINING

For the purpose of this section, 'qualification training' is understood as being training designed to impart knowledge and skills appropriate to the qualification stream to be pursued in the service provider's operational environment.

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SYSTEM/EQUIPMENT RATING TRAINING

For the purpose of this section, 'system/equipment-rating training' is understood as being training designed to impart system/equipment-related knowledge and skills leading towards operational competence.

CONTINUATION TRAINING

For the purpose of this section, 'continuation training' is understood as being training designed to maintain and/or augment existing knowledge and skills related to the ATSEP assigned responsibilities and duties.

AMC1 ATSEP.OR.205(a)(1) and AMC1 ATSEP.OR.105(a)(2) Basic training
GENERAL

The subjects, topics, and sub-topics should be tailored to:

(a) the responsibility of the ATSEP regarding the service provider's activities; and

(b) prior experience and education of the candidate ATSEP.

AMC1 ATSEP.OR.205(a)(1) Basic training
SHARED

The objectives contained in Appendix Ia to this AMC should be included in the basic training course.

AMC1 ATSEP.OR.205(a)(2) Basic training
STREAMS

The topics, sub-topics and objectives contained in Appendix IIa to this AMC should be included in the basic training course.

GM1 ATSEP.OR.205(b) Basic training
ENTRY LEVEL

In some instances, only a limited number of training objectives will need to be taught to learners ATSEP. This is usually the case when the entry level of learners includes some form of previous qualification (e.g. engineering degree or diploma). In this case, the length of training and the number of objectives may be less than that of a course directed to learners who have little or no engineering or technical qualifications. If no engineering or technical qualifications are required prior to starting the basic training, then it may be necessary to include additional objectives in the training that will prepare learners to deal with the basic training.

GM1 ATSEP.OR.205 Basic training & GM1 ATSEP.OR.210 Qualification training
MINIMUM TRAINING

The basic and qualification training contained within the requirement is the minimum training that needs to be followed by all who aim at becoming ATSEP. However, service providers may decide to add additional subjects or topics that may be specific to their national or local environment.

COMPOSITION OF COURSES

(a) Basic training may be provided as a stand-alone course or as part of a larger initial training course (i.e. basic plus qualification training).

(b) Qualification training may be provided as (a) stand-alone course(s) or as part of a larger course.

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AMC1 ATSEP.OR.210 Qualification training
GENERAL

The subjects, topics, and sub-topics should be tailored to:

(a) the responsibility of the ATSEP regarding the service provider's activities; and

(b) prior experience and education of the candidate ATSEP.

AMC1 ATSEP.OR.210 Qualification training
SHARED

The objectives contained in Appendix IIIa to this AMC should be included in the qualification training course.

GM1 ATSEP.OR.210 Qualification training

Service providers may choose to add content to a qualification stream to tailor the training to meet the needs of the individual organisation.

AMC1 ATSEP.OR.210(a) Qualification training
STREAMS

The objectives contained in Appendix IVa to this AMC should be included in the qualification training course.

GM1 ATSEP.OR.210(a) Qualification training
STREAMS

For the purpose of this section, 'streams' is understood as being a cluster of training objectives that support a particular area of work.

GM2 ATSEP.OR.210(a) Qualification training
SYSTEM MONITORING AND CONTROL (SMC)

(a) There are two recognised routes to achieve SMC competence. Organisations may choose which route is most appropriate for their environment.

(b) Both SMC competence routes may be used by individuals and/or service providers at different times during their careers.

(c) In some organisations, SMC of operational system and equipment tasks are performed after the initial competence in a stream or collection of streams that make up a domain (e.g. the Communication domain comprises the COMMUNICATION-VOICE and COMMUNICATION-DATA streams) has been achieved and appropriate SMC development training has been completed. This route is considered to be the development route to SMC competence. The objectives contained within the four Qualification training SMC stream(s) may be completed as part of this development training.

(d) The alternative option, used by some organisations, is to provide training for SMC duties directly after basic training. This is based on an arrangement where SMC operators perform level A tasks. If level B tasks are required, these are performed under supervision or are delegated to appropriately qualified personnel. This route is considered to be the direct route to SMC competence, and the four

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Qualification training streams relating to SMC apply, such as, for instance, SMC Communication, SMC Navigation, SMC Surveillance and/or SMC Data. To start S/E rating training on level A tasks for the monitored and/or controlled S/E, no additional qualification training stream (e.g. QUAL NAV-VOR) is required because the relevant information is contained in the related SMC qualification training stream(s) already.

(e) Level tasks represent the categorisation by complexity, knowledge, skills and operational impact. Three categories will usually suffice, but could be further subdivided for highly complex or diverse systems:

(1) Level A tasks: Level A maintenance tasks are primarily associated with immediate service restoration or reconfiguration ('front-panel level'). They are appropriate for personnel that have been trained to understand the elements of an equipment or system(s), their interrelationships and functional purpose, but do not require in-depth knowledge of these elements.

(2) Level B tasks: Level B maintenance tasks involve in-depth fault analysis at the system/equipment level ('functional level'). They are usually carried out by personnel that have been trained for the more complicated maintenance tasks on the equipment/system.

(3) Level C tasks: Level C maintenance tasks involve the detailed diagnosis of a software problem, of a faulty Line Replacement Unit (LRU), Printed Circuit Board (PCB) or module ('component level'). They usually require the use of automated test equipment at a suitable location and are usually carried out by personnel that have been trained in detailed fault diagnosis and repair techniques. If a Level C task is carried out in an offline environment (e.g. a workshop), it is not mandatory that the personnel carrying out this task is trained as ATSEP. However, an organisation may choose to train that personnel as ATSEP.

(f) The diagram below illustrates the SMC competence routes.

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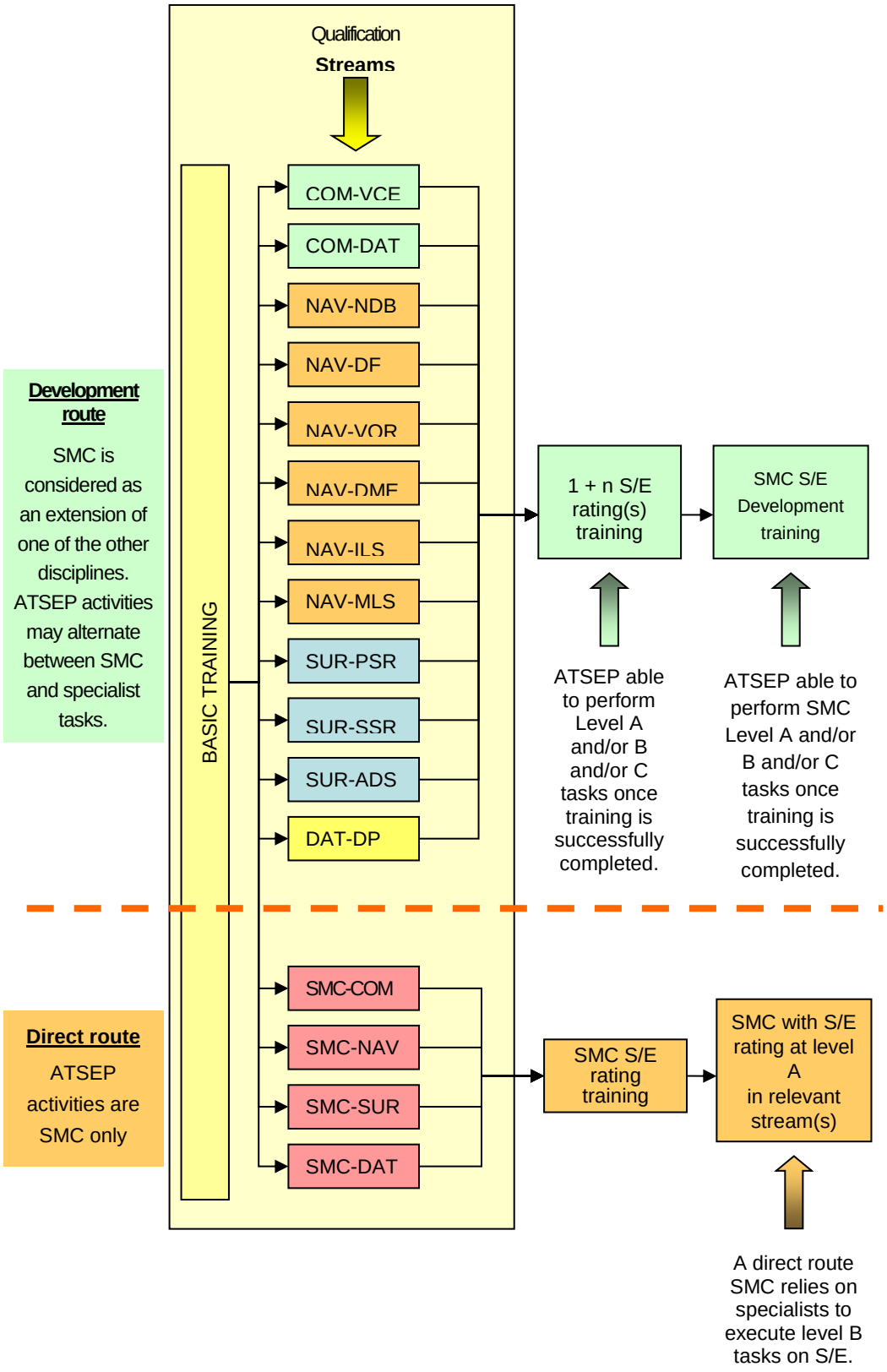
Qualification
Streams
BASIC TRAINING
COM-VCE
COM-DAT
NAV-NDB
NAV-DF
NAV-VOR
NAV-DME
NAV-ILS
NAV-MLS
SUR-PSR
SUR-SSR
SUR-ADS
DAT-DP
SMC-COM
SMC-NAV
SMC-SUR
SMC-DAT
Development route
SMC is considered as an extension of one of the other disciplines. ATSEP activities may alternate between SMC and specialist tasks.
Direct route
ATSEP activities are SMC only
1 + n S/E rating(s) training
SMC S/E Development training
ATSEP able to perform Level A and/or B and/or C tasks once training is successfully completed.
ATSEP able to perform SMC Level A and/or B and/or C tasks once training is successfully completed.
SMC S/E rating training
SMC with S/E rating at level A in relevant stream(s)
A direct route SMC relies on specialists to execute level B tasks on S/E.

GM1 ATSEP.OR.215 System and equipment rating training
SYSTEM AND EQUIPMENT RATING

A system and equipment rating is the authorisation which allows the ATSEP to perform operational tasks on specific system/equipment and may, optionally, include an association with operational site/s, location/s and/or maintenance task levels. The award of this rating follows the successful assessment of operational competence.

The term 'rating' in the definition of 'system/equipment rating training' should not be associated with the definition of 'rating' in Regulation (EC) No 216/2008.

AMC1 ATSEP.OR.220 Continuation training
GENERAL

The frequency and duration of continuation training should be determined by taking into account the ATSEP task exposure (recency) as well as the complexity of the operation and of the maintenance of systems.

GM1 ATSEP.OR.220 Continuation training
REFRESHER TRAINING

(a) For the purpose of this section, 'refresher training' is understood as being training designed to review, reinforce or upgrade existing knowledge and skills (including team skills).

(b) Refresher training may periodically include training to refresh and augment ATSEP team skills. Team skills include, but are not limited to communication, negotiation, decision-making, conflict resolution and listening skills.

EMERGENCY TRAINING

(c) 'Emergency training' is understood as being training designed to broaden knowledge, skills, and behaviour in case of emergency, unusual or degraded situation. Most of the training will be site-specific or may make use of incident or accident analysis.

(d) The term 'emergency' is considered as a serious, unexpected and/or potentially dangerous situation requiring immediate action(s), e.g. complete loss of any of the following:

— radar display picture;

— Electronic Flight Progress Strip system;

— main, standby and emergency communications on multiple frequencies due to external interference blocking the radiotelephony channels.

(e) The term 'unusual situation' is considered as a set of circumstances which are neither habitually nor commonly experienced and for which an ATSEP has not developed a practised response.

(f) The term 'degraded situation' is considered as a situation that is the result of a technical system failure or malfunction or a set of circumstances arising from human error or violation of rules affecting the quality of the service provided (i.e. the service continues to be available, even though in a reduced or limited way). For instance, external mains supply failure to a Category III ILS localiser field site cabin or a normally dual channel DME having a fault on one channel.

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Section 3 — Competence assessment requirements

GM1 ATSEP.OR.300(a) Competence assessment — General

'Competence' is understood as a situation where ATSEP possess the required level of knowledge, technical and behavioural skills and experience, and language proficiency when required, in order to be authorised to perform duties on the system and equipment they are competent to work on.

GM1 ATSEP.OR.305(a)(1) Assessment of initial and ongoing competence

INITIAL COMPETENCE ASSESSMENT

If the competence assessment is done by the same person training the ATSEP learner during the S/E training phase, the service provider should have in place a process to reduce biases.

GM1 ATSEP.OR.305(a)(3) Assessment of initial and ongoing competence

SUPERVISION OF NON-COMPETENT PERSONNEL

Supervision of personnel for lack of competence may be necessary due to a number of circumstances including but not restricted to:

(a) the ATSEP still being trained;

(b) the ATSEP undergoing remedial training due to loss of competence; and

(c) the ATSEP having lost competence due to extended absence from tasks that require competence.

GM1 ATSEP.OR.305(b)(2) Assessment of initial and ongoing competence

BEHAVIOURAL SKILLS

Behavioural skills are non-technical skills and attitudes that ATSEP need to perform effectively. Examples of potential behavioural skills criteria related to initial and ongoing competence are:

(a) cooperation within a team;

(b) attitudes towards safety and security;

(c) flexibility;

(d) analytical thinking; and

(e) ability to communicate effectively.

Section 4 — Instructors and assessors

AMC1 ATSEP.OR.400 Technical skills assessors

SUITABLE

To be considered suitable, technical skills assessors should:

(a) have clear understanding of the service provider's assessment process and procedures applicable;

(b) have clear understanding of the performance required of the ATSEP during the assessment and/or on-going assessment;

(c) have the ability to evaluate, in an objective and independent manner, whether the ATSEP has achieved or is maintaining the level of performance required;

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(d) have the ability to assess and, if required, act when intervention is necessary to ensure that safety is not compromised;

(e) have the ability to analyse and accurately describe and/or record strengths and weaknesses of an ATSEP performance; and

(f) use appropriate interpersonal and communication skills to brief and debrief an ATSEP, if required.

GM1 ATSEP.OR.405 Technical skills assessors
GENERAL

The technical skills assessor is the person who is considered suitable to determine whether an ATSEP is technically competent to operate, maintain, release from and return into operations systems that are necessary for the provision of services. This assessment may be in any context where assessment of technical skills is required, e.g. assessment of first competence, ongoing competence.

GM2 ATSEP.OR.405 Technical skills assessors
ASSESSMENT RESPONSIBILITIES

(a) Where a technical skills assessor works regularly with an ATSEP, he/she is required to assess the ATSEP. Continuous assessment may be appropriate, i.e. assessment may be achieved by the technical assessor observing the standard of an ATSEP's work on a continuous basis as he/she works with the ATSEP during normal operational duties.

(b) If the appointed technical assessor also acts as line manager to the individual ATSEP, the service provider should have in place a process to reduce biases. Responsibility for determining competence lies with the person having the safety accountability for the ATSEP function.

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APPENDIX Ia

The subjects, topics and sub-topics are repeated in this AMC for the convenience of the reader and do not form a part of it.

SUBJECT 1: INDUCTION

TOPIC 1: INDUCTION

SUB-TOPIC 1.1: Training and assessment overview

1.1.1	Describe the training scheme and progression towards ATSEP competence	2	Initial (basic and qualification), S/E rating and continuation training. Course aims, objectives, and topics.
1.1.2	State the assessment requirements, procedures, and methods	1	—

SUB-TOPIC 1.2: National organisation

1.2.1	Describe the organisational structure, purpose and functions of the national service provider(s) and regulatory structures	2	e.g. headquarters, control centres, training facilities, airports, outstations, civil/military interfaces, regulatory interfaces.
1.2.2	Describe the structure and functions of the major departments within the service provider national organisation	2	e.g. organisational handbook (plans, concepts and structure, finance model).
1.2.3	State appropriate accountabilities and responsibilities of the service provider(s) and competent authority	1	—

SUB-TOPIC 1.3: Workplace

1.3.1	State the role of trade unions and professional organisations	1	e.g. international, European, national, local level
1.3.2	Consider security of site facilities and personnel against unlawful interference	2	Environmental, physical and information security measures, employee vetting, and reference checks.
1.3.3	Describe actions when suspecting a security breach	2	e.g. inform police, security agencies and managers. Security manual and/or contingency plan.

SUB-TOPIC 1.4: ATSEP role

1.4.1	Describe the key responsibilities of an ATSEP	2	Initial (basic and qualification), S/E rating and continuation training. Course aims, objectives, and topics.

SUB-TOPIC 1.5: European/worldwide dimension

1.5.1	Explain the relationship between States and its relevance to ATM operations	2	e.g. harmonisation, flow management, bilateral agreement, sharing of ATM relevant data, major studies, research programmes, and policy documents.

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1.5.2	Define the regulatory framework of international and national ATM	1	e.g. ICAO, European and national concepts, responsibilities.
1.5.3	State the purpose of a range of international bodies	1	ICAO, EU, EASA e.g. ECAC, EUROCONTROL, FAA RTCA, EUROCAE

SUB-TOPIC 1.6: International Standards and Recommended Practices

1.6.1	Explain how the regulatory environment of ICAO notifies and implements legislation	2	Annexes, SARPs
1.6.2	State which major/key ATM engineering 'standards' and 'practices' are applicable	1	e.g. ICAO Annex 10, ICAO Doc 8071, ICAO Doc 9426-3, available EUROCONTROL standards, guidance material on reliability, maintainability and availability.

SUB-TOPIC 1.7: Data security

1.7.1	Explain the importance of ATM security	2	
1.7.2	Describe the security of operational data	2	Secure, restricted access by authorised personnel.
1.7.3	Explain security policies and practices for information and data	2	Backup, storing, hacking, confidentiality, copyright.
1.7.4	Describe the possible external interventions which may interrupt or corrupt ATM services	2	Introduction of software viruses, illegal broadcasts, jamming, spoofing.

SUB-TOPIC 1.8: Quality management

1.8.1	Explain the need for quality management and the need for it	2	e.g. ISO, EFQM
1.8.2	Explain the need for configuration management	2	Importance for safe operations e.g. S/E build state, software adaption/version

SUB-TOPIC 1.9: Safety Management System

1.9.1	Explain why there is a need for high-level safety requirements for aeronautical activities	2	Safety policy and rules, system safety cases, system safety requirements.

SUB-TOPIC 1.10: Health and safety

1.10.1	Explain personal safety responsibilities in the work environment	2	Safety statement, first aid, rules about climbing
1.10.2	Explain potential hazards to health and safety generated by equipment, or contained within the work environment	2	e.g. health consequences of electric shock and static discharges, precautions with chemical products (batteries), mechanical hazards (rotating machinery/antennas), toxic materials (beryllium), biological hazards, faulty earthing
1.10.3	Describe fire safety and first-aid regulations and practices	2	Requirements and rules e.g. standards

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1.10.4	State any applicable legal requirements and safety rules	1	National, international regulations e.g. for working on power supply and/or air conditioning
1.10.5	Describe the main features and uses of the different types of fire detectors and extinguishers	2	e.g. VESDA, Type A, B, C, D extinguishers

SUBJECT 2: AIR TRAFFIC FAMILIARISATION

TOPIC 1: AIR TRAFFIC FAMILIARISATION

SUB-TOPIC 1.1: Air Traffic Management

1.1.1	Define Air Traffic Management	1	ICAO, EU regulations
1.1.2	Describe operational ATM functions	2	ATFCM, ATS, ASM
1.1.3	Describe ATM concepts and associated terminology	2	e.g. concepts: FUA, free flight, gate-to-gate, performance-based ATM operations (PBN, RCP), operational concepts (ICAO, EUROCONTROL, SESAR). Terminology: glossary
1.1.4	Explain the operational importance of technical services required for ATM	2	e.g. Regulation (EC) No 552/2004
1.1.5	State future developments in systems and/or ATM/ANS practices which may impact on services provided	1	e.g. data link, satellite-based navigation, gate-to-gate (CDM), ATC tools, continuous approach, 4D trajectory, business trajectory, SWIM, NOP, SESAR (UDPP, modes of separation), ASAS.
1.1.6	List the standard units of measurement used in aviation	1	Speed, distance, vertical distance, time, direction, pressure, temperature.

SUB-TOPIC 1.2: Air Traffic Control

1.2.1	Define airspace organisation	1	— ICAO Annex 11, Regulation (EU) No 923/2012 e.g. FIR, UTA, TMA, CTR, ATS routes
1.2.2	Describe commonly used airspace terminologies and concepts	2	e.g. sectorisation, identification of ATS routes, restricted airspace, significant points.
1.2.3	State the general organisation of aerodromes	1	e.g. obstacle limitation surfaces, different departure and arrival trajectories, approach and landing categories, operational status of radio navigation aids.
1.2.4	State the purpose of ATC	1	ICAO Doc 4444
1.2.5	State the organisation of ATC services	1	ICAO Doc 4444 e.g. area, approach, aerodrome control services

SUB-TOPIC 1.3: Ground-based Safety nets

1.3.1	Describe the purpose of ground-based safety nets	2	e.g. STCA, MSAW, APW, runway incursion alerts

SUB-TOPIC 1.4: Air Traffic Control tools and monitoring aids

1.4.1	Explain the main characteristics and use of ATC support and monitoring tools	2	e.g. MTCD, sequencing and metering tools (AMAN, DMAN), A-SMGCS, CLAM, RAM, CORA

SUB-TOPIC 1.5: Familiarisation

1.5.1	Take account of ATC tasks	2	e.g. simulation, role play, PC, Part Task Trainer, observations in the operational environment
1.5.2	Explain the need for good communication, coordination and cooperation between operational staff	1	e.g. handovers, MIL/CIV, planner/tactical, SV Tech (SMC) and SV ATCO, site visit(s) to ATC units
1.5.3	Consider the purpose, function and role of various operational stations in respect of ATM-related operations	2	*Site visit(s) to ATC units* e.g. MET Office, e.g. meteorological providers, remote sites, airport operations
1.5.4	Define the phases of flight	1	Take-off, climb, cruise, descent and initial approach, final approach and landing
1.5.5	Recognise the cockpit environment and associated equipment, in relation to ATC	1	Relevant pilot HMI e.g. familiarisation flight or cockpit simulator training (where practicable), antenna
1.5.6	Define airborne collision avoidance systems	1	ACAS, EGPWS *e.g. TCAS*

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APPENDIX IIa

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SUBJECT 3: AERONAUTICAL INFORMATION SERVICES (AIS)

TOPIC 1: AERONAUTICAL INFORMATION SERVICES

SUB-TOPIC 1.1: Aeronautical Information Services

1.1.1	State the organisation of the AIS	1	—
1.1.2	Define the AIP service	1	e.g. data contents of AIP, supplementary, AIC and types of publication: AIRAC, non-AIRAC, data collection and preparation, data format, distribution channels, supporting systems and tools
1.1.3	Define the aeronautical charting service	1	Types of aeronautical charts, operational use of charts, supporting systems and tools
1.1.4	Define the NOTAM services	1	—
1.1.5	Define the ATS Reporting Office	1	e.g. purpose of flight plans and other ATS messages, types of flight plans (FPL and RPL), contents of flight plans and other ATS messages, distribution of flight plans and other ATS messages, supporting systems and tools
1.1.6	Define the European AIS Database	1	e.g. paper/data, central single source, validated, redundancy, EAD structure
1.1.7	Define procedures for providing Communications, Navigation and Surveillance (CNS) data to AIS	1	Information of a permanent nature, information of a temporary nature, status report of NAVAIDs

SUBJECT 4: METEOROLOGY

TOPIC 1: Meteorology

SUB-TOPIC 1.1: Introduction to meteorology

1.1.1	State the relevance of meteorology in aviation	1	Influence on the operation of aircraft, flying conditions, aerodrome conditions
1.1.2	State the weather prediction and measurement systems available	1	—

SUB-TOPIC 1.2: Impact on aircraft and ATS operation

1.2.1	State the meteorological conditions and their impact on aircraft operations	1	e.g. atmospheric circulation, wind, visibility, temperature/humidity, clouds, precipitation
1.2.2	State the meteorological conditions hazardous to aircraft operations	1	e.g.; turbulence, thunderstorms, icing, microbursts, squall, macro bursts, wind shear, standing water on runways (aquaplaning)
1.2.3	Explain the impact of meteorological conditions and	2	e.g. effects on equipment performance (e.g. temperature inversion, rain density), increased vertical and horizontal separation, low visibility

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	hazards on ATS operations		procedures, anticipation of flights not adhering to tracks, diversions, missed approaches
1.2.4	Explain the effects of weather on propagation	2	e.g. anaprop, rain noise, sunspots

SUB-TOPIC 1.3: Meteorological parameters and information

1.3.1	List the main meteorological parameters	1	Wind, visibility, temperature, pressure, humidity
1.3.2	List the most common weather messages and broadcasts used in aviation	1	e.g. ICAO Annex 3 Meteorology messages: TAF, METAR, SNOWTAM Broadcasts: ATIS/flight meteorology broadcast (VOLMET)

SUB-TOPIC 1.4: Meteorological systems

1.4.1	Explain the basic principles of the main meteorological systems in use	2	e.g. weather display and information systems, wind speed (anemometer), wind direction (weather vane), visibility (types of IRVR, forward scatter), temperature probes, pressure (aneroid barometers), humidity, cloud base (laser ceilometers)

SUBJECT 5: COMMUNICATION

TOPIC 1: GENERAL INTRODUCTION

SUB-TOPIC 1.1: Introduction to communications

1.1.1	State the structure of the communication domain	1	Voice communication, data communication
1.1.2	State major substructures of the communication domain	1	Air-ground, ground-ground, air-air communications
1.1.3	State ATS requirements for safe communications	1	Safety, reliability, availability, coverage, QoS, latency
1.1.4	State the aeronautical communication services	1	Mobile, fixed

TOPIC 2: VOICE COMMUNICATION

SUB-TOPIC 2.1: Introduction to voice communications

2.1.1	Describe system architecture	2	—
2.1.2	Explain the purpose, principles and role of voice communication systems in ATS	2	e.g. audio bandwidth, dynamic range, fidelity, routing, switching, lineside/deskside, coverage, communication chain between controller and pilot
2.1.3	Describe the way in which voice communication systems function	2	Analogue/digital comparisons, distortion, harmonics
2.1.4	State methods used to route and switch voice communications	1	e.g. multichannels, multi-users, party lines, VHF/UHF linkage, HF, SELCAL
2.1.5	State how systems interface to	1	—

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	produce an integrated service to ATS		
2.1.6	State radio spectrum and frequency allocation constraints and procedures	1	Spectrum, interference sources, commercial allocations, world radio conference, ITU, common aviation position, efficient utilisation of frequency bands, channel spacing
2.1.7	State voice recording systems in use	1	e.g. digital recording equipment, analogue recording
2.1.8	State ICAO and local legal requirements regarding recording and retention of voice communications	1	Regulatory requirements, incident recording and playback, recording equipment
2.1.9	State the purpose of ATIS and VOLMET	1	—

SUB-TOPIC 2.2: Air-ground communication

2.2.1	State the functions and basic operation of routing and switching equipment in use in the ATS environment	1	Voice switching
2.2.2	Describe the purpose and operation of the elements of a communication chain in use in the ATS environment	2	Functionality, emergency systems, transmission/reception, CWP, on-board equipment e.g. channel spacing, antenna switching, CLIMAX, voting systems
2.2.3	State ways of achieving quality of service	1	e.g. importance of coverage and redundancy of equipment, overlapping coverage, backup system, functional redundancy vs element redundancy
2.2.4	Recognise the elements of the CWP that are used for air-ground communication	1	Frequency selection, emergency, station selection, coupling, microphone, headset, loudspeaker, footswitch, PTT
2.2.5	List future developments and techniques which may have an impact on ATS voice communications	1	*e.g. CPDLC, VDL Modes 2*

SUB-TOPIC 2.3: Ground-ground communication

2.3.1	State the functions and the basic operations of routing and switching equipment in use in ATS environment	1	General architecture
2.3.2	Describe how ground-ground systems interface to provide an integrated service to ATS environment	2	International/national links, ACC interoperability, voice and data integration
2.3.3	Describe the purpose and operation of the elements of a system	2	Functionality, emergency systems, PTT interfaces e.g. MFC and ATS-Qsig, switching, local PABX equipment
2.3.4	Recognise the elements of the CWP used for ground-ground communication	1	Selection, emergency, loudspeaker, headset, microphone
2.3.5	List developments in ground-ground	1	e.g. protocols (TCP/IP,

	technologies which may impact on ATS voice communication		voice-over IP) future development

TOPIC 3: DATA COMMUNICATIONS

SUB-TOPIC 3.1: Introduction to data communications

3.1.1	Explain the purpose, principles and role of data communication systems in ATS	2	e.g. terminology, principles and theory of networks, layering (e.g.: OSI or TCP/IP), data links, LAN, WAN
3.1.2	Define the concept of data transmission	1	e.g. packet switching, protocols, multiplexing, demultiplexing, error detection and correction, routing, switching, hops, cost, bandwidth/speed
3.1.3	Describe the function of various elements of the data systems in use in ATS environment	2	Switch, router, gateways, end systems, redundancy
3.1.4	Define protocols in current use	1	e.g. TCP/IP, X.25, frame relay, asynchronous transfer mode

SUB-TOPIC 3.2: Networks

3.2.1	State ATS requirements for safe data communications	1	Reliability, availability
3.2.2	Describe the different types of networks	2	LAN, WAN, ATN, national network for ATM e.g. satellite-dedicated networks, AFTN
3.2.3	State the functions of a network management system	1	Priorities, rights e.g. SNMP

SUB-TOPIC 3.3: Aviation specific networks, applications and ATM/ANS providers

3.3.1	Name a range of air-ground aviation-related network concepts	12	ATN e.g. Subnetworks: ATN air-ground subnetwork, AMSS, VDL, HFDL Protocols: ACARS Communication service providers: ARINC, SITA, States, LINK16
3.3.2	Name a range of ground-ground aviation-related network concepts	12	ATN, PENS Optional content e.g. Physical networks: PENS, AFTN/CIDIN, RAPNET *Communication protocols: IP, X.25, ASTERIX, FMTP* Communication service providers: SITA, ARINC, national carriers, ANSPs Applications: AMHS, AIDC, OLDI

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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	Characterise 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	Oblate spheroid e.g. earth's parameters
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

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

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SUB-TOPIC 3.3: Means of navigation

3.3.1	State the different means of navigation	1	Sole, primary, supplementary

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, MLS e.g. Loran C, MLS, TACAN, marker beacons
4.1.3	Recognise 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, MLS
4.1.5	Recognise 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

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	Recognise the basic architecture of a core satellite positioning system	1	GPS e.g. Galileo
4.3.3	Recognise 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

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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 Europe	1	B-RNAV-5, P-RNAV-1, RNP approaches

SUB-TOPIC 5.2: Future developments

5.2.1	State future navigation developments	21	e.g. 4D-RNAV, free routes, rationalisation plans, advanced RNP1

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 defence 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)

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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 harmonisation	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	ASTERIX, etc.

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, polarisation, multielevation scanning, frequency band

SUB-TOPIC 1.8: Integration of surveillance information

1.8.1	Describe complementary use of different sensors	2	_

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	12	TDOA principle, hyperboloic 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	Recognise surveillance information on a display	1	e.g. PSR and MSSR tracks, position identification, FL, speed vector, RDP and FDP information

SUB-TOPIC 1.12: Analysis Tools

1.12.1	State analysis tools	1	e.g. SASS-C, SASS-S, RAPS

SUBJECT 8: DATA PROCESSING

TOPIC 1: DATA PROCESSING

SUB-TOPIC 1.1: Introduction to data processing

1.1.1	Describe the functions and generic architecture of the systems	2	Generic FDP and SDP overall functional block diagrams
1.1.2	Describe how the systems interface with other systems	2	Surveillance sensors, displays, CFMU, recording, international ATM networks e.g. safety nets, military interfaces
1.1.3	Define basic software functions/applications	1	FDP (IFPS, route processing, code/call sign correlation, code allocation, strip distribution, track labelling) SDP (coordinate conversion, plot and track processing, MRP, safety nets, track labelling)
1.1.4	State the legal aspects for data processing in ATM	1	Traceability and recording of data and actions, configuration control
1.1.5	State the additional data used by ATM system	1	e.g. MET, airlines
1.1.65	State current developments and future possibilities	1	e.g. Coflight, iTEC, SESAR, multisensor tracking

SUB-TOPIC 1.2: System software and hardware principles

1.2.1	Describe the current hardware configurations used in ATM	2	Redundancy and backup e.g. driver, interfaces, hardware platforms, fault tolerant systems
1.2.2	Describe the current software platforms, used in ATM	2	Operating systems

SUB-TOPIC 1.3: Surveillance data processing

1.3.1	State ATC requirements	1	QoS, mandatory data recording, dependability
1.3.2	Explain the principles of SDP	2	e.g. single, multi, plot, track
1.3.3	Describe the functions of SDP	2	Plot processing, tracking, single sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording e.g. ARTAS tracker
1.3.4	Describe radar data inputs/outputs	2	Tracks, plots, messages, code/call sign, time, control and monitoring, conflict alerts, FDP interface, maps, adaptation
1.3.5	Describe the surveillance data-based monitoring functions	2	Safety nets, ATC tools e.g. safety nets: STCA, MSAW, APW, runway incursion alerts ATC Tools: MTCD, AMAN, DMAN, A-SMGCS

SUB-TOPIC 1.4: Flight data processing (FDP)

1.4.1	State ATC requirements	1	QoS, unambiguous, accurate, error free, timely
1.4.2	Explain the functions of FDP	2	Flight strip production, flight plan data updates, code/call sign correlation, flight progress monitoring, coordination and transfer *e.g. CIV/MIL coordination*
1.4.3	Define inputs and outputs	1	Flow control (CFMU/IFPS/FMP, ETFMS), flight strips/data displays, MRT, environmental data, static data, airspace adaptation
1.4.4	Describe the basic software functions/applications	2	FDP (IFPS, route processing, code/call sign correlation, code allocation, strip distribution, track labelling)
1.4.5	Describe the FPL data update process	2	Automatic and manual update

SUB-TOPIC 1.5: Human machine interface systems

1.5.1	Describe the different display technologies	2	Raster scan, common graphic display interface, LCD, plasma, TFT, Touch Input Device
1.5.2	Recognise what information is normally displayed on the ATCO and ATSEP HMI	1	—

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SUB-TOPIC 1.6: Miscellaneous information

1.6.1	State the additional data used by ATM system	1	e.g. MET, airlines

SUBJECT 9: SYSTEM MONITORING AND CONTROL

TOPIC 1: SYSTEM MONITORING AND CONTROL (SMC)

SUB-TOPIC 1.1: Overview of SMC Function

1.1.1	Describe the principles and purpose of the operational management of the technical services	2	Service requirements, interfaces, boundaries of tactical responsibility e.g. hierarchy of authority for the technical and ATC structures
1.1.2	Describe the technical system architecture of the SMC function and its subordinate systems	2	Main monitoring and control architecture e.g. Surveillance: Radar stations, communications, processing, display Communications: TX/RX, circuit management, networks, HMI, standby facilities, recording Navigation: NDB, VOR, ILS, DF DP: FDPS, data communications Facilities: Power, generators, UPS, battery, environmental (heating, cooling), fire and security
1.1.3	Describe the transfer of responsibility for a service	2	Operational and technical responsibility Configuration and monitoring access and responsibility

SUB-TOPIC 1.2: System configuration:

1.2.1	Describe the range of configurations that can be used	2	*Equipment or channel switching, parameter settings*
1.2.2	Describe the general techniques that are employed to make configuration changes	2	e.g. physical switching
1.2.3	State procedures required to implement a planned major system change	1	e.g. safety requirement, authorisation, coordination, implementation plan, fallback strategies, major system change, activation of new version of software in a subordinate system, transfer of a service to a new system, change of a database

SUB-TOPIC 1.3: Monitoring and control functions

1.3.1	State the monitoring functions that are available	1	e.g. BITE, status, parameters, software and hardware watchdogs
1.3.2	State the control functions that are available	1	e.g. switching, parameters, set configurations
1.3.3	Explain the importance of SMC management and coordination of maintenance activities	2	—

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1.3.4	State analysis tools associated with SMC	1	e.g. possible malfunctions (SASS-C, SASS-S, RAPS, track and noise monitoring tools)

SUB-TOPIC 1.4: Coordination and reporting

1.4.1	State why coordination and reporting is required and how it is achieved	1	Facility interrupts, deconflict multiple outages, legal requirements e.g. causes: service failure, planned outage, loss of backup, software upgrade Relevant parties: external service providers, ATC, other centres Relevant information: NOTAM, logbook

SUB-TOPIC 1.5: Emergency coordination

1.5.1	Describe situations where coordination and reporting will be necessary	2	e.g. hijack, mayday, R/T fail, loss of aircraft, MIL action, fire, flood, security, terrorist threat or action, medical
1.5.2	State which parties may be involved in the coordination and reporting of emergency situations	1	e.g. ATC supervisors (local and remote), ATSEP supervisors (local and remote), management, police, MIL, medical, accident investigation branch
1.5.3	Explain the responsibilities and/or duties of SMC members during an emergency situation by using an example scenario	2	—
1.5.4	State the succession of authorities and responsibilities in the event that the nominated person or function is not available	1	Hierarchy of responsibility

SUB-TOPIC 1.6: Equipment operating

1.6.1	Define the principles and ergonomics of the HMI of the SMC central system and its subordinate systems	1	Permissions, control tokens, ergonomic conventions (e.g. green is good or safe, red is fail or unsafe)
1.6.2	State the routine tasks required and the criticality of their completion and any legal requirements	1	e.g. audio circuit voice checking, audio recording checking, archive media changing and storage, VOLMET

SUBJECT 10: MAINTENANCE PROCEDURES

TOPIC 1: MAINTENANCE PROCEDURES

SUB-TOPIC 1.1: Maintenance procedures

1.1.1	Explain handling precautions to be taken to ensure equipment protection	2	Isolation, protection devices, electrostatic sensitive devices, power supplies, heavy loads, high voltage
1.1.2	Explain the classifications of maintenance	2	e.g. preventative, corrective, service configuration
1.1.3	Explain the maintenance strategy and rules	2	Organisation and planning of maintenance, rules controlling deviation from planned maintenance,

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			intervention tracking, return to service
1.1.4	State the scope or responsibility of an S/E rated person	1	e.g. tracing maintenance actions and objectives, liability of maintenance personnel actions, safety of service, safety of equipment

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APPENDIX IIIa

The subjects, topics and sub-topics are repeated in this AMC for the convenience of the reader and do not form a part of it.

SUBJECT 1: SAFETY

TOPIC 1: SAFETY MANAGEMENT

SUB-TOPIC 1.1: Policy and principles

1.1.1	Explain the underlying need for safety management policy and principles	2	ICAO Annex 19, lessons learnt from events, evolving environment, requirements
1.1.2	State the safety management policy	1	ICAO Annex 19, priority of safety, the safety objective of ATM, roles and responsibilities
1.1.3	Explain safety management principles	2	ICAO Annex 19, safety achievement, safety assurance, safety promotion
1.1.4	Appreciate the reactive and proactive nature of safety management policy and principles	3	*e.g.* ICAO Annex 19 *e.g. nature of events, reason model, events investigation, safety assessment*
1.1.5	Explain the link between safety management principles and the life cycle of an ATM system	2	ICAO Annex 19, safety occurrences, setting of safety levels, system safety assessment, safety surveys, safety monitoring, system safety assessment documentation, lesson dissemination, safety improvement, use of safety data to assist in decommissioning or replacement of system
1.1.6	Relate the ATSEP role and responsibilities to safety management	4	Competency, occurrence reporting *e.g. 'just culture' (ref.:EAM2 GUI6), risk assessment*
1.1.7	State the role and content of a typical SMS within an ANSP	1	ICAO Annex 19
1.1.8	Explain the 'just culture' concept	2	Benefits, prerequisites, constraints *e.g. EAM2 GUI6*

SUB-TOPIC 1.2: Concept of risk and principles of risk assessment

1.2.1	Describe the concept of risk	2	Types of risk, components of risk, risk contributors (people, procedure, organisations and equipment)
1.2.2	State ways of assessing risk	1	Risk comparisons, risk analysis
1.2.3	Describe the concept of risk tolerability	2	Risk assessment and mitigation, ALARP Principle *e.g. Risk perception, risk management*

SUB-TOPIC 1.3: Safety assessment process

1.3.1	Explain the methods for the assessment of hazards and possible failures	2	*e.g. Failure and hazard brainstorm session, Fault tree analysis*
1.3.2	Appreciate the importance of adopting a total system approach covering human, procedure, organisation and	3	ATM system description (including scope definition and limitation), end-to-end integrity of safety assessment

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	equipment elements		*e.g. Concept of TRM*
1.3.3	Describe the overall safety assessment process and its relationships with risk assessment during the total life cycle of ANS system	2	Collection and presentation of results, contingency arrangements, back-up procedures *e.g. Risk-based process, FHA, (safety objectives), preliminary system safety assessment PSSA (safety requirements), system safety assessment SSA (safety monitoring and evidence)*

SUB-TOPIC 1.4: Air navigation system risk classification scheme

1.4.1	Describe the ATM system risk classification scheme	2	*e.g. Scenario of failure of air navigation system (incident chain), component of a risk classification scheme, severity classes, probability classes (qualitative and quantitative)*

SUB-TOPIC 1.5: Safety regulation

1.5.1	Describe the role of safety regulation	2	The purpose of European (EASA, EU) regulations and international standards, objectives of the EUROCONTROL Safety Regulation Commission, objective of the national regulator
1.5.2	Explain the relationship between the safety regulation documents	2	ICAO documentation (SARPS), EASA/EU Regulations, AMCs and GM, national regulation
1.5.3	Explain how the safety regulation documents affect ATM service provision	2	ICAO documentation (SARPS), EASA/EU Regulations, AMCs and GM, national regulation
1.5.4	Explain the interface between the safety regulator and the ANSP	2	Information to be provided to regulator by ANSP and vice versa, importance of incident reporting

SUBJECT 2: HEALTH AND SAFETY

TOPIC 1: HAZARD AWARENESS AND LEGAL RULES

SUB-TOPIC 1.1: Hazard awareness

1.1.1	State potential hazards to health and safety generated by equipment used in CNS/ATM	1	*e.g. COM/SUR/SMC: mechanical hazards, electrical hazards (LV, HV, EMI), chemical hazards* *NAV: includes RF energy* *DP: none*

SUB-TOPIC 1.2: Regulations and procedures

1.2.1	State applicable international requirements	1	*e.g. European norms, CENELEC, DIN*
1.2.2	State any applicable national requirements	1	—
1.2.3	State safety procedure for the persons working on or near relevant equipment	1	*e.g. COM/NAV/SUR/SMC: isolation (clothing, tools), fire extinction types, safety man presence, safety interlocks, isolating switches, security of the site, climbing procedures, earthing, direct or indirect contact with HV*

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SUB-TOPIC 1.3: Handling of hazardous material

1.3.1	State European and local regulations for electronic device disposal	1	Protection of environment *e.g. recycling*

SUBJECT 3: HUMAN FACTORS

TOPIC 1: INTRODUCTION TO HUMAN FACTORS

SUB-TOPIC 1.1: Introduction

1.1.1	Explain why human factors are particularly important in the ATM environment	2	Historical background, safety impact on ATM, incidents
1.1.2	Define human factors	1	*e.g. ICAO Human Factors Training Manual*
1.1.3	Explain the concept of systems and its relevance in the ATM environment	2	People, procedures, equipment
1.1.4	Explain the use of the SHELL model	2	*e.g. ICAO Human Factors Training Manual, visits to OPS and technical rooms*
1.1.5	State the factors which can affect personal and team performance	1	*e.g. psychological, medical, physiological, social, organisational, communication, stress, human error, working knowledge and skills*

TOPIC 2: WORKING KNOWLEDGE AND SKILLS

SUB-TOPIC 2.1: ATSEP knowledge, skills and competence

2.1.1	Explain the importance of maintaining and updating professional knowledge and skills	2	Assure safety
2.1.2	Explain the importance of maintaining non-technical skills and professional competence	2	*e.g. communication, human relationship, knowledge of environment, human limit awareness*
2.1.3	State the available means to maintain professional knowledge and skills	1	*e.g. practice, personal study, briefing, seminars, courses, technical periodicals, technical books, OJT, simulation, CBT, e-learning, visits, feedback, TRM*

TOPIC 3: PSYCHOLOGICAL FACTORS

SUB-TOPIC 3.1: Cognition

3.1.1	Describe major aspects of human information processing	2	Perception, attention, memory, judgement, decision-making, response execution, control of execution
3.1.2	Describe the factors which influence information processing	2	*e.g. stress and strain, experience, knowledge, distraction, interpersonal relations, working environment, risk perception, attitude, workload, fatigue, confidence, job security*
3.1.3	Appreciate factors which influence information processing	3	*e.g. case study, simulation, role playing*

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TOPIC 4: MEDICAL

SUB-TOPIC 4.1: Fatigue

4.1.1	Describe the effect of fatigue on human performance	2	Physiological, cognitive and relational effects *e.g. lack of concentration, irritability, frustration*
4.1.2	Recognise the signs of fatigue in oneself and in others	1	*e.g. making frequent mistakes, unable to concentrate, lack of normal humour, sleeping and/or eating disorders*
4.1.3	Explain how to respond to indications of fatigue in an appropriate manner	2	Take time off, rest for short periods of time, seek professional help

SUB-TOPIC 4.2: Fitness

4.2.1	Describe signs of lack of personal fitness	2	—
4.2.2	Describe actions to prevent or resolve lack of personal fitness	2	Healthy lifestyle *e.g. healthy diet, sleeping, physical and mental activities*
4.2.3	Explain the influence of psychoactive substances on human performance	2	*e.g. nervous system, medication, smoking, alcohol, habitual and occasional use of psychoactive substances*

SUB-TOPIC 4.3: Work environment

4.3.1	Describe the influence of the work environment on human performance	2	Ergonomics, effects of noise, electromagnetic waves, temperature, working circumstances

TOPIC 5: ORGANISATIONAL AND SOCIAL FACTORS

SUB-TOPIC 5.1: Basic needs of people at work

5.1.1	Explain basic needs of people at work	2	*e.g. balance between individual ability and workload, working time and rest periods; adequate working conditions, positive working environment*
5.1.2	Characterise the factors of work satisfaction	2	*e.g. money, motivation, achievement, recognition, advancement, challenge*

SUB-TOPIC 5.2: Team resource management

5.2.1	State the objectives of TRM	1	Experience sharing, feedback, improved interpersonal relations, indirect increase in safety

SUB-TOPIC 5.3: Teamwork and team roles

5.3.1	Describe the differences between social human relations and professional interactions	2	—
5.3.2	Identify reasons for loss of team effectiveness and actions to prevent it and prevent repetition	3	*e.g. roles poorly defined, goals poorly identified, bad planning, too many leaders or not enough, respect for others, divergence in values, misunderstandings*
5.3.3	Describe the principles of teamwork	2	*e.g. team membership, group dynamics,*

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			advantages/disadvantages of teamwork
5.3.4	Identify reasons for conflict	3	—
5.3.5	Describe actions to prevent human conflicts	2	—
5.3.6	Describe strategies to cope with human conflicts	2	*e.g. in your team*

TOPIC 6: COMMUNICATION

SUB-TOPIC 6.1: Written report

6.1.1	Appreciate the importance of recording information by writing effectively	3	ATSEP technical report, logs, system degradation reports, specification, system manager report
6.1.2	Use appropriate terminology to communicate effectively in writing	3	Be concise, clear; common technical terms; convey key points

SUB-TOPIC 6.2: Verbal and non-verbal communication

6.2.1	Describe the human communication process	2	—
6.2.2	Characterise the factors which affect verbal communication	2	*e.g. Cognitive: lack of knowledge of the procedures, of technical terms, workload, poor receiver references* *Affective: being shy, feelings of not being listened to, not being part of the group, not being assertive, poor eye contact while talking, stress* *Physiological: stuttering, low voice level*
6.2.3	Describe factors which affect non-verbal communication	2	*e.g. touch, noise, interruption, body language*
6.2.4	Use appropriate vocabulary to communicate effectively on technical matters	3	Technical 'jargon', language differences, standard words/phrases
6.2.5	Use appropriate language for professional communication with non-ATSEP	3	Term sharing, translation, being concise, simple words, selection of information and detail level according to the receiver

TOPIC 7: STRESS

SUB-TOPIC 7.1: Stress

7.1.1	Explain the process of stress	2	Causes, stress mechanism, consequences in different work situations (e.g. *online intervention, maintenance, training)*
7.1.2	State the symptoms of stress	1	*e.g. frustration, anger, irritability, aggressive and/or irrational behaviour, helplessness*

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SUB-TOPIC 7.2: Stress management

7.2.1	Act to relieve or minimise stress in self and/or others	3	The effect of personality in coping with stress, benefits of active stress management
7.2.2	Appreciate how assistance is obtained in stressful situations	3	Benefits of asking, offering and accepting help in stressful situations *e.g. CISM*
7.2.3	Recognise the effects of shocking and stressful situations	1	For oneself and for others, abnormal situations
7.2.4	Consider the benefits of critical incident stress management	2	—

TOPIC 8: HUMAN ERROR

SUB-TOPIC 8.1: Human error

8.1.1	Describe human error	2	—
8.1.2	Explain the relationship between human error and safety	2	Mechanism, error-prone conditions, consequences *e.g. reason model, feedback*
8.1.3	State different types of errors using an appropriate model	1	*e.g. Rasmussen model, Gagne model*
8.1.4	Differentiate between errors and violations	2	—
8.1.5	Explain how to detect errors	2	*e.g. individual and collective strategy, event report, procedure*
8.1.6	Explain, in general terms, how errors are mitigated	2	—
8.1.7	Appreciate two significant ATM incidents/accidents involving ATSEP/engineering contributory factors	3	—

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APPENDIX IVa

Subjects, topics and sub-topics from Appendix IV are repeated in this AMC for the convenience of the reader and do not form a part of it.

Stream COM-VOICE

SUBJECT 1: VOICE

TOPIC 1: AIR-GROUND

SUB-TOPIC 1.1:Transmission/reception

1.1.1	Perform typical measurements on a transmitter	3	Frequency (single carrier, offset carrier), modulation, channel spacing, output power, SWR
1.1.2	Adjust a generic radio transmitter	4	Noise, intermodulation, harmonics, power, bandwidth
1.1.3	Analyse the block diagram of a generic radio transmitter	4	Characteristics (modulation, single carrier, channel spacing), functionalities
1.1.4	Perform typical measurements on a receiver	3	Frequency, modulation, channel spacing, sensitivity, selectivity
1.1.5	Adjust a generic radio receiver	4	Signal to noise ratio, harmonics
1.1.6	Analyse the block diagram of a generic radio receiver	4	Characteristics (single carrier, channel spacing, sensitivity, selectivity)

SUB-TOPIC 1.2: Radio antenna systems

1.2.1	Explain antenna parameters	2	Impedance, polar diagram, bandwidth, polarisation, types of antennas
1.2.2	Characterise the coverage of the radio system	2	Polar diagram, types of antennas, frequency bands, propagation mode
1.2.3	Characterise budget link according to various conditions	2	Output power, antennae, propagation, geographic, meteorological, day and night
1.2.4	Characterise the elements of a generic antenna system	2	Filters, combiners, multi-cavity system
1.2.5	Check the conformity of a system to ITU and national regulation	3	Ref.: ICAO Annex 10 (VHF, UHF)
1.2.6	Perform measurements with generic radio test equipment	3	Spectrum analyser *e.g. scanner*

SUB-TOPIC 1.3: Voice switch

1.3.1	Analyse switching functionalities	4	General architecture, digital, analogue, multiplex types, PCM *e.g. cross-coupling, split headset (radio both ears, telephone single ear)*
1.3.2	Explain the principles of non-blocking switches	2	Advantages, disadvantages, delays (digital)

1.3.3	Describe the signal processing all along the chain	2	Signal tracing treatment, protocols (a few), data flow

SUB-TOPIC 1.4: Controller working position

1.4.1	Describe the most common features of a controller working position	2	Frequency selection, emergency, station selection, coupling, headset, loudspeaker, footswitch, Push to Talk *e.g. microphone (noise cancelling), short time recording*

SUB-TOPIC 1.5: Radio interfaces

1.5.1	Describe the different types of interface	2	Internal, external, phantom keying, in-band signal

TOPIC 2: GROUND-GROUND

SUB-TOPIC 2.1: Interfaces

2.1.1	Describe the different types of interfaces	2	Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb)
2.1.2	Explain the advantages and disadvantages of each type	2	Analogue (2, 4, 6 and 8 wires), digital (ISDN; 64 Kb, 2 Mb)
2.1.3	Operate measuring equipment	3	*e.g. dB meters, level meters, generators, sniffer*

SUB-TOPIC 2.2: Protocols

2.2.1	Operate standard protocol analysers	3	*e.g. MFC R2 and/or ATS QSIG (rerouting), impulse dialling and DTMF dialling, ISDN*
2.2.2	Analyse communication protocol with appropriate tools and documentation	4	*e.g. MFC R2 , ATS QSIG (rerouting), impulse dialling and DTMF dialling, ISDN, national protocols*

SUB-TOPIC 2.3: Switch

2.3.1	State the similarities between ground-ground and air-ground switches	1	Switching techniques
2.3.2	Describe the most commonly used functionality of PABX	2	General architecture, digital, analogue, multiplex types, PCM30
2.3.3	Analyse conversion analogue-digital, digital-analogue	4	General architecture, analogue-digital-analogue

SUB-TOPIC 2.4: Communication chain

2.4.1	Appreciate the replacement of components in a communication chain in a safe way	3	Continuity of service, communication chain integrity Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training

SUB-TOPIC 2.5: Controller working position

2.5.1	Describe the most common features	2	—

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	of a controller working position and the HMI		

SUBJECT 2: TRANSMISSION PATH

TOPIC 1: LINES

SUB-TOPIC 1.1: Lines theory

1.1.1	Calculate parameters of a line	3	*e.g. equation, attenuation, impedance, S-parameters, Smith chart, bandwidth, HF specifics (dipoles, multipoles), SWR*

SUB-TOPIC 1.2: Digital transmission

1.2.1	Calculate parameters for digital transmission	3	*e.g. signal definition, Fourier Theory, signal processing (sampling, etc.), bandwidth, carrier, modulation, noises, S/N, delays, group delay, line quality (signal distortion, rate of failure), transmission speed*

SUB-TOPIC 1.3: Types of lines

1.3.1	Describe the different types of lines and their physical characteristics	2	*e.g. copper wires (twisted pairs, symmetrical cables), optic fibres (monomodes or multimodes, connectors, splicer), coaxial* *attenuation, losses, bending, characteristic impedance, EMC and noise immunity*
1.3.2	Appreciate the appropriate type of line for a given specific application	3	*e.g. bandwidth, noise immunity*
1.3.3	Check the typical parameters of lines	3	*e.g. impedance, insulation, signal level, time delay*

TOPIC 2: SPECIFIC LINKS

SUB-TOPIC 2.1: Microwave link

2.1.1	Describe a microwave link	2	*e.g. carrier frequency, type of modulation, Fresnel Theory, loss, atmospheric influences*

SUB-TOPIC 2.2: Satellite

2.2.1	Describe the parameters of a satellite link	2	Uplinks, downlinks, antennas, footprint, delays, atmospheric influences

SUBJECT 3: RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how service providers comply	2	*e.g. storage media, access to recording and reproducing room, time to store information*

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	with the regulations		*(overwrite/erase voice or data), procedure to reproduce information.*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to communication system, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output. Ref.: safety policy and implementation

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Stream COM-DATA1

SUBJECT 1: DATA

TOPIC 1: INTRODUCTION TO NETWORKS

SUB-TOPIC 1.1: Types

1.1.1	State the evolution of network topologies	1	LAN, WAN *e.g. architectures, size of the segments, length of the systems, quality of service*
1.1.2	Explain how networks meet requirements	2	Redundancy, bandwidth, BER, time delay, network security

SUB-TOPIC 1.2: Networks

1.2.1	Analyse the features of a network	4	Routing scheme, rate, internal networking, routers, bridges, gateways, modems, switches, firewalls *e.g. wireless networks*
1.2.2	Describe network standards and devices	2	Ethernet, fibre optic, wireless
1.2.3	Appreciate the replacement of components in a network in a safe way	3	Continuity of service, network integrity Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training

SUB-TOPIC 1.3: External network services

1.3.1	Define aspects of external network services	1	Provided QoS *e.g. SLAs*

SUB-TOPIC 1.4: Measuring tools

1.4.1	Operate the usual set of network measuring or monitoring tools to find the values of the main parameters	3	Data analyser (sniffer) *e.g.net scout*
1.4.2	Perform analysis to support fault-finding for correction	3	Data analyser (sniffer) *e.g.net scout*

SUB-TOPIC 1.5: Troubleshooting

1.5.1	Appreciate how to troubleshoot a network	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. broken lines, unusable network components, overload, integrity problems*

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

2.1.1	Apply the principles of layers	3	Differences between layers

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			e.g. layer(s) of sniffer information
2.1.2	Apply the principles of addressing strategy	3	Masks, subnets IP addressing, MAC addressing *e.g. same logical network computers and systems*
2.1.3	Apply the principles of routing strategy	3	Routing tables, priorities, fault tolerance, management of routing strategy, static and dynamic routing *e.g. unicast, multicast, broadcast*

SUB-TOPIC 2.2: General protocols

2.2.1	Describe the general protocols	2	TCP/IP (segments, packets, addressing) *e.g. X25, LAPB, pdH, sdH*
2.2.2	Analyse the general protocols using the appropriate tools and documentation	4	TCP/IP *e.g. X25, LAPB*

SUB-TOPIC 2.3: Specific protocols

2.3.1	Describe the specific protocols	2	*e.g. BATAP — ARINC 620, FMTP*

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

3.1.1	Name the national networks to which the organisation is connected	1	*e.g. ANSP, MET, military, PTT, airlines, national network(s)*
3.1.2	Describe the interfaces between national and global networks	2	—

TOPIC 4: EUROPEAN NETWORKS

SUB-TOPIC 4.1: Network technologies

4.1.1	State emerging network technologies	1	*e.g.as used in EAN, NEAN, AMHS, PENS*
4.1.2	Describe the characteristics of current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 5: GLOBAL NETWORKS

SUB-TOPIC 5.1: Networks and standards

5.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

SUB-TOPIC 5.2: Description

5.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 5.3: Global architecture

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5.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 5.4: Air-ground subnetworks

5.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 5.5: Ground-ground subnetworks

5.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 5.6: Networks on board of the aircraft

5.6.1	State the existence of subnetworks inside the aircraft relevant for ATM communications	1	*e.g. AFDX — ARINC 429*

SUB-TOPIC 5.7: Air-ground applications

5.7.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 2: TRANSMISSION PATH

TOPIC 1: LINES

SUB-TOPIC 1.1: Lines theory

1.1.1	Calculate parameters of a line	3	*e.g. equation, attenuation, impedance, S-parameters, Smith chart, bandwidth, HF specifics (dipoles, multipoles), SWR*

SUB-TOPIC 1.2: Digital transmission

1.2.1	Calculate parameters for digital transmission	3	*e.g. signal definition, Fourier Theory, signal processing (sampling, etc.), bandwidth, carrier, modulation, noises, S/N, delays, group delay, line quality (signal distortion, rate of failure), transmission speed*

SUB-TOPIC 1.3: Types of lines

1.3.1	Describe the different types of lines and their physical characteristics	2	*e.g. copper wires (twisted pairs, symmetrical cables), optic fibres (monomodes or multimodes, connectors, splicer), coaxial* *attenuation, losses, bending, characteristic impedance, EMC and noise immunity*
1.3.2	Appreciate the appropriate type of line for a given specific application	3	*e.g. bandwidth, noise immunity*
1.3.3	Check the typical parameters of lines	3	*e.g. impedance, insulation, signal level, time delay*

TOPIC 2: SPECIFIC LINKS

SUB-TOPIC 2.1: Microwave link

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2.1.1	Describe a microwave link	2	*e.g. carrier frequency, type of modulation, Fresnel Theory, loss, atmospheric influences*

SUB-TOPIC 2.2: Satellite

2.2.1	Describe the parameters of a satellite link	2	Uplinks, downlinks, antennas, footprint, delays, atmospheric influences

SUBJECT 3: RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how service providers comply with the regulations	2	*e.g. confidentiality when handling recorders, procedures for access to recorders, storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to communication system, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output. Ref.: safety policy and implementation

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Stream NAVIGATION — NON-DIRECTIONAL BEACON (NDB)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-Board Performance Monitoring and Alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3 Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2 GROUND-BASED SYSEMS — NDB

TOPIC 1: NDB/LOCATOR

SUB-TOPIC 1.1: Use of the system

1.1.1	Appreciate the principles of NDB	3	Relative bearing, measuring method
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.3	Explain the technical limitations of NDB	2	Lack of accuracy, lack of integrity, sensitivity to interference
1.1.4	Describe the current situation	2	*e.g. number, type, users, user groups, European context*

SUB-TOPIC 1.2: Ground station architecture

1.2.1	Describe the main components of an NDB ground station	2	Electronic cabinet, antennas, power supply, remote controls and monitoring

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			e.g. auto-tune antenna units
1.2.2	Relate NDB station design to operational requirements	4	Coverage, ID code, VOR backup, double beacon approach, siting

SUB-TOPIC 1.3: Transmitter subsystem

1.3.1	Characterise the main NDB signal parameters	2	Carrier and ident frequency, output power, depth of modulation
1.3.2	Perform typical measurements on the main NDB signal parameters	3	*e.g. carrier and ident frequency, power measurements, depth of modulation, audio distortion, antenna current, spectrum measurements, ID code*

SUB-TOPIC 1.4: Antenna subsystem

1.4.1	Explain NDB antenna characteristics	2	Impedance, polar diagram, polarisation, ground reflections
1.4.2	Appreciate the interface between power stage and the antenna	3	SWR, radiated power

SUB-TOPIC 1.5: Monitoring and control subsystems

1.5.1	Describe the purpose of monitoring	2	Integrity, continuity of service, availability
1.5.2	Describe which parameters are used for the monitoring	2	Antenna current, ID code, depth of modulation
1.5.3	Appreciate how the operational status of the NDB monitoring system is checked	3	System status Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training
1.5.4	Describe the issues associated with NDB obstacle limitations and obstacle removal	2	Siting

SUB-TOPIC 1.6: On-board equipment

1.6.1	Describe the on-board equipment (ADF)	2	Receiver, antenna, displays
1.6.2	Describe how NDB information is used on-board	2	ADF indicator, RMI, HSI, ND

SUB-TOPIC 1.7: System check and maintenance

1.7.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.7.2	Appreciate calibration tasks and flight inspection results	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.7.3	Appreciate troubleshooting of an	3	Additional: for achievement of competence, this

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	NDB		objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.7.4	Appreciate the origins of NDB errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. multipath, EMC, interference with radio broadcast transmissions*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

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2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY — TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

SUBJECT 5: FUNCTIONAL SAFETY — TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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Stream NAVIGATION — DFI

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3 Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — DFI

TOPIC 1: DF

SUB-TOPIC 1.1: Use of the system

1.1.1	State the different types of DF	1	VDF, DDF, IDF
1.1.2	Describe the user HMI	2	Indication on radar picture, DF indicator
1.1.3	Appreciate the principles of DF	3	Bearing, measuring method (standard, Doppler, interferometry)
1.1.4	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.5	Explain the technical limitations of DF	2	Sensitivity to interference
1.1.6	Describe the current situation	2	*e.g. number, type, users, national context*

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SUB-TOPIC 1.2: VDF/DDF equipment architecture

1.2.1	Describe the main components of DF equipment	2	Electronic cabinet, antennas, power supply, remote controls and monitoring

SUB-TOPIC 1.3: Receiver subsystem

1.3.1	Explain the main signal parameters	2	Frequency band (UHF, VHF)

SUB-TOPIC 1.4: Antenna subsystem

1.4.1	Explain DF antenna characteristics	2	Impedance, polar diagram, polarisation, types of antennas
1.4.2	Appreciate protection areas	3	Obstacles, ICAO Annex 10 *e.g. manufacturers manuals*

SUB-TOPIC 1.5: Monitoring and control subsystems

1.5.1	Describe the purpose of monitoring	2	Integrity, continuity of service, availability
1.5.2	Describe which parameters are used for the monitoring	2	Noise figure, stability of measurement
1.5.3	Appreciate how the operational status of the DF monitoring system is checked	3	System status Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training
1.5.4	Describe the issues associated with DF obstacle limitations and obstacle removal	2	Surrounding environment, protection of bearing accuracy

SUB-TOPIC 1.6: System check and maintenance

1.6.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMV + SAR), ICAO Annex 10 *e.g. European regulations*
1.6.2	Perform typical measurements on a DF system	3	Frequency, channel spacing, sensitivity, selectivity, bearing accuracy
1.6.3	Appreciate calibration tasks and flight inspection results	3	Ground-based bearing checks, test oscillator Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. North setting, range, multipath Maintenance and flight inspection manuals, procedures and reports*
1.6.4	Appreciate troubleshooting of DF	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. sensitivity, local oscillator level Maintenance and flight inspection manuals, procedures and reports*
1.6.5	Appreciate the origin of DF errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by

			the end of the S/E rating training *e.g. multipath, EMC, interference with radio broadcast transmissions*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g.* *e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

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TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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Stream NAVIGATION — OMNIDIRECTIONAL RADIO RANGE (VOR)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness e.g. Time To First Fix
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — VOR

TOPIC 1: VOR

SUB-TOPIC 1.1: Use of the system

1.1.1	State the types of VOR Systems	1	Conventional, doppler
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.3	Explain the technical limitations of CVOR	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes
1.1.4	Appreciate the differences between CVOR and DVOR	3	Signal broadcast differences, bearing information robustness
1.1.5	Describe the current situation	2	*e.g. number, type, users, user groups, national context, European context*

SUB-TOPIC 1.2: Fundamentals of CVOR and/or DVOR

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1.2.1	Appreciate the mathematical signal description	3	Declination, equations of CVOR and/or DVOR, reference and variable signals
1.2.2	Appreciate the principles for generating the variable signal	3	CVOR Rotating antenna principle Generating a rotating radiation pattern with static antennas and/or DVOR Frequency modulation through switching antenna

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the main components of a CVOR and/or DVOR ground station	2	Electronic cabinet, antenna system, power supply, remote controls and monitoring
1.3.2	Relate VOR station design to operational requirements	4	Siting, coverage, ID code, NDB backup

SUB-TOPIC 1.4: Transmitter subsystem

1.4.1	Characterise main signal parameters for a CVOR and/or DVOR	2	Carrier frequency stability, output power, signals generated
1.4.2	Perform typical transmitter measurements on VOR signals	3	Radiation pattern accuracy, power and modulation measurements, spectrum measurements, ID coding

SUB-TOPIC 1.5: Antenna subsystem

1.5.1	Explain VOR antenna characteristics	2	Impedance, polar diagram, polarisation, types of antennas
1.5.2	Appreciate the interface between power stage and the antennae	3	SWR, radiated power
1.5.3	Appreciate protection areas	3	Obstacles, ICAO Annex 10 *e.g. manufacturers manuals*

SUB-TOPIC 1.6: Monitoring and control subsystem

1.6.1	Describe the purpose of monitoring	2	Integrity, continuity of service, availability
1.6.2	Describe which VOR parameters are monitored	2	ICAO and RTCA/EUROCAE requirements e.g. NSA requirements
1.6.3	Describe the principles of the CVOR and/or DVOR monitoring systems	2	Near field sensors, far field sensors, recombination Local and remote monitoring
1.6.4	Appreciate how the operational status of the CVOR and/or DVOR monitoring systems are checked	3	Near field sensors, far field sensors, recombination Local and remote monitoring Additional: for achievement of competence, this objective should be applied practically, at the latest, by the end of the S/E rating training

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			e.g. BITE, Watchdog
1.6.5	Describe the issues associated with VOR obstacle limitations and obstacle removal	2	Surrounding environment, multipath prevention
1.6.6	Explain the optional ILS interface	2	—

SUB-TOPIC 1.7: On-board equipment

1.7.1	Describe the on-board equipment	2	Antenna, receiver HMI *e.g. CDI, RMI, HSI, ND, PFD*
1.7.2	Describe how the VOR information is used on board	2	*e.g. single VOR, VOR-VOR, approach procedures, manual mode, automatic mode*

SUB-TOPIC 1.8: System check and maintenance

1.8.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10
1.8.2	Perform typical system measurements	3	In space modulation, phase sideband/carrier, ground check for bearing errors
1.8.3	Appreciate calibration tasks and flight inspection results	3	Flight inspection (coverage, flight check for bearing errors and modulation) Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance manuals, procedures and reports*
1.8.4	Appreciate troubleshooting of a CVOR and/or DVOR	3	Carrier frequency deviation, depth of modulation, lack of power, harmonics ratio Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.8.5	Analyse the origins of CVOR and/or DVOR errors	4	CVOR System-dependent, adjustments, drifts, multipath, on-board errors and/or DVOR North Adjustment *e.g. DVOR: antenna feeding* *DVOR and CVOR: multipath, EMC, interference with*

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			radio broadcast transmissions

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

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3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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Stream NAVIGATION — DISTANCE MEASURING EQUIPMENT (DME)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — DME

TOPIC 1: DME

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for DME	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the limitations of DME	2	Accuracy, integrity, capacity
1.1.3	Describe the current situation	2	*e.g. number, types, users, user groups, national context, European context*
1.1.4	State the role of the DME infrastructure in the future navigation applications	1	PBN

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1.1.5	Explain the differences between DME and TACAN for civilian use	2	*e.g. azimuth and range*

SUB-TOPIC 1.2: Fundamentals of DME

1.2.1	Describe the key elements of DME system operation	2	Two-way ranging technique, slant range, time measurement A/c interrogation, pulse pairs, ground reply, fixed time delay, interrogation stagger, 'X' and 'Y' channels
1.2.2	Explain the frequency spectrum and the channel spacing allocated	2	ICAO Annex 10, L-band

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the main components of a DME ground station	2	Electronic cabinet, antenna system, power supply, remote controls and monitoring
1.3.2	Relate DME station design to operational requirements	4	Coverage, ID code, siting

SUB-TOPIC 1.4: Receiver subsystem

1.4.1	Explain the main receiver parameters for a DME	2	Sensitivity, selectivity, dynamic range, jamming immunity
1.4.2	Perform the typical measurements on the interrogation signals	3	Sensitivity, selectivity, dynamic range, jamming immunity

SUB-TOPIC 1.5: Signal processing

1.5.1	Explain the functions performed by a DME/N signal processor	2	Decode, Reply Delay, Automatic Reply Rate Control, Encode, priority (Ident, DME signal, Squitter)
1.5.2	Perform the typical measurement on the DME/N transponder signals	3	Reply delay, Reply delay offset, decode parameters, rate of replies

SUB-TOPIC 1.6: Transmitter subsystem

1.6.1	Characterise the main signal parameters from the ground station	2	Carrier frequency, output power, pulse shape, pulse spacing, pulse repetition frequency, main delay, ID code
1.6.2	Perform the typical measurements on a DME	3	Power and pulse measurements, spectrum measurements, modulation measurements

SUB-TOPIC 1.7: Antenna subsystem

1.7.1	Explain DME antenna characteristics	2	Patterns, antennas
1.7.2	Appreciate the interface between power stage and the antenna	3	SWR, radiated power, propagation delay, distribution circuit (e.g. duplexer, circulator)

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1.7.3	Appreciate protection areas	3	ICAO Annex 10, protection area criteria and enforcement *e.g. manufacturers manuals*

SUB-TOPIC 1.8: Monitoring and control subsystem

1.8.1	Describe the purpose of monitoring	2	Integrity, continuity of service
1.8.2	Describe which DME parameters are monitored	2	ICAO and RTCA/EUROCAE requirements *e.g. NSA requirements*
1.8.3	Appreciate how the operational status of the DME monitoring system is checked	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training
1.8.4	Describe the issues associated with DME obstacle limitations and obstacle removal	2	Multipath, blanking

SUB-TOPIC 1.9: On-board equipment

1.9.1	Describe the on-board equipment	2	Transmitter, antenna, receiver, HMI *e.g. HSI, DME range indication, ND*
1.9.2	Describe how the DME information is used on board	2	*e.g. single DME, multi-DME navigation (rho rho), approach procedures, manual mode, automatic mode*

SUB-TOPIC 1.10: System check and maintenance

1.10.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.10.2	Appreciate calibration tasks and flight inspection results	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.10.3	Appreciate troubleshooting of a DME	3	Carrier frequency deviation, depth of modulation, lack of power, harmonics ratio Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. main delay and monitor shutdown errors, interference* *Maintenance and flight inspection manuals, procedures and reports*
1.10.4	Appreciate the origin of DME errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. Multipath, EMC, interference with radio broadcast*

			transmissions (harmonics)

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

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TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

SUBJECT 5: FUNCTIONAL SAFETY — TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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Stream NAVIGATION — INSTRUMENT LANDING SYSTEM (ILS)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

SUBJECT 2: GROUND-BASED SYSTEMS — ILS

TOPIC 1: ILS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performance for ILS	2	ICAO Annexes 10 and 14 Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the limitations of ILS	2	ICAO Annexes 10 and 14 Only 40 channels, no segmented paths of approach, beam corruption due to multipath
1.1.3	Interpret ILS facility performance categories	5	ICAO Annexes 10 and 14 Cat I, Cat II, Cat III Different operational category depending on operational minima, equipment and airport facilities

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1.1.4	Define obstacle-free zones for ILS components	1	ICAO Annexes 10 and 14 Dimensions *e.g. national regulations*
1.1.5	Explain the importance and need for ILS obstacle-free zones	2	ILS beam protection, increased significance during LVP conditions
1.1.6	Explain the current situation	2	*e.g. number, type, users, national context*
1.1.7	Consider the need for ATC ILS status indications	2	No continuous monitoring by ATSEP

SUB-TOPIC 1.2: Fundamentals of ILS

1.2.1	Explain how to obtain a change in depth of modulation of an amplitude-modulated signal as a function of angular position	2	Addition of a carrier signal and a side band signal in space
1.2.2	Characterise the signals to be radiated	2	Amplitude and phase relationship, antenna systems
1.2.3	Relate the adjustment of signals generated to the resulting beam patterns and standards	4	Phases and amplitudes in antenna array, modulations on carrier signal, phase and amplitude of side band
1.2.4	Describe the required performance of an antenna array	2	Beam bend potential, coverage, impact on location of critical and sensitive area

SUB-TOPIC 1.3: 2F-Systems

1.3.1	Explain the limitations of a 1F system	2	Multipath in adverse environment and terrain
1.3.2	Describe the capture effect	2	Capture effect in receiver circuits
1.3.3	Describe radiation parameters for 2F-LOC and 2F-GP	2	Types of antenna arrays, patterns, coverage, signal distribution, radiated power

SUB-TOPIC 1.4: Ground station architecture

1.4.1	Describe the layout of an ILS	2	—
1.4.2	Describe the main components of the LOC (1F and 2F), GP (1F and 2F), markers and field monitors	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication *e.g. DME*
1.4.3	Relate ILS station design to operational requirements	4	Coverage, ID code, siting

SUB-TOPIC 1.5: Transmitter subsystem

1.4.2	Describe the main components of the LOC (1F and 2F), GP (1F and 2F), markers and field monitors	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication *e.g. DME*
1.4.3	Relate ILS station design to operational requirements	4	Coverage, ID code, siting

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SUB-TOPIC 1.6: Antenna subsystem

1.6.1	Explain ILS antenna characteristics: LOC, GP and Marker Beacons	2	Types, position, polarisation, patterns, coverage, antenna matching, distribution circuits, radiated power, ground reflection

SUB-TOPIC 1.7: Monitoring and control subsystem

1.7.1	Describe the purpose of monitoring	2	Integrity, continuity of service
1.7.2	Describe the parameters for the monitoring according to ICAO Annex 10: LOC, GP and Marker Beacons	2	RF level, DDM, SDM on position and width
1.7.3	Explain the key additional required monitoring: LOC and GP	2	External, internal and integral monitoring
1.7.4	Explain the purpose, advantages and disadvantages of the FFM system	2	*e.g. content position, width, requirement for Cat III operations (some States)*
1.7.5	Draw a diagram of the monitoring system: LOC, GP, FFM and Marker Beacons	1	Near-field, integral network, internal network, monitor signal processor *e.g. DME*
1.7.6	Explain the optional DME interface	2	Identity coding ratio

SUB-TOPIC 1.8: On-board equipment

1.8.1	Describe the on-board equipment associated with LOC, GP and Marker Beacon	2	Antennas, receiver, pilot interface (cross pointer) *e.g. FMS*
1.8.2	Describe how ILS information is used on board	2	*e.g. approach procedures, landing, roll-out, manual, automatic mode (auto-pilot)*

SUB-TOPIC 1.9: System check and maintenance

1.9.1	Appreciate the conformity of LOC, GP and marker beacons to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.9.2	Justify the occasions when it is necessary to downgrade an ILS facility performance category	4	*e.g. system failures, environmental changes/disturbance*
1.9.3	Explain the implications of ILS facility performance categories to the pilot	2	Link with prevailing Instrument RVR, weather dictating decision height
1.9.4	Perform some typical measurements	3	Output power, spectrum analysis, modulation, ID code

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1.9.5	Appreciate calibration tasks and flight inspection results	3	LOC, GP and marker beacons Flight inspection and ground calibration results, LOC Centreline measurement, width and centreline field measurements Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. RF interference monitoring maintenance and flight inspection manuals, procedures and reports*
1.9.6	Appreciate troubleshooting of ILS LOC, GP and marker beacons	3	DDM and SDM misalignment, coverage pilot reported errors, field checks, monitor checks Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. lack of power, carrier frequency deviation, harmonic ratio, depth of modulation maintenance and flight inspection manuals, procedures and reports*
1.9.7	Appreciate the origin of ILS errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. Multipath, EMC, interference with radio broadcast transmissions (harmonics)*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS	2	ICAO Annex 10, Vol. 1

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	NOTAM		

SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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Stream NAVIGATION — MICROWAVE LANDING SYSTEM (MLS)

SUBJECT 1: PERFORMANCE-BASED NAVIGATION

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: Operational requirements

1.1.1	Explain the main performance characteristics of a navigation system	2	Accuracy, precision, stability, integrity, availability, continuity of service, coverage, robustness *e.g. Time To First Fix*
1.1.2	Explain the relationship between performance measures and the phases of flight	2	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.2: Performance-based navigation

1.2.1	Describe the PBN concept	2	ICAO and EUROCONTROL documents, airspace concept, application supported by navigation infrastructure and navigation specifications, functionality of the avionics
1.2.2	Differentiate between an RNAV and an RNP navigation specification	2	On-board performance monitoring and alerting
1.2.3	State which navigation applications support the different phases of flight	1	PBN Manual ICAO Doc 9613

SUB-TOPIC 1.3: Area navigation concept (RNAV)

1.3.1	Differentiate between conventional navigation and area navigation	2	Fixed route vs flexible route structure

SUB-TOPIC 1.4: NOTAM

1.4.1	Explain the need for NOTAMs	2	—

2. SUBJECT 2: GROUND-BASED SYSTEMS — MLS

TOPIC 1: MLS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe approach and landing path	2	Azimuth station, elevation station, back azimuth station, approach DME, equipment layout, ICAO defined benchmarks
1.1.2	Describe the overall performances for MLS	2	Coverage, accuracy, availability of the system, integrity, continuity, category and level
1.1.3	Explain the technical limitations of MLS	2	Sensitivity to weather conditions, complexity, sensitively to multipath, criticality of signal at edge of coverage
1.1.4	Explain the advantages of MLS	2	Type of information, accuracy, small critical and sensitive areas, number of channels, complex approach paths, less prone to interference, reduced sensitivity to multipath, size of antennae array

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1.1.5	Interpret MLS facility performance categories	5	Cat 1, 2, 3 Different operational category depending on operational minima, equipment and airport facilities
1.1.6	Define MLS critical and sensitive areas	1	Critical and sensitive area dimensions
1.1.7	Explain the importance and need for MLS critical and sensitive areas	2	MLS beam protection, increased significance during LVP conditions
1.1.8	Describe the current situation	2	Multi-mode receivers, ground and aircraft equipment *e.g. low equipage, users, number of manufacturers*
1.1.9	Consider the need for ATC MLS status indications	2	No continuous monitoring by ATSEP

SUB-TOPIC 1.2: Fundamentals of MLS

1.2.1	Explain the principle for generating a scanning beam	2	Phase changes, phase relations
1.2.2	Describe the relationship between beam pattern and accuracy	2	Beam width, side lobe level reduction
1.2.3	Explain why data transmission is necessary	2	Station coordinates, ident, function synchronisation, time reference
1.2.4	Describe the data transmission structure	2	ICAO specification

SUB-TOPIC 1.3: Ground station architecture

1.3.1	Describe the layout of an MLS	2	—
1.3.2	Describe the main components of the azimuth, elevation, back azimuth and DME stations	2	Electronic cabinet, antennas, power supply, remote controls and monitoring, tower indication
1.3.3	Relate MLS station design to operational requirements	4	Coverage, ID code, siting

SUB-TOPIC 1.4: Transmitter subsystem

1.4.1	Characterise main signal parameters for azimuth, elevation and back azimuth station	2	Carrier frequency, output power, signals generated
1.4.2	Explain the main components of the transmitters	2	Azimuth, elevation, back azimuth station synthesiser, modulator, power amplifier, control coupler, RF changeover

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SUB-TOPIC 1.5: Antenna subsystem

1.5.1	Explain MLS antenna characteristics: azimuth, elevation and back azimuth stations	2	Types, location, polarisation, pattern, coverage, distribution circuits, radiated power

SUB-TOPIC 1.6: Monitoring and control subsystem

1.6.1	Describe the purpose of monitoring	2	Integrity, continuity of service
1.6.2	Describe the parameters for the monitoring according to ICAO Annex 10: azimuth, elevation and back azimuth stations	2	RF level, beam width, scan speed
1.6.3	Explain how the parameters are monitored: azimuth, elevation and back azimuth station	2	External and internal monitoring
1.6.4	Explain the FFM system	2	Requirements for CAT 3 operations
1.6.5	Draw a diagram of the monitoring system	1	—

SUB-TOPIC 1.7: On-board equipment

1.7.1	Describe the on-board equipment	2	Antennas, receiver, pilot interface, HMI *e.g. FMS*
1.7.2	Describe how the MLS information is used on board	2	Approach procedures, ILS-like display

SUB-TOPIC 1.8: System check and maintenance

1.8.1	Appreciate the conformity to international and national regulations	3	ITU regulations (EMC + SAR), ICAO Annex 10 *e.g. European regulations*
1.8.2	Justify the occasions when it is necessary to downgrade an MLS facility performance category	4	—
1.8.3	Explain the implications of MLS facility performance categories to the pilot	2	Link with prevailing instrument RVR, weather dictating decision height
1.8.4	Consider the need for ATSEP MLS remote maintenance and monitoring systems	2	Control, status, performance monitoring including alarm logging
1.8.5	Perform the typical system measurements	3	Output power, spectrum analysis, data link modulation, ID code, Ground field checks

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1.8.6	Appreciate calibration tasks and flight inspection results	3	Azimuth, back azimuth, azimuth centreline measurement, width and centreline measurements, elevation Flight inspection and ground calibration results Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance manuals, procedures and reports*
1.8.7	Appreciate troubleshooting of an MLS	3	Lack of power, carrier frequency deviation, harmonic ratio, beam pattern Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. maintenance and flight inspection manuals, procedures and reports*
1.8.8	Appreciate the origin of MLS errors	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. Multipath, EMC, weather influence*

SUBJECT 3: GNSS

TOPIC 1: GNSS

SUB-TOPIC 1.1: General view

1.1.1	Explain the importance and continuing development of GNSS	2	FANS CNS/ATM concept, ICAO Doc 9849, Navigation Application & NAVAID Infrastructure Strategy for the ECAC Area up to 2020, EUROCONTROL GNSS Policy, SESAR ATM Master Plan
1.1.2	Describe the elements of GNSS within Europe	2	Core constellations, ABAS, SBAS (EGNOS) *e.g. GBAS, SCAT 1, APV, ICAO Annex 10*
1.1.3	Appreciate the sources of interference to GNSS signals	3	Intentional, unintentional, ionospheric interference, solar activity
1.1.4	Explain who has responsibility for GNSS oversight in your State and how it is carried out	2	*e.g. EASA, GSA, NSA, ANSP*
1.1.5	Appreciate the impact of the modernisation of GNSS on the ARNS bands	3	Introduction of L5, E5A, E5B *e.g. COMPASS*
1.1.6	Explain the need for a minimum number of visible satellites needed to provide integrity monitoring	2	*e.g. AUGUR*
1.1.7	Describe the purpose of the GNSS NOTAM	2	ICAO Annex 10, Vol. 1

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SUBJECT 4: ON-BOARD EQUIPMENT

TOPIC 1: ON-BOARD SYSTEMS

SUB-TOPIC 1.1: On-board systems

1.1.1	Explain the purpose and use of a navigation computer	2	Sensors, navigation database
1.1.2	Explain the purpose and use of an FMS	2	Sensors, navigation database, path steering, displays

TOPIC 2: AUTONOMOUS NAVIGATION

SUB-TOPIC 2.1: Inertial navigation

2.1.1	Describe the principles and key features of INS/IRS navigation	2	Gyros, accelerometer, accuracy, drift, updating

TOPIC 3: VERTICAL NAVIGATION

SUB-TOPIC 3.1: Vertical navigation

3.1.1	Describe the different types of vertical sensors and their limitations	2	Barometric, radio altimetry, geodetic *e.g. air data computers, manual intervention, dynamic information (AGL), undulation (WGS84)*

SUBJECT 5: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to navigation systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe in terms of exposure time, environment, effect on controller and effect on pilot, the types of functional failures	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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Stream SURVEILLANCE — PRIMARY SURVEILLANCE RADAR

SUBJECT 1: PRIMARY SURVEILLANCE RADAR

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability
1.1.2	Relate key parameters of PSR to system performance	4	Key parameters: PRF, signal energy, frequency diversity, antenna gain, update rate, polarisation, receiver MDS, beamwidth Performance: range, accuracy, resolution, extractor minimum target threshold, weather influence, PD, blind speed, ambiguities, capacity *e.g. weather channel*

SUB-TOPIC 1.2: Antenna (PSR)

1.2.1	Describe antenna types, accuracy and problems	2	Antenna beam(s), side lobes, reflector antenna, active (phased array) antenna, rotating joints, waveguide interface, pressurisation, dehumidification, polarisation, azimuth encoding, drive systems

SUB-TOPIC 1.3: Transmitters

1.3.1	Describe the basic characteristics of a transmitter	2	Supply, EHT, RF source (appropriate to type chosen), modulation, interlocks
1.3.2	Describe the signals at all key points	2	Supply, EHT, RF source (appropriate to type chosen), modulation, interlocks
1.3.3	Describe a generic transmitter block diagram for both compressed and non-compressed system	2	*e.g. solid state, klystron, magnetron, travelling wave tube*
1.3.4	State possible failures and where they can occur in the transmitter system	1	*e.g. solid state modules, arcing, corona discharge, component stress, control loops, isolation*
1.3.5	State constraints and problems on the high voltage circuitry	1	*e.g. corona discharge, dielectric stress, isolation, arcing, ageing, interlocks, stability (including control loop)*

SUB-TOPIC 1.4: Characteristics of primary targets

1.4.1	Appreciate the characteristics of targets detected by PSR	3	Backscatter, radar cross section (such as reflectivity, stealth technologies, aspect), Doppler shift, ground speed, wind turbines *e.g. Swerling Case*

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SUB-TOPIC 1.5: Receivers

1.5.1	Describe the basic characteristics of a receiver	2	Low noise, high dynamic range, bandwidth, detection, frequency, sensitivity, selectivity
1.5.2	Describe the basic elements of a generic receiver	2	LNA, local oscillator, coherent oscillator, down-converter, filtering, rejection, IF, PSD, AGC, STC, beam switching
1.5.3	Appreciate the importance of STC	3	Saturation, RF-IF dynamic range

SUB-TOPIC 1.6: Signal processing and plot extraction

1.6.1	Describe the basic function of data processing	2	Plot extraction (range bin reports, range correlation, azimuth correlation), target reports, sliding window, weighted centre, local tracking
1.6.2	Appreciate the basic functions of a current radar signal processor	3	A/D conversion, I/Q matching, target detection, detection criteria (fixed, adaptive), MTD and clutter maps
1.6.3	Describe the processing techniques to improve the quality of target reports using scan-to-scan information	2	Tracking, environment mapping, adaptive feedback to extraction parameters

SUB-TOPIC 1.7: Plot combining

1.7.1	Describe the basic function of plot combining	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation
1.7.2	Describe the basic functions of a current radar plot combiner	2	Scan-to-scan correlation, angel filtering, vehicle filtering, output format

SUB-TOPIC 1.8: Characteristics of primary radar

1.8.1	Explain the basic principles of electromagnetism, propagation, signal detection, RF power generation and distribution	2	Frequency and phase, electromagnetic radiation, spectrum and bandwidth, noise, HPA, waveguide problems

TOPIC 2: SMR

SUB-TOPIC 2.1: Use of SMR for Air Traffic Services

2.1.1	Describe the operational requirements of SMR	2	Range, resolution, coverage, MTBF, availability
2.1.2	Relate key parameters and necessity to achieve performances	4	Specific equations for ranging and power budget, PRF, frequency with respect to range and accuracy, PD, frequency diversity, range with respect to TX power, antenna gain, receiver MDS, update rate, beamwidth, extractor minimum target threshold, polarisation, influence to meteorology

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SUB-TOPIC 2.2: Radar sensor

2.2.1	Explain the layout of the SMR	2	Dual system, service display
2.2.2	Describe the basic functions of the receiver/transmitter unit	2	Hardware/function overview
2.2.3	Describe how to operate a sensor	2	*e.g. block diagram, timing relations, video path, frequency diversity, polarisation, controller structure*
2.2.4	Describe the basic functions of the antenna unit	2	*e.g. hardware function overview, control/switch unit, external interface, azimuth encoding, monopulse techniques*

TOPIC 3: TEST AND MEASUREMENT

SUB-TOPIC 3.1: Test and measurement

3.1.1	Appreciate how measurements can be made on PSR and SMR	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. spectrum analyser, vector voltmeter, oscilloscope, SWR meter, sensor analysis tools*

SUBJECT 2: HUMAN MACHINE INTERFACE (HMI)

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUB-TOPIC 1.2: ATSEP HMI

1.2.1	Describe the user interface scope and ergonomics as seen by different users and at different locations	2	System management displays characteristics both control and monitoring
1.2.2	Describe the analytical and status data available to the users	2	Radar video, front panel and CMS data, HMI on each subsystem

SUB-TOPIC 1.3: Pilot HMI

1.3.1	Describe the transponder interface	2	Mode A, change procedure, SPI, Mode C, deselection, hijack
1.3.2	Be aware of the ACAS/TCAS display and future potential developments	0	Characteristics, accuracy, alerts, ADS B, CDTI
1.3.3	Be aware of the EGPWS display and of future potential developments	0	—

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SUB-TOPIC 1.4: Displays

1.4.1	Describe the display types available and their advantages and disadvantages	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performances (cost, availability, maintainability, ergonomics)

SUBJECT 3: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, Surveillance Data Networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUB-TOPIC 1.2: Verification methods

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. data analyser, line analyser*

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to the surveillance systems, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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SUBJECT 5: DATA PROCESSING SYSTEMS

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 1.1: Surveillance data processing systems

1.1.1	Identify all functions of an SDP system	3	Plot processing, tracking, single-sensor and multisensor tracker *e.g. radar, ADS, MLAT, estimating limits and accuracy of multisensor tracker, recording* *e.g. ARTAS tracker*
1.1.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
1.1.3	Differentiate SDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
1.1.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
1.1.5	Explain the principles of emergency switching	2	—

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Stream SURVEILLANCE — SECONDARY SURVEILLANCE RADAR

SUBJECT 1: SECONDARY SURVEILLANCE RADAR (SSR)

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684
1.1.2	Relate key parameters of SSR to system performance	4	Key parameters: rotation rate, PRF, interlaced modes, capacity, frequencies, power budget (uplink, downlink), monopulse techniques Consequences: FRUIT, garbling, side lobes reception and transmission, transponder availability, PD, 2nd recurrence replies

SUB-TOPIC 1.2: Antenna (SSR)

1.2.1	Describe the principles of SSR/MSSR antenna	2	Monopulse antenna techniques, coaxial connection, sum, difference and control pattern, error angle measurement, azimuth encoding, beam sharpening, side lobes

SUB-TOPIC 1.3: Interrogator

1.3.1	Describe the characteristics of an interrogator	2	Frequency, spectrum, interrogation modes, duty cycle, ISLS, IISLS, staggering
1.3.2	Explain a generic interrogator	2	Timing, interface, modulator, BITE
1.3.3	Explain the need for integrity monitoring	2	Safeguards against erroneous transmission, BITE

SUB-TOPIC 1.4: Transponder

1.4.1	Explain the operational use of the transponder	2	Diagram of interaction between transponder and aeroplane
1.4.2	Define the global performances	1	Range, accuracy, fixed delay to respond
1.4.3	Describe the basic characteristics of a transponder	2	Transceiver, aerial location, switching and polar diagram, size ACAS Mode S and ADS compatibility, maximum reply rate, ISLS compatibility
1.4.4	Explain the advantages of the transponder	2	Longer range, more information
1.4.5	Explain the limitations of the transponder	2	Hundreds of feet precision, 3A limited codes
1.4.6	Describe the conformity to regulations	2	Equipage obligations, ICAO Annex 10
1.4.7	Describe the data format of the received transponder messages	2	P1, P2, P3, P4, P5, P6 signals and DPSK modulation (P6)

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1.4.8	Describe the data format of the transmitted transponder messages	2	Field lengths, data bits, Gray code, unused bits, Mode S reply (preamble and data)
1.4.9	Describe the basic characteristics of a transmitter	2	Timing, modulation, pulse width, power output
1.4.10	Describe the use of the transponder as a field monitor	2	—

SUB-TOPIC 1.5: Receivers

1.5.1	Describe the basic characteristics of an SSR receiver	2	Standard/MSSR receiver, sensibility, bandwidth, dynamic range, GTC (normal, sectorised), monopulse processor, RSLS, multi-path and interferences

SUB-TOPIC 1.6: Signal processing and plot extraction

1.6.1	Describe monopulse extraction	2	Phase and amplitude modulation, off boresight angle calculation, azimuth encoding
1.6.2	Describe sliding window SSR extraction	2	Leading edge, trailing edge, azimuth accuracy, azimuth encoding
1.6.3	Describe the signal processing	2	Video digitiser, pulse processor, reply decoder (bracket pair detector), synchronous reply correlator
1.6.4	Decode a transponder message	3	Standard message with SPI set *e.g. Mode S*
1.6.5	Describe the SSR processing techniques	2	Discrete code correlation, general association, zones, categories, code swapping, general correlation Mode A code data, Mode C data, target position report
1.6.6	Explain the reasons for surveillance processing and the key options	2	False target identification and elimination, data validation, data correction, reflection identification and processing, enhanced resolution performance

SUB-TOPIC 1.7: Plot combining

1.7.1	Describe the basic function of plot combining	2	Secondary/primary combining, secondary/primary assigning, prime target, range and azimuth collimation
1.7.2	Describe the basic functions of a current radar plot combiner	2	_

SUB-TOPIC 1.8: Test and measurement

1.8.1	Appreciate how measurements can be made on SSR	3	Additional: for achievement of competence, this objective should be applied practically, at the latest, by the end of the S/E rating training *e.g. spectrum analyser, vector voltmeter, oscilloscope, SWR meter, sensor analysis tools*

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TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode interlace pattern, operational use of all-call, roll-call
2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

SUB-TOPIC 2.2: Mode S system

2.2.1	Describe the theory of operation of Mode S hardware and software	2	Performance of the system, theory of operation of the system, interfaces to customer equipment
2.2.2	Describe testing possibilities for Mode S	2	*e.g. SASS-C, SASS-S*

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT in use

3.1.1	Explain how pilot and controller operations are impacted by the use of an MLAT system	2	Mode A assigned at gate, coverage of MLAT
3.1.2	Describe the ground mode of transponders	2	Aircraft interrogations, squitters, change of transponder mode

SUB-TOPIC 3.2: MLAT principles

3.2.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.2.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation *e.g. SCAS*
3.2.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.2.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

TOPIC 4: SSR ENVIRONMENT

SUB-TOPIC 4.1: SSR Environment

4.1.1	Explain the operational use of ACAS and implications for pilots and controllers	2	Traffic Advisories, Resolution Advisories, pilot responses and controller information

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4.1.2	Describe the users of the 1 030 MHz 1 090 MHz channels	2	Modes 1, 3, A, C and S, military, Mode S uplink and downlink capability, ACAS (TCAS), acquisition and extended squitter, PRF-FRUIT ratios, DME and other interferences

SUBJECT 2: HUMAN MACHINE INTERFACE (HMI)

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUB-TOPIC 1.2: ATSEP HMI

1.2.1	Describe the user interface scope and ergonomics as seen by different users and at different locations	2	System management displays characteristics, both control and monitoring
1.2.2	Describe the analytical and status data available to the users	2	Radar video, front panel and CMS data, HMI on each subsystem

SUB-TOPIC 1.3: Pilot HMI

1.3.1	Describe the transponder interface	2	Mode A, change procedure, SPI, Mode C, deselection, hijack
1.3.2	Be aware of the ACAS/TCAS display and future potential developments	0	Characteristics, accuracy, alerts, ADS B, CDTI
1.3.3	Be aware of the EGPWS display and of future potential developments	0	—

SUB-TOPIC 1.4: Displays

1.4.1	Describe the display types available and their advantages and disadvantages	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performances (cost, availability, maintainability, ergonomics)

SUBJECT 3: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, Surveillance Data Networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of*

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			service, RADNET
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUB-TOPIC 1.2: Verification methods

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training e.g. data analyser, line analyser

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1: SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to the surveillance systems, safety reports and occurrences, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation,

SUBJECT 5: DATA PROCESSING SYSTEMS

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 1.1: Surveillance data processing systems

1.1.1	Identify all functions of an SDP system	3	Plot processing, tracking, single-sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording e.g. ARTAS tracker
1.1.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
1.1.3	Differentiate SDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
1.1.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
1.1.5	Explain the principles of emergency switching	2	—

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Stream SURVEILLANCE — AUTOMATIC DEPENDENT SURVEILLANCE

SUBJECT 1: AUTOMATIC DEPENDENT SURVEILLANCE (ADS)

TOPIC 1: GENERAL VIEW ON ADS

SUB-TOPIC 1.1: Definition of ADS

1.1.1	Describe the basic characteristics of a ADS	2	Performance, integrity, latency, QoS, implementation options (e.g. ATN/FANS)
1.1.2	List the types of navigation sensors	1	GNSS, INS, radio NAVAIDs, navigation solutions from FMS, FoM
1.1.3	State the latest developments, implementation plans and projects	1	*e.g. current and recent test and trials, ICAO status, EUROCONTROL, FAA and other authorities positions, airline and equipment manufacturer positions, ATC procedures, time scales*

TOPIC 2: ADS-B

SUB-TOPIC 2.1: Introduction to ADS-B

2.1.1	Explain the basic principles of ADS-B	2	Autonomous operation, navigation solutions, link options, aircraft situation awareness
2.1.2	Identify the major elements of ADS-B	3	*e.g. ADS-B global chain (from the aircraft to the controller HMI), GNSS, FMS, encoding, scheduling, link*

SUB-TOPIC 2.2: Techniques of ADS-B

2.2.1	Explain the characteristics of the data links used in ADS B	2	VDL Mode 4, Mode S extended squitter, UAT
2.2.2	Describe the major ADS-B applications	2	*e.g. ADS-B-NRA, ADS-B-RAD, ASAS*

SUB-TOPIC 2.3: VDL Mode 4 (STDMA)

2.3.1	Describe the use of VDL Mode 4	2	High-level description

SUB-TOPIC 2.4: Mode S extended squitter

2.4.1	Describe the use of the Mode S extended squitter	2	High-level description
2.4.2	Explain the principles related to signals in space	2	Modulation scheme, signal structure, key data and frequency
2.4.3	Explain the principles related to random access technology	2	Consequences on the RF environment (1 090 MHz)
2.4.4	Explain the relevant messages	2	Information in each field, information encoding and decoding
2.4.5	Recognise the structure of a Mode S extended squitter signal	1	Signal timing and sequencing, data encoding

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2.4.6	Explain the interface between the BDS and the extended squitter message	2	—

SUB-TOPIC 2.5: UAT

2.5.1	State the use of the UAT	1	High-level description

SUB-TOPIC 2.6: ASTERIX

2.6.1	Decode and analyse a signal coded according to the ASTERIX category 21 standard	3	Reference to ASTERIX standard Decode position, call sign, Mode S address, etc.

TOPIC 3: ADS-C

SUB-TOPIC 3.1: Introduction to ADS-C

3.1.1	Explain the basic principles of ADS-C	2	Contract, multi-contract, time, event triggering
3.1.2	Identify the major elements of the ADS-C system	3	ADS-C global chain (from the aircraft to the controller HMI), GNSS, processor, link, ground station

SUB-TOPIC 3.2: Techniques in ADS-C

3.2.1	Explain the characteristics of the data links used in ADS-C	2	*e.g. subnetworks (VDLs, AMSS, HFDL)*

SUBJECT 2: HUMAN MACHINE INTERFACE (HMI)

TOPIC 1: HMI

SUB-TOPIC: 1.1 ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUB-TOPIC 1.2: ATSEP HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters

SUB-TOPIC 1.3: Pilot HMI

1.3.1	Describe the transponder interface	2	Mode A, change procedure, SPI, Mode C, deselection, hijack
1.3.2	Be aware of the ACAS/TCAS display and future potential developments	0	Characteristics, accuracy, alerts, ADS B, CDTI
1.3.3	Be aware of the EGPWS display and of future potential developments	0	—

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SUB-TOPIC 1.4: Displays

1.4.1	Describe the display types available and their advantages and disadvantages	2	Raster/rotating, raw/synthetic, monochrome/colour, CRT/LCD, performances (cost, availability, maintainability, ergonomics)

SUBJECT 3: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUB-TOPIC 1.2: Verification methods

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training e.g. data analyser, line analyser

SUBJECT 4: FUNCTIONAL SAFETY

TOPIC 1 SAFETY ATTITUDE

SUB-TOPIC 1.1: Safety attitude

1.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to surveillance systems, safety monitoring

TOPIC 2: FUNCTIONAL SAFETY

SUB-TOPIC 2.1: Functional safety

2.1.1	Describe the implications of functional failures in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

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SUBJECT 5: DATA PROCESSING SYSTEMS

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 1.1: Surveillance data processing systems

1.1.1	Identify all functions of an SDP system	3	Plot processing, tracking, single-sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording *e.g. ARTAS tracker*
1.1.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
1.1.3	Differentiate SDP features in the ATS units	2	Area Control Centres Approach Control Units Aerodrome Control Towers
1.1.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
1.1.5	Explain the principles of emergency switching	2	—

Stream DATA — DATA PROCESSING

SUBJECT 1: COMMUNICATION DATA

TOPIC 1: INTRODUCTION TO NETWORKS

SUB-TOPIC: 1.1 Types

1.1.1	State the evolution of network topologies	1	LAN, WAN e.g. architectures, size of the segments, length of the systems, quality of service
1.1.2	Explain how networks meet requirements	2	Redundancy, bandwidth, BER, time delay, network security

SUB-TOPIC 1.2: Networks

1.2.1	Analyse the features of a network	4	Routing scheme, rate, internal networking, routers, bridges, gateways, modems, switches, firewalls *e.g. wireless networks*
1.2.2	Describe network standards and devices	2	Ethernet, fibre optic, wireless
1.2.3	Appreciate the replacement of components in a network in a safe way	3	Continuity of service, network integrity Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training

SUB-TOPIC 1.3: External network services

1.3.1	Define aspects of external network services	1	Provided QoS *e.g. SLAs*

SUB-TOPIC 1.4: Measuring tools

1.4.1	Operate the usual set of network measuring or monitoring tools to find the values of the main parameters	3	Data analyser (sniffer) *e.g. net scout*
1.4.2	Perform analysis to support fault-finding for correction	3	Data analyser (sniffer) *e.g. net scout*

SUB-TOPIC 1.5: Troubleshooting

1.5.1	Appreciate how to troubleshoot a network	3	Additional: for achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training *e.g. broken lines, unusable network components, overload, integrity problems*

TOPIC 2: PROTOCOLS

SUB-TOPIC 2.1: Fundamental theory

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2.1.1	Apply the principles of layers	3	Differences between layers *e.g. layer(s) of sniffer information*
2.1.2	Apply the principles of the addressing strategy	3	Masks, subnets IP addressing, MAC addressing *e.g. same logical network computers and* systems
2.1.3	Apply the principles of the routing strategy	3	Routing tables, priorities, fault tolerance, management of routing strategy, static and dynamic routing *e.g. unicast, multicast, broadcast*

SUB-TOPIC 2.2: General protocols

2.2.1	Describe the general protocols	2	TCP/IP (segments, packets, addressing) *e.g. X25, LAPB, pdH, sdH*
2.2.2	Analyse the general protocols using the appropriate tools and documentation	4	TCP/IP *e.g. X25, LAPB*

SUB-TOPIC 2.3: Specific protocols

2.3.1	Describe the specific protocols	2	*e.g. BATAP — ARINC 620, FMTP*

TOPIC 3: NATIONAL NETWORKS

SUB-TOPIC 3.1: National networks

3.1.1	Name the national networks to which the organisation is connected	1	*e.g. ANSP, MET, military, PTT, airlines, national network(s)*
3.1.2	Describe the interfaces between national and global networks	2	—

SUBJECT 2: SURVEILLANCE PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability

SUBJECT 3: SURVEILLANCE SECONDARY

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684

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1.1.2	Relate key parameters of SSR to system performance	4	Key parameters: rotation rate, PRF, interlaced modes, capacity, frequencies, power budget (uplink, downlink), monopulse techniques Consequences: FRUIT, garbling, side lobes reception and transmission, transponder availability, PD, 2nd recurrence replies

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode interlace pattern, operational use of all-call, roll-call
2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation e.g. SCAS
3.1.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.1.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

SUBJECT 4: SURVEILLANCE — HMI

TOPIC 3: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUBJECT 5: SURVEILLANCE DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

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SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks (e.g. RADNET), messages CAT 1+
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment e.g. software fallback capability, contingency of service, RADNET
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUBJECT 6: FUNCTIONAL SAFETY

TOPIC 1: FUNCTIONAL SAFETY

SUB-TOPIC 1.1: Functional safety

1.1.1	Describe the implications of functional failure in terms of exposure time, environment, effect on controller and effect on pilot	2	Total or partial, premature or delayed operation, spurious, intermittent, loss or corruption of data, missing or incorrect input or output Ref.: Safety policy and implementation

SUB-TOPIC 1.2: Software integrity and security

1.2.1	Appreciate how a system can be defended against potential hostile intent via the data processing systems	3	Input verification, secure sources *e.g. leased lines, private networks, eligibility*
1.2.2	Explain how the normal output of a system could be used by non-authorised persons with hostile intent	2	*e.g. terrorists using radar data to coordinate an attack*
1.2.3	Estimate the impact of security and integrity failure to the operational service	3	*e.g. system crashes due to incorrect input data, main and standby and fallback systems all have same input, possible loss in total of system, results in capacity reductions and safety consequences*
1.2.4	Appreciate error detection and handling in data, hardware and process	3	Identification, consequence, scope, reporting, fault tolerance, soft fail, failsafe, monitoring, fallback

TOPIC 2: SAFETY ATTITUDE

SUB-TOPIC 2.1: Safety attitude

2.1.1	State the role of ATSEP in safety management routines and in reporting processes	1	Safety assessment documentation related to data processing systems, safety monitoring

SUBJECT 7: DATA PROCESSING SYSTEMS

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

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1.1.1	Explain ATCO missions and services needed in an area control centre	2	Operational requirements *e.g. separation, flight progress monitoring and coordination, trajectory prediction, coordination with adjacent centres*
1.1.2	Explain ATCO missions and services needed in an approach control unit	2	Operational requirements *e.g. vectoring, sequencing, AMAN, CDM*
1.1.3	Explain ATCO missions and services needed in an aerodrome control tower	2	Operational requirements *e.g. runway management, DMAN*

SUB-TOPIC 1.2: Trajectories, prediction and calculation

1.2.1	State different types of trajectories	1	*e.g. FPL-based, surveillance data-based, FMS-based*
1.2.2	Explain the main processes for trajectory prediction	2	SDP trajectory, FPL trajectory, merged trajectory, predicted trajectory

SUB-TOPIC 1.3: Ground safety nets

1.3.1	Describe the function of safety nets and their legal status	2	STCA, APW, MSAW, ASMGCS-based safety nets

SUB-TOPIC 1.4: Decision support

1.4.1	Explain the major steps in the air traffic planning process	2	ATFCM with strategic, pre-tactical and tactical, ATC sector planning, tactical control
1.4.2	Explain the principles of trajectory prediction, conformance monitoring and medium term conflict detection processes	2	Route adherence monitoring *e.g. CORA, MTCD, CLAM, Level adherence monitoring*
1.4.3	Explain the benefit of these tools for safety and efficiency	2	—

TOPIC 2: SYSTEM COMPONENTS

SUB-TOPIC 2.1: Processing systems

2.1.1	Describe all major components of a data processing system	2	Functional architecture, technical architecture, supervision

SUB-TOPIC 2.2: Flight data processing systems

2.2.1	Identify all functions of an FDP system	3	FDPS reference model, message handling, initial flight data handling, relationship with other functions, air-ground data link processing, trajectory prediction, flight data management and distribution, SSR Mode A code assignment and management, correlation, coordination and transfer
2.2.2	Describe all major components of an FDP	2	Functional architecture, technical architecture e.g. HMI, ATC tools, support tools (technical supervision, QoS monitors and logging)

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2.2.3	Differentiate FDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
2.2.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
2.2.5	Explain the principles of emergency switching	2	—

SUB-TOPIC 2.3: Surveillance data processing systems

2.3.1	Identify all functions of an SDP system	3	Plot processing, tracking, single sensor and multisensor tracker (e.g. radar, ADS, MLAT), estimating limits and accuracy of multisensor tracker, recording *e.g. ARTAS tracker*
2.3.2	Describe all major components of an SDP	2	Functional architecture, technical architecture
2.3.3	Differentiate SDP features in the ATS units	2	Area control centres Approach control units Aerodrome control towers
2.3.4	Appreciate how to operate the system	3	*e.g. configuration, adjust parameters, start up and shut down, monitoring*
2.3.5	Explain the principles of emergency switching	2	—

SUBJECT 8: DATA PROCESS

TOPIC 1: SOFTWARE PROCESS

SUB-TOPIC 1.1: Middleware

1.1.1	Define middleware	1	Additional specialised functional built on the OS
1.1.2	List the middleware used on the national major systems	1	*e.g. CORBA, UBSS, OTM, EJB*
1.1.3	Demonstrate the use of a middleware in an ATM environment	2	Duel processing system

SUB-TOPIC 1.2: Operating systems

1.2.1	Describe the major aspects of a relevant operating system	2	*e.g. design, start-up, configuration, back-up and restore*
1.2.2	Perform relevant operating system commands	3	—
1.2.3	Characterise typical consequences of an OS upgrade	2	Some possible implications on HW (performance, memory), middleware (compatibility) and SW components

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1.2.4	Explain downward compatibility	2	Checks on embedded SW modules ability to run under new OS version
1.2.5	Take account of hardware/software compatibility	2	Examples of HW requirements of specific SW implementations
1.2.6	Describe interactions between application and OS	2	Examples of OS calls by the application software if no middleware is in use
1.2.7	Describe the life cycle management of an operating system	2	*e.g. versions, releases, patches, migration*

SUB-TOPIC 1.3: Configuration control

1.3.1	Describe the principles of configuration control	2	Clear identification of all versions, proof of testing and 'build state', tool and mechanisms to aid control, authorisation, audit trail, appropriate quality standard requirements of the administration

SUB-TOPIC 1.4: Software development process

1.4.1	State the main software development processes	1	SWALs *e.g. life cycle, waterfall model, RUP*
1.4.2	List the main steps of two of the main software development processes	1	—
1.4.3	Explain the main differences between two software development processes	2	*e.g. advantages/disadvantages*

TOPIC 2: HARDWARE PLATFORM

SUB-TOPIC 2.1: Equipment upgrade

2.1.1	Explain the key factors that have to be considered when data processing equipment is upgraded or changed	2	Specification, compatibility, 'proven' or 'state-of-the-art' technology, maintenance and operating consequence (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing

SUB-TOPIC 2.2: COTS

2.2.1	Explain the advantages and disadvantages of commercial off-the-shelf equipment	2	Cost, multiplicity of suppliers, quality, maintainability, life cycle, liability

SUB-TOPIC 2.3: Interdependence

2.3.1	Describe the technical issues regarding the interdependence of various equipment and systems	2	Interface requirements, common point of failure, data conditioning, response time

SUB-TOPIC 2.4: Maintainability

2.4.1	Identify the issues that will affect the maintainability of hardware for the planned life of a system	3	Commercial product life, commercial support commitments, company volatility, spares provision, shelf life and logistics

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TOPIC 3: TESTING

SUB-TOPIC 3.1: Testing

3.1.1	Appreciate the techniques available for system and performance requirements testing	3	*e.g. code walkthrough, modelling, simulation real time and fast time, black box testing, formal methods, use of independent test personnel, data corruption simulation, hardware failure simulation*
3.1.2	Appreciate the techniques available for system testing and integration	3	*e.g. system integration testing, load testing, regression testing*

SUBJECT 9: — DATA

TOPIC 1: DATA ESSENTIALS FEATURES

SUB-TOPIC 1.1: Data significance

1.1.1	Explain the significance of data	2	Criticality (critical/non critical), legality (ICAO, CAA, organisation), use (advisory, control)

SUB-TOPIC 1.2: Data configuration control

1.2.1	Explain the control procedures for changes to operational data	2	Designated roles/persons for authorising changes and verifying/checking changes

SUB-TOPIC 1.3 Data Standards

1.3.1	Name the authority responsible for standards	1	*e.g. EUROCONTROL, ICAO, ISO*
1.3.2	State the standards related to ATM data, their sources and their status	1	*e.g. ASTERIX, WGS84, OLDI, FMTP, AMHS, ADEX-P, FPL*
1.3.3	Decode a typical OLDI message	3	*e.g. ACT, PAC*
1.3.4	State the nature of ATM processing requirements	1	Data volatility (e.g. radar), system integrity, consequence of failure

TOPIC 2: ATM DATA DETAILED STRUCTURE

SUB-TOPIC 2.1: System area

2.1.1	Describe how a system area is defined	2	*e.g. size, system centre (reference point)*
2.1.2	Describe the data related to the system area	2	*e.g. radar data, flight plan data, maps, coordinates*

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SUB-TOPIC 2.2: Characteristic points

2.2.1	State types of characteristic points used in an ATM system and their structure	1	Geographic, routing, sector *e.g. Geographic: airports and runways, ILS, radar, limit points* *Routing and sectors: coded routes, SID allocation parameters, area navigation waypoints, adjacent FIRs, holding, sectors*
2.2.2	Explain the importance of characteristic points in the correct presentation of data	2	—
2.2.3	Describe the process by which amended adaptation files are introduced	2	—

SUB-TOPIC 2.3: Aircraft performances

2.3.1	List the performance data used in FDPS	1	Example of data from in-house system
2.3.2	Describe the structure of aircraft performance data	2	—
2.3.3	*Define* speeds, rates and levels	1	—
2.3.4	Explain the consequences of the use of the wrong type of aircraft	2	—

SUB-TOPIC 2.4: Screen manager

2.4.1	Describe how the screen manager is used to set up the ATC HMI	2	—

SUB-TOPIC 2.5: Auto-coordination messages

2.5.1	Describe the meaning of coordination messages in the control process	2	Coordination parameters, conditions groups, OLDI conditions groups, characteristics of remote centres
2.5.2	Describe the characteristics of the remote centres relevant to OLDI	2	Civil and military

SUB-TOPIC 2.6: Configuration control data

2.6.1	Explain the structure of the configuration data	2	Sector CSU link, sectorisation plan, control parameters

SUB-TOPIC 2.7: Physical configuration data

2.7.1	Explain the structure of the physical configuration data	2	External configuration, device configuration

SUB-TOPIC 2.8: Relevant meteorology data

2.8.1	Explain the organisation of the data	2	Meteorology, QNH TL areas, CB activity

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	related to meteorology		

SUB-TOPIC 2.9: Alert and error messages to ATSEP

2.9.1	Explain the importance of alert and error messages	2	—
2.9.2	Describe different categories of two alert and error messages	2	—

SUB-TOPIC 2.10 Alert and error messages to ATCO

2.10.1	Describe the structure of the data used in these types of message	2	MSAW, conflict alert parameters
2.10.2	Explain alerts and error messages, and their importance from an ATCO point of view	2	*e.g. MSAW, conflict alert, MTCD*

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Stream SYSTEM MONITORING AND CONTROL — COMMUNICATION

SUBJECT 1: COMMUNICATION VOICE

TOPIC 1: AIR-GROUND

SUB-TOPIC 1.1: Controller working position

1.1.1	Describe the most common features of a controller working position	2	Frequency selection, emergency, station selection, coupling, headset, loudspeaker, footswitch, push to talk *e.g. microphone (noise cancelling), short time recording*

TOPIC 2: GROUND-GROUND

SUB-TOPIC 2.1: Interfaces

2.1.1	Describe the different types of interfaces	2	Analogue (2, 4, 6 and 8 wires), digital ISDN (64 Kb, 2 Mb)

SUB-TOPIC 2.2: Switch

2.2.1	State the similarities between ground-ground and air-ground switches	1	Switching techniques
2.2.2	Describe the most commonly used functionality of PABX	2	General architecture, digital, analogue, multiplex types, PCM30
2.2.3	Analyse conversion analogue-digital, digital-analogue	4	General architecture, analogue-digital-analogue

SUB-TOPIC 2.3: Controller working position

2.3.1	Describe the two most common features of a controller working position and the HMI	2	—

SUBJECT 2: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

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SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 3: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations
1.1.3	Explain how the service provider complies with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 4: NAVIGATION — PBN NDB

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explain the need for NOTAMs	2	—

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SUBJECT 5: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—
1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM Context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, ATFCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices *e.g. security, access control (building and platform), safety, fire*

SUBJECT 6: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*
1.1.3	Take account of the end	2	*e.g. ATC Units, airports, airlines*

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	users/customers affected		
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciate the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1 User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, Met, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

SUBJECT 7: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19, Annex IV to Regulation (EU) No XXX/XXXX

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures
1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, safety event processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. safety event procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*
2.1.2	Describe within which functional	2	*e.g. network providers, facilities management,*

	areas maintenance agreements will occur		*communications*
2.1.3	Describe where in the SMS manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—
3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external* service providers, ATM stakeholders
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 8: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

SUB-TOPIC 1.2: Communication

1.2.1	Describe the key aspects of control and monitoring system capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.2.2	Appreciate the impact of the replacement of components in a communication chain	3	Continuity of service, communication chain integrity

SUB-TOPIC 1.3: Facilities

1.3.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*

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1.3.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

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Stream SYSTEM MONITORING AND CONTROL — NAVIGATION

SUBJECT 1: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks course

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 2: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations

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1.1.3	Explain how service providers comply with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information.*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 3: NAVIGATION — PBN NDB

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explain the need for NOTAMs	2	—

SUBJECT 4: NAVIGATION — GROUND-BASED SYSTEMS-NDB

TOPIC 1: NDB LOCATOR

SUB-TOPIC 1.1: Use of the system

1.1.1	Appreciate the principles of NDB	3	Relative bearing, measuring method
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.3	Explain the technical limitations of NDB	2	Lack of accuracy, lack of integrity, sensitivity to interference
1.1.4	Describe the current situation	2	*e.g. number, type, users, user groups, European context*

SUBJECT 5: NAVIGATION — GROUND-BASED SYSTEMS-DF

TOPIC 1: DF

SUB-TOPIC 1.1: Use of the system

1.1.1	State the different types of DF	1	VDF, DDF, IDF
1.1.2	Describe the user HMI	2	Indication on radar picture, DF indicator
1.1.3	Appreciate the principles of DF	3	Bearing, measuring method (standard, Doppler, interferometry)
1.1.4	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.5	Explain the technical limitations of DF	2	Sensitivity to interference
1.1.6	Describe the current situation	2	*e.g. number, type, users, national context*

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SUBJECT 6: NAVIGATION — GROUND-BASED SYSTEMS-VOR

TOPIC 1 VOR

SUB-TOPIC 1.1: Use of the system

1.1.1	State the types of VOR Systems	1	Conventional, doppler
1.1.2	Describe the overall performance	2	Coverage, accuracy, availability of the system, integrity, continuity
1.1.3	Explain the technical limitations of CVOR	2	Type of information (azimuth), accuracy, integrity, suitable for a network of fixed routes
1.1.4	Appreciate the differences between CVOR and DVOR	3	Signal broadcast differences, bearing information robustness
1.1.5	Describe the current situation	2	*e.g. number, type, users, user groups, national context, European context*

SUBJECT 7: NAVIGATION — GROUND-BASED SYSTEMS-DME

TOPIC 1: DME

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for DME	2	Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the limitations of DME	2	Accuracy, integrity, capacity
1.1.3	Describe the current situation	2	*e.g. number, types, users, user groups, national context, European context*
1.1.4	State the role of the DME infrastructure in the future navigation applications	1	PBN
1.1.5	Explain the differences between DME and TACAN for civilian use	2	*e.g. azimuth and range*

SUBJECT 8: NAVIGATION — GROUND-BASED SYSTEMS-ILS

TOPIC 1: ILS

SUB-TOPIC 1.1: Use of the system

1.1.1	Describe the overall performances for ILS	2	ICAO Annexes 10 and 14 Coverage, accuracy, availability of the system, integrity, continuity, number of users
1.1.2	Explain the technical limitations of ILS	2	ICAO Annexes 10 and 14 Only 40 channels, no segmented paths of approach, beam corruption due to multi-path
1.1.3	Interpret ILS Facility Performance Categories	5	ICAO Annexes 10 and 14 Cat I, Cat II, Cat III Different operational category depending on operational minima, equipment and airport facilities

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1.1.4	Define obstacle free zones for ILS components	1	ICAO Annexes 10 and 14 Dimensions *e.g. national regulations*
1.1.5	Explain the importance and need for ILS obstacle free zones	2	ILS beam protection, increased significance during LVP conditions
1.1.6	Explain the current situation	2	*e.g. number, type, users, national context*
1.1.7	Consider the need for ATC ILS status indications	2	No continuous monitoring by ATSEP

SUBJECT 9: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—
1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, AFTCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices *e.g. security, access control (building and platform), safety, fire*

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SUBJECT 10: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*
1.1.3	Take account of the end users/customers affected	2	*e.g. ATC units, airports, airlines*
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciate the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1: User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, MET, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

SUBJECT 11: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures

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1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, Safety Event Processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. Safety Event Procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*
2.1.2	Describe within which functional areas maintenance agreements will occur	2	*e.g. network providers, facilities management, communications*
2.1.3	Describe where in the SMS manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—
3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external service providers, ATM stakeholders*
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 12: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

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SUB-TOPIC 1.3: Navigation

1.3.1	Describe the key aspects of control and monitoring system capability	2	e.g. parameters presented to the SMC and types of actions that can be taken
1.3.2	Appreciate the impact of the replacement of components in navigation equipment	3	Continuity of service, navigation aid integrity

SUB-TOPIC 1.6: Facilities

1.6.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.6.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

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Stream SYSTEM MONITORING AND CONTROL — SURVEILLANCE

SUBJECT 1: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 2: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations

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1.1.3	Explain how service providers comply with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 3: NAVIGATION — PBN

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explaining the need for NOTAMs	2	—

SUBJECT 4: SURVEILLANCE — PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability

SUBJECT 5: SURVEILLANCE — SECONDARY

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode Interlace Pattern, Operational use of All- call, Roll-call
2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

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TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation *e.g. SCAS*
3.1.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.1.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

SUBJECT 6: SURVEILLANCE — HMI

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUBJECT 7: SURVEILLANCE — DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUBJECT 8: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—

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1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the maintenance policy that apply specifically to SMC	2	—

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, AFTCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices *e.g. security, access control (building and platform), safety, fire*

SUBJECT 9: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*
1.1.3	Take account of the end users/customers affected	2	*e.g. ATC units, airports, airlines*
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciating the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

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TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1: User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, MET, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

SUBJECT 10: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures
1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, safety event processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. safety event procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*
2.1.2	Describe within which functional areas maintenance agreements will occur	2	*e.g. network providers, facilities management, communications*
2.1.3	Describe where in the SMS Manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—

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3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external service providers, ATM stakeholders*
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 11: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

SUB-TOPIC 1.4 Surveillance

1.4.1	Describe the key aspects of control and monitoring system capability	2	e.g. parameters presented to the SMC and types of actions that can be taken
1.4.2	Appreciate the impact of the replacement of components in a surveillance chain	3	Continuity of service, surveillance chain integrity

SUB-TOPIC 1.6 Facilities

1.6.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.6.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

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Stream SYSTEM MONITORING AND CONTROL — DATA

SUBJECT 1: COMMUNICATION DATA

TOPIC 1: EUROPEAN NETWORKS

SUB-TOPIC 1.1: Network technologies

1.1.1	State emerging network technologies	1	*e.g. as used in EAN, NEAN, AMHS, PENS*
1.1.2	Describe the characteristics of the current networks	2	Surveillance data, flight plan data and AIS networks *e.g. CIDIN, OLDI, CFMU-RCA, quality of service, architecture, FMTP, AMHS*

TOPIC 2: GLOBAL NETWORKS

SUB-TOPIC 2.1: Networks and standards

2.1.1	List the global networks and the standards on which they are based	1	*e.g. ICAO for AFTN/CIDIN/AMHS, ICAO for ATN, FANS 1 and FANS A for ACARS applications (SITA and ARINC)*

SUB-TOPIC 2.2: Description

2.2.1	Describe the characteristics of the AFTN networks	2	Users and data, architectures, quality of service

SUB-TOPIC 2.3: Global architecture

2.3.1	Describe the architecture of the ATN	2	Air-ground subnetworks, ground-ground subnetworks, airborne networks

SUB-TOPIC 2.4: Air-ground subnetworks

2.4.1	Describe the air-ground subnetworks	2	VDL (mode 2), HFDL, AMSS, SATCOM

SUB-TOPIC 2.5: Ground-ground subnetworks

2.5.1	Describe the composition of ground-ground subnetworks	2	PTT, commercial telecom providers, ARINC, SITA

SUB-TOPIC 2.6: Air-ground applications

2.6.1	State the main communication applications using data link systems	1	*e.g. CPDLC, DLIC/AFN, ATIS, DCL*

SUBJECT 2: COMMUNICATION RECORDERS

TOPIC 1: LEGAL RECORDERS

SUB-TOPIC 1.1: Regulations

1.1.1	Explain the international regulations	2	ICAO (recording and reproducing)
1.1.2	Explain national regulations	2	Appropriate national regulations

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1.1.3	Explain how the service provider complies with the regulations	2	*e.g. storage media, access to recording and reproducing room, time to store information (overwrite/erase voice or data), procedure to reproduce information*

SUB-TOPIC 1.2: Principles

1.2.1	Explain the principles of recording and reproducing	2	*e.g. storage media (tape, optical and magnetic disc), A/D-D/A converters, frequency range (300 to 3 400 Hz), channel capacity, time synchronisation, connection to a network, synchronisation of radar and voice recording, replay limitations*

SUBJECT 3: NAVIGATION — PBN

TOPIC 1: NAV CONCEPTS

SUB-TOPIC 1.1: NOTAM

1.1.1	Explain the need for NOTAMs	2	—

SUBJECT 4: SURVEILLANCE — PRIMARY

TOPIC 1: ATC SURVEILLANCE

SUB-TOPIC 1.1: Use of PSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach PSR	2	Range, resolution, coverage, availability

SUBJECT 5: SURVEILLANCE — SECONDARY

TOPIC 1: SSR AND MSSR

SUB-TOPIC 1.1: Use of SSR for Air Traffic Services

1.1.1	Describe the operational requirements of an en-route or an approach SSR	2	Range, coverage, resolution, performance, update rate ICAO Doc 9684

TOPIC 2: MODE S

SUB-TOPIC 2.1: Introduction to Mode S

2.1.1	Explain the need for and benefits of Mode S	2	Classical SSR limitations, resolution, accuracy, integrity, enhanced data (e.g. 25 ft resolution, aircraft ID, BDS information)
2.1.2	Explain the working principles of Mode S	2	Mode S interrogation, Mode S reply, Mode S uplink and downlink capability, Mode S formats/protocols, ELS, EHS
2.1.3	Explain the complementary use of Mode S and conventional SSR	2	Mode interlace pattern, operational use of all-call, roll-call

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2.1.4	Explain Mode S implementation	2	Elementary and enhanced surveillance, II and SI codes, use of BDS

TOPIC 3: MULTILATERATION

SUB-TOPIC 3.1: MLAT principles

3.1.1	Explain the MLAT system architecture	2	Standards, transmitters and receivers, data processing/fusion, redundancy, performance, costs, timing solutions, etc.
3.1.2	Appreciate the principles of MLAT system	3	Triangulation, coverage, position calculation *e.g. SCAS*
3.1.3	Describe how to operate the system	2	Tracking, map creation and blanking
3.1.4	Describe testing possibilities for MLAT	2	*e.g. SASS-C*

SUBJECT 6: SURVEILLANCE — HMI

TOPIC 1: HMI

SUB-TOPIC 1.1: ATCO HMI

1.1.1	Describe the display types available	2	Video, synthetic, mixed
1.1.2	State the type of selections available	1	Source, range, maps, filters
1.1.3	Describe the advantages of different display types	2	Clarity, configurability, fallback, data integration

SUBJECT 7: SURVEILLANCE — DATA TRANSMISSION

TOPIC 1: SURVEILLANCE DATA TRANSMISSION

SUB-TOPIC 1.1: Technology and protocols

1.1.1	Describe the implementation of formats and protocols	2	Network protocols, surveillance data networks *e.g. RADNET, messages CAT 1+*
1.1.2	Decode ASTERIX messages	3	*e.g. categories 1, 2, 20, 21, 34, 48, and 62*
1.1.3	Identify the data transmission architecture in a multisensor environment	3	Fault tolerance, redundancy of line equipment *e.g. software fallback capability, contingency of service, RADNET*
1.1.4	Characterise the degradations of the surveillance transmission network	2	*e.g. saturation, excess latency*

SUBJECT 8: DATA PROCESSING — DPS SYSTEMS

TOPIC 1: USER REQUIREMENTS

SUB-TOPIC 1.1: Controller requirements

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1.1.1	Explain ATCO missions and services needed in an area control centre	2	Operational requirements *e.g. separation, flight progress monitoring and coordination, trajectory prediction, coordination with adjacent centres*
1.1.2	Explain ATCO missions and services needed in an approach control unit	2	Operational requirements *e.g. vectoring, sequencing, AMAN, CDM*
1.1.3	Explain ATCO missions and services needed in an aerodrome control tower	2	Operational requirements *e.g. runway management, DMAN*

SUB-TOPIC 1.2: Trajectories, prediction and calculation

1.2.1	State different types of trajectories	1	*e.g. FPL-based, surveillance data-based, FMS-based*
1.2.2	Explain the main processes for trajectory prediction	2	SDP trajectory, FPL trajectory, merged trajectory, predicted trajectory

SUB-TOPIC 1.3: Ground safety nets

1.3.1	Describe the function of safety nets and their legal status	2	STCA, APW, MSAW, ASMGCS-based safety nets

SUB-TOPIC 1.4: Decision support

1.4.1	Explain the major steps in the air traffic planning process	2	ATFCM with strategic, pre-tactical and tactical, ATC sector planning, tactical control
1.4.2	Explain the principles of trajectory prediction, conformance monitoring and medium term conflict detection processes	2	Route adherence monitoring *e.g. CORA, MTCD, CLAM, level adherence monitoring*
1.4.3	Explain the benefit of these tools for safety and efficiency	2	—

SUBJECT 9: DATA PROCESSING — DATA PROCESS

TOPIC 1: HARDWARE PLATFORM

SUB-TOPIC 1.1: Equipment upgrade

1.1.1	Explain the key factors that have to be considered when data processing equipment is upgraded or changed	2	Specification, compatibility, 'proven' or 'state-of-the-art' technology, maintenance and operating consequence (e.g. personnel, training, spares, procedures), environmental requirements (e.g. size, power requirements, temperature, interfaces), testing

SUB-TOPIC 2.2: COTS

2.2.1	Explain the advantages and disadvantages of commercial off-the-shelf equipment	2	Cost, multiplicity of suppliers, quality, maintainability, life cycle, liability

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SUB-TOPIC 2.3: Interdependence

2.3.1	Describe the technical issues regarding the interdependence of various equipment and systems	2	Interface requirements, common point of failure, data conditioning, response time

SUBJECT 10: DATA PROCESSING — DATA

TOPIC 1: DATA ESSENTIALS FEATURES

SUB-TOPIC 1.1: Data significance

1.1.1	Explain the significance of data	2	Criticality (critical/non critical), legality (ICAO, CAA, organisations), use (advisory, control)

SUB-TOPIC 1.2: Data configuration control

1.2.1	Explain the control procedures for changes to operational data	2	Designated roles/persons for authorising changes and verifying/checking changes

SUB-TOPIC 1.3: Data standards

1.3.1	Name the authority responsible for standards	1	*e.g. EUROCONTROL, ICAO, ISO*
1.3.2	State the standards related to ATM data, their sources and their status	1	*e.g. ASTERIX, WGS84, OLDI, FMTP, AMHS, ADEX-P, FPL,*
1.3.3	Decode a typical OLDI message	3	*e.g. ACT, PAC*
1.3.4	State the nature of ATM processing requirements	1	Data volatility (*e.g. radar*), system integrity, consequence of failure

SUBJECT 11: SMC — ANS STRUCTURE

TOPIC 1: ANSP ORGANISATION AND OPERATION

SUB-TOPIC 1.1: ANSP organisation and operation

1.1.1	Describe the SMC function within the organisation	2	What the SMC does, interfaces with other functions, similarities and major differences between SMC function at different sites
1.1.2	Describe the structure, roles and responsibilities of the SMC team and any direct interfaces	2	—
1.1.3	Explain the duties of the ATC supervisor	2	—

TOPIC 2: ANSP MAINTENANCE PROGRAM

SUB-TOPIC 2.1: Policy

2.1.1	Describe, in general terms, the ANSP maintenance policy	2	—
2.1.2	Describe the aspects of the	2	—

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	maintenance policy that apply specifically to SMC		

TOPIC 3: ATM CONTEXT

SUB-TOPIC 3.1: ATM context

3.1.1	Describe the ATM requirements and the related services provided by the SMC	2	Service level agreements, working arrangements *e.g. ASM, AFTCM*

TOPIC 4: ANSP ADMINISTRATIVE PRACTICES

SUB-TOPIC 4.1: Administration

4.1.1	Describe any ANSP administrative procedures, specifically applicable to SMC	2	Any non-technical practices e.g. security, access control (building and platform), safety, fire

SUBJECT 12: SMC — ANS SYSTEM/EQUIPMENT

TOPIC 1: OPERATIONAL IMPACTS

SUB-TOPIC 1.1: Degradation or loss of system/equipment services

1.1.1	Describe the importance of monitoring system performance	2	—
1.1.2	Describe possible ways in which the SMC may become aware of degradation of services and/or systems	2	*e.g. monitoring systems, telephone calls, aural alerts, user complaint*
1.1.3	Take account of the end users/customers affected	2	*e.g. ATC Units, airports, airlines*
1.1.4	Appreciate the implications for end users/customers	3	—
1.1.5	Appreciate the appropriate actions to restore service	3	*e.g. switching, replacing, reconfiguration, calling external service provider*
1.1.6	Appreciate the need for appropriate communication before and after restoring service	3	*e.g. users, customers, external and internal providers*

TOPIC 2: USER POSITION FUNCTIONALITY AND OPERATION

SUB-TOPIC 2.1: User working position

2.1.1	Appreciate working position performance to agreed parameters	3	*e.g. ATCO, MET, ATSEP, airport positions*

SUB-TOPIC 2.2: SMC working position

2.2.1	Appreciate SMC working position performance to agreed parameters	3	—

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SUBJECT 13: SMC — TOOLS, PROCESSES AND PROCEDURES

TOPIC 1: REQUIREMENTS

SUB-TOPIC 1.1: SMS

1.1.1	Describe the ICAO and European requirements and the national and ATSP SMS	2	ICAO Annex 19, Annex II to Regulation (EU) No XXX/XXXX.

SUB-TOPIC 1.2: QMS

1.2.1	Describe the quality management system requirements	2	*e.g. ISO, EFQM*

SUB-TOPIC 1.3: SMS application in the working environment

1.3.1	Describe the relationship between the SMS and the application of SMC	2	Reporting procedures
1.3.2	Explain which occurrences require incident reporting and follow-up action(s)	2	*e.g. national categories for reporting, safety event processing*
1.3.3	Apply incident reporting procedures to example occurrence(s)	3	*e.g. safety event procedure*

TOPIC 2: MAINTENANCE AGREEMENTS WITH OUTSIDE AGENCIES REQUIREMENTS

SUB-TOPIC 2.1: Principles of agreements

2.1.1	Describe the principles and need for maintenance agreements	2	*e.g. types of service level provided*
2.1.2	Describe within which functional areas maintenance agreements will occur	2	*e.g. network providers, facilities management, communications*
2.1.3	Describe where in the SMS Manual these agreements are included or referenced	2	—

TOPIC 3: SMC GENERAL PROCESSES

SUB-TOPIC 3.1: Roles and responsibilities

3.1.1	Describe the role and general method of operations of the SMC	2	—
3.1.2	Describe the need to monitor service conditions and the way to take appropriate action to ensure service performance	2	*e.g. process to interrupt services for planned maintenance purposes, management of service provision during corrective maintenance, continuity of service, availability*
3.1.3	Describe the coordination role of the SMC	2	*e.g. ATSEPs, ATCOs, external service providers, ATM stakeholders*
3.1.4	Describe how risk analysis can contribute towards decision-making	2	*e.g. assessing risk, handling of service interventions*

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TOPIC 4: MAINTENANCE MANAGEMENT SYSTEMS

SUB-TOPIC 4.1: Reporting

4.1.1	Describe how maintenance activities and SMC events/actions are recorded	2	*e.g. procedures to follow, terminology to use, record keeping for traceability*
4.1.2	Explain the importance of accurate record keeping and dissemination for handover and quality management purposes	2	*e.g. information is logged in database or report is generated and distributed according to defined procedures*

SUBJECT 14: SMC — TECHNOLOGY

TOPIC 1: TECHNOLOGIES AND PRINCIPLES

SUB-TOPIC 1.1: General

1.1.1	Describe the principles of control and monitoring systems used	2	*e.g. national basis, colour codes, ergonomics*

SUB-TOPIC 1.5: Data processing

1.5.1	Describe the key aspects of control and monitoring system capability	2	e.g. parameters presented to the SMC and types of actions that can be taken
1.5.2	Appreciate the impact of the replacement of components in data processing chain	3	Continuity of service, data processing, chain integrity

SUB-TOPIC 1.6: Facilities

1.6.1	Describe the key aspects of system management capability	2	*e.g. parameters presented to the SMC and types of actions that can be taken*
1.6.2	Appreciate the impact of the loss of supply and/or replacement of components in facility equipment	3	Continuity of service, integrity

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GM1 to Appendix Ia, IIa, IIIa and IVa

SYLLABI STRUCTURE

This guidance material provides explanatory material on how to read the tables in the appendices contained in this Subpart A of ANNEX XIII.

(a) Structure of the syllabi

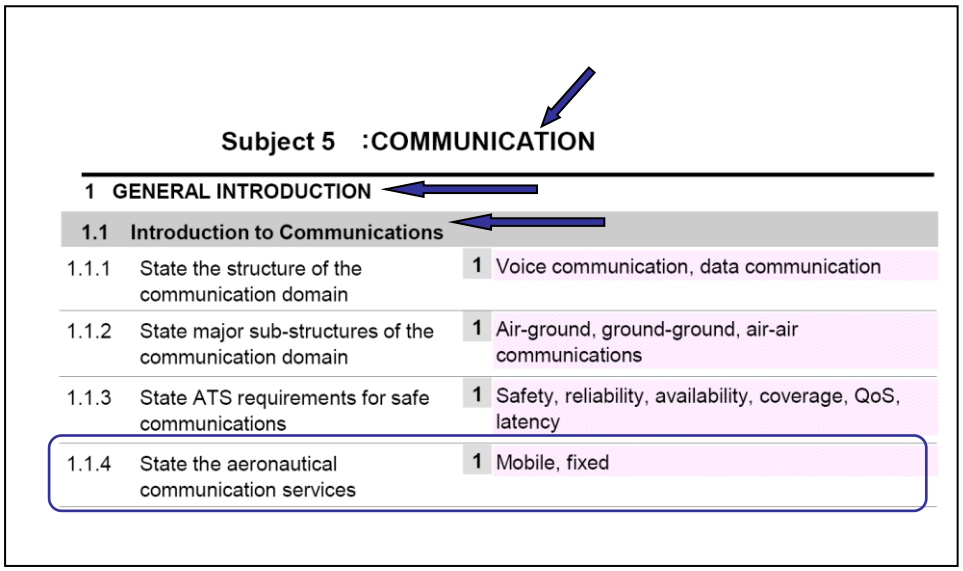
Each table represents a syllabus which has been structured according to the following:

(1) for ease of reading, each table repeats the titles of all subjects that are listed in the Implementing Rule; and

(2) these subjects are further divided into the topics that are listed in the Implementing Rule; then

(3) topics are divided into one or more sub-topics; and

(4) sub-topics contain one or more training objectives.



Subject 5 :COMMUNICATION			
1 GENERAL INTRODUCTION			
1.1 Introduction to Communications			
1.1.1	State the structure of the communication domain	1	Voice communication, data communication
1.1.2	State major sub-structures of the communication domain	1	Air-ground, ground-ground, air-air communications
1.1.3	State ATS requirements for safe communications	1	Safety, reliability, availability, coverage, QoS, latency
1.1.4	State the aeronautical communication services	1	Mobile, fixed

Figure 1: Structure of tables

(b) Training objectives

Each training objective should be understood to contain three mandatory elements:

(1) Corpus, which is a description of the required performance. It always contains an action verb at the beginning of the sentence to ensure that the outcome is observable. The action verb is always associated with a defined taxonomy.

(2) Taxonomy Level, which is the numerical representation of the classification of the action verb.

(3) Content.

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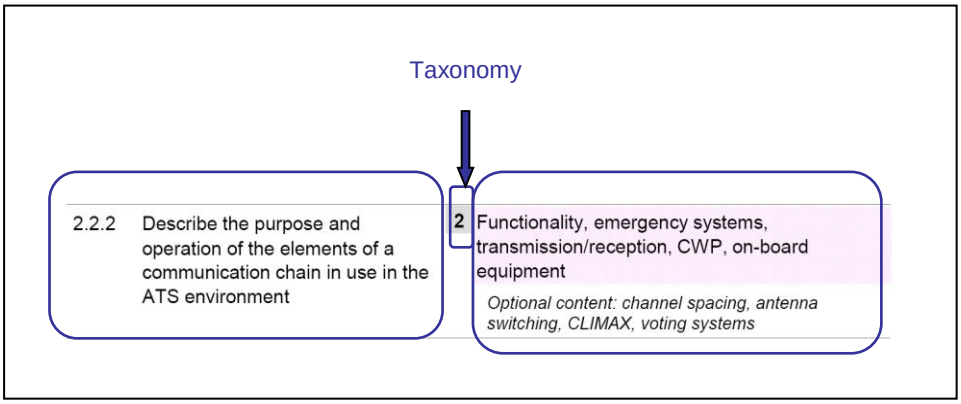

Figure 2: A training objective consists of corpus, taxonomy level and content.

(c) Corpus

Objectives relate to single activities, where possible.

A number of the objectives refer to 'generic equipment' within the corpus. In this context, generic equipment is considered a piece of equipment and/or didactic device which can be used to meet objectives. The equipment/device is not necessarily identical or similar to the operational equipment.

Note: Generic equipment gives flexibility to the course designer. In some instances, operating organisations may, as an alternative to the above, choose to conduct the training on equipment that is similar or identical to the operational equipment that will be used during system/equipment rating training.

1.1.2	Adjust a generic radio transmitter	4	Noise, intermodulation, harmonics, power, bandwidth

Figure 3: Example of an objective with generic equipment

The objective above may be achieved through the use of any type of radio transmitter.

(d) Taxonomy levels

The five taxonomy levels should be understood to have the following levels of complexity:

(1) Level 1 — Basic knowledge of the subject. It is the ability to remember essential points, to memorise data, and retrieve it.

(2) Level 2 — The ability to understand and to discuss the subject matter intelligently in order to represent and act upon certain objects and events.

(3) Level 3 — Thorough knowledge of the subject and the ability to apply it with accuracy. The ability to make use of the repertoire of knowledge to develop plans and activate them.

(4) Level 4 — The ability to establish a line of action within a unit of known applications following the correct chronology and the adequate method to resolve a problem situation. This involves the integration of known applications in a familiar situation.

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(5) Level 5 — The ability to analyse new situations in order to elaborate and apply one or another relevant strategy to solve a complex problem. The defining feature is that the situation is qualitatively different to those previous met, requiring judgement and evaluation of options.

(e) Content

The content illustrates and details performance.

It may be composed of two parts: implicit and explicit. The explicit content is what is written in the content field proper to the objective, while the implicit content is not written in the content field of each objective, but rather implied in the corpus of the objective and other elements (stream, subject, etc.).

When the items are in a list, each of them is to be addressed as a minimum.

Optional content items are italicised and clearly preceded with the words 'Optional content'. They help to illustrate the type of content that may be used to achieve given objectives.

Even when all of the items are optional, the objective has to be performed according to the action verb included.

Where content refers to other documents (e.g. ICAO Standards and Recommended Practices), users should take care to use the most recent version of the referenced document(s) or its parts.

(f) Additional note in content

(1) Contained within the content of some objectives that have been assigned, the action verb 'Appreciate' is an additional note that elaborates on the ultimate intentions of the objective. The additional note states: 'For achievement of competence, this objective shall be applied practically, at the latest, by the end of the S/E rating training.'

1.2.1	Identify the causes of a fault, based on test tool measurements	3	Additional: for achievement of competence, this objective should be applied practically, at the latest, by the end of the S/E rating training *e.g. data analyser, line analyser*

Figure C: Example of an objective with 'Appreciate + additional note'

(2) When the verb 'appreciate' is used with the additional note, the objective may, as a minimum, be taught as a theoretical objective during qualification training. This is permitted when using 'appreciate', i.e. learners should be able to understand a situation and know what is involved in a problem-solving situation, to state a plan without applying it. However, it is acknowledged that these objectives, without any practical application, are of extremely limited operational competence value. Therefore, these objectives should, at the latest, be achieved practically during system/equipment rating training.

(g) Common training objectives

An objective should be considered common to two or more qualification streams if the objective recurs verbatim and the context within which the objective is applied does not change.

Common objectives should be taught at least once when:

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(1) training for two or more qualification streams are combined to form one course; or

(2) a course is provided for the purpose of an ATSEP acquiring an additional qualification stream.

(h) Action verbs

The tables below list action verbs and their associated taxonomy levels that are used in training objectives.

Definition of verbs — Level 1

Verb	Definition	Example
Define	State what it is and what its limits are; state the definition.	Define airborne safety nets.
Draw	Produce a picture, pattern, or diagram.	Draw the MLAT system architecture.
List	Say one after the other.	List the most common weather messages.
Name	Give the name of objects or procedures.	Name a range of air-ground aviation-related network concepts.
Recognise	Know what it is, because you have seen it before.	Recognise surveillance information on a display.
State	Say or write in a formal or definite way.	State the function of a network management system.

Definition of verbs — Level 2

Verb	Definition	Example
Characterise	Describe the quality of features in something.	Characterise navigation methods.
Consider	Think carefully about it.	Consider the benefits of Critical Incident Stress Management (CISM).
Demonstrate	Describe and explain. Logically or mathematically, prove the truth of the statement.	Demonstrate the use of middleware in an ATM environment.
Describe	Say what it is like or what happened.	Describe the elements of Global Navigation Satellite System (GNSS) in Europe.
Differentiate	Show the difference between things.	Differentiate conventional navigation from area navigation.
Explain	Give details about something or describe so that it can be understood.	Explain the function of FDP.

Take account of	Take into consideration before deciding.	Take account of hardware/software compatibility.

Definition of verbs — Level 3

Verb	Definition	Example
Apply	Use something in a situation or activity.	Apply the principles of layers.
Appreciate	Understand a situation and know what is involved in a problem-solving situation, to state a plan without applying it.	Appreciate how to troubleshoot a network.
Calculate	Discover from information you already have by arithmetic; to think about a possible cause of action in order to form an opinion or decide what to do.	Calculate parameters of a line.
Check	Make sure the information is correct (satisfactory).	Check the conformity of a system to ITU and national regulation.
Decode	Turn into ordinary writing, decipher.	Decode a typical OLDI message.
Estimate	Form an approximate judgement of a number, form an opinion.	Estimate the impact of security and integrity failure to the operational service.
Identify	Associate oneself inseparably with, establish the identity.	Identify the major elements of the ADS-C system.
Operate	Conduct work on equipment.	Operate measuring equipment.
Perform	Carry into effect, go through, execute.	Perform measurements with generic radio test equipment.
Use	Employ for a purpose, handle as instrument, put into operation.	Use appropriate vocabulary to communicate effectively on technical matters.

Definition of verbs — Level 4

Verb	Definition	Example
Adjust	Change to a new position, value or setting.	Adjust a generic radio receiver.
Analyse	Examine minutely the constitution of.	Analyse the block diagram of a generic radio receiver.
Justify	Show the rightness of a choice or of an option.	Justify the occasions when it is necessary to downgrade an ILS facility performance category.

Relate	Establish link with.	Relate VOR station design to operational requirement.

Definition of verbs — Level 5

Verb	Definition	Example
Interpret	Decide on the meaning or significance of something when there is a choice.	Interpret ILS facility performance categories.

(i) Acronyms

The following abbreviations are applied within the tables:

AAIM	Aircraft Autonomous Integrity Monitoring
ABAS	Aircraft-Based Augmentation System
ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
ACC	Area Control Centre
A/D	Analogue/Digital
ADEX-P	ATS Data Exchange Presentation
ADS	Automatic Dependent Surveillance
ADS B	ADS — Broadcast
ADS C	ADS — Contract
ADF	Automatic Direction Finder
AFDX	Avionics Full-duplex Ethernet Switch
AFTN	Aeronautical Fixed Telecommunications Network
AGC	Automatic Gain Control
AIC	Aeronautical Information Circular
AIDC	ATS Interfacility Data Communications
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AIS	Aeronautical Information Services
ALARP	As Low As Reasonably Practicable
AMAN	Arrival Manager
AMHS	Aeronautical Message Handling System
AMSS	Automatic Message Switching System
ANS	Air Navigation Services
ANSP	ANS Provider
APV	Approach Procedure with Vertical guidance

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APW	Area Proximity Warning
ARINC	Aeronautical Radio Incorporated
ARTAS	ATC Radar Tracker and Server
ASAS	Airborne Separation Assistance/Assurance System
ASM	Airspace Management
ASMGCS	Advanced SMGCS
ASTERIX	All purpose Structured EUROCONTROL Radar Information Exchange
ATC	Air Traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSEP	Air Traffic Safety Electronics Personnel
AUGUR	EUROCONTROL RAIM Prediction Tool
BATAP	'Type-B' Application-to-Application Protocol
BDS	Binary Data Store
BER	Bit Error Rate
BITE	Built-In Test Equipment
B-RNAV	Basic-RNAV
CAA	Civil Aviation Authority
CB	Cumulonimbus
CBT	Computer-Based Training
CDM	Collaborative Decision-Making
CDTI	Cockpit Display of Traffic Information
CFMU	Central Flow Management Unit
CIDIN	Common ICAO Data Interchange Network
CISM	Critical Incident Stress Management
CIV	Civil
CLAM	Cleared flight Level Adherence Monitoring
CLIMAX	Multi-station carrier offset mode, with voting override
CMS	Control and Monitoring System
CNS/ATM	Communication Navigation and Surveillance/Air Traffic Management
CORA	Conflict Resolution Advisory
CORBA	Common Object Request Broker Architecture

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COTS	Commercial off-the-Shelf
CPDLC	Controller-Pilot Data Link Communications
CRT	Cathode Ray Tube
CSU	Control Sector Unit
CTR	Control Zone
CVOR	Conventional VOR
CWP	Controller Work Position
DCL	Departure Clearance
DDF	Doppler DF
DDM	Difference of Depth of Modulation
DF	Direction Finding
DLIC	Data Link Initiation Capability
DMAN	Departure Manager
DME	Distance Measuring Equipment
DME/N	DME/Normal
DME/P	DME/Precision
DPSK	Differential Phase Shift Keying
DTMF	Dual Tone Modulation-Frequency
DVOR	Doppler VOR
EAD	European Aeronautical Database
EAN	European ANSP Network
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
EFQM	European Foundation for Quality Management
EGNOS	European Geostationary Navigation Overlay Service
EGPWS	Enhanced Ground Proximity Warning System
EHS	Enhanced Mode S
EHT	Extremely High Tension
EJB	Enterprise Java Bean
ELS	Elementary Mode S
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ETFMS	Enhanced Tactical FMS
EU	European Union
EUROCAE	European Civil Aviation Electronics

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EUROCONTROL	European Organisation for the Safety of Air Navigation
FAA	Federal Aviation Administration (US)
FANS	Future Air Navigation Systems
FDP	Flight Data Processing
FDPS	FDP System
FFM	Far Field Monitor
FHA	Functional Hazard Assessment
FIR	Flight Information Region
FMS	Flight Management System
FMTP	Flight Plan Messaging Transport Protocol
FoM	Figures of Merit
FPL	(Filed) Flight Plan
FRUIT	False Reply Unsynchronised in Time
FUA	Flexible Use of Airspace
GALILEO	Satellite radio navigation system
GBAS	Ground-Based Augmentation System
GLONASS	GLObal'naya NAvigatsionnaya Sputnikovaya Sistema (Global Navigation Satellite System)
GNSS	Global Navigation Satellite System
GP	Glide Path
GPS	Global Positioning System
GRAS	Ground-based Regional Augmentation System
GSA	GNSS Supervisory Authority
GTC	Gain/Time Control
HF	High Frequency
HFDL	High Frequency Data Link
HMI	Human-Machine Interface
HPA	High Power Amplifier
HSI	Horizontal Situation Indication
HV	High Voltage
HW	Hardware
Hz	Hertz
ICAO	International Civil Aviation Organization
IDF	Interferometric DF
IF	Intermediate Frequency
IFF	Identification Friend/Foe

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IFPS	(Integrated) Initial Flight Plan Processing System
ILS	Instrument Landing System
INS	Inertial Navigation System
I/O	Input/Output
IP	Internet Protocol
IRS	Inertial Reference System
IRVR	Instrument Runway Visual Range
I/Q	In phase and Quadrature
ISDN	Integrated Services Digital Network
ISLS	Interrogator Side Lobe Suppression
IISLS	Improved Interrogator Side Lobe Suppression
iTEC	Interoperability Through European Collaboration
ITU	International Telecommunication Union
ISO	International Standards Organisation
LAM	Local Area Multilateration
LAN	Local Area Network
LAPB	Link Access Protocol, Balanced
LCD	Liquid-Crystal Display
LLZ	Localiser
LNA	Low Noise Amplifier
LVP	Low Visibility Procedures
MDS	Minimum Detectable Signal
MET	Meteorology
METAR	Meteorological Actual Report
MFC	Multi-Frequency Coding
MHz	Megahertz
MIL	Military
MLAT	Multilateration
MLS	Microwave Landing System
MOTNE	Meteorological Operational Telecommunications Network Europe
MRP	Multi-radar Processing
MRT	Multi-radar Tracker
MSAW	Minimum Safe Altitude Warning
MSSR	Mono-pulse SSR
MTBF	Mean Time Between Failure

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MTCD	Medium-Term Conflict Detection
MTD	Moving Target Detection
NAVAID	Navigation(al) Aid
ND	Navigation Display
NEAN	North European ADS-B Network
NDB	Non-Directional Beacon
NOP	Network Operations Plan
NOTAM	Notice to Airmen
NPA	Non-Precision Approach
NRA	Non-Radar Area
NSA	National Supervisory Authority
OJTI	On-The-Job Training Instructor
OLDI	On-Line Data Interchange
OS	Operating System
OSI	Open System Interconnection
OST	On-site Training
OTM	Object Transaction Monitor
PA	Precision Approach
PABX	Private Automatic Branch Exchange
PBN	Performance-Based Navigation
PCM	Pulse Code Modulation
PD	Probability of Detection
PENS	Pan-European Fixed Network Services
PFD	Primary Flight Display
PPI	Plan Position Indicator
PRF	Pulse Repetition Frequency
P-RNAV	Precision RNAV
PSD	Phase Sensitive Detector
PSSA	Preliminary System Safety Assessment
PSR	Primary Surveillance Radar
PTT	Post, Telephone and Telegraph (generic term to identify the provider)
QoS	Quality of Service
QNH	Q-code for atmospheric pressure at sea level
Qsig	Quality of signal
RAIM	Receiver Autonomous Integrity Monitoring

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RAPNET	(European) Regional Aeronautical Packet switched Network (CBN + DAKOS)
RAPS	Recording, Analysis, Playback and Simulation system for radar data (COMSOFT)
RDP	Radar Data Processing
RCA	Remote Client Application
RF	Radio Frequency
RMI	Relative Magnetic Indicator
RNAV	Area Navigation
RNP	Required Navigation Performance
RPL	Repetitive Flight Plan
RSLS	Receiver Sidelobe Suppression
R/T	Radiotelephony
RTCA	Radio Technical Commission for Aeronautics
RUP	Rational Unified Process
RVR	Runway Visual Range
RX	Receiver
SAR	Specific Energy Absorption Rate
SARPS	Standards And Recommended Practices
SASS	Surveillance Analysis Support System
SASS-C	SASS-Centre
SASS-S	SASS-Sensor
SATCOM	Satellite Communications
SBAS	Space/Satellite-Based Augmentation System
SCAS	Surveillance Coverage Analysis Suite
SCAT-1	Special Category 1
SDM	Sum of Depth of Modulation
SDP	Surveillance Data Processing
S/E	System/Equipment
SELCAL	Selective Calling
SESAR	Single European Sky AM Research
SID	Standard Instrument Departure
SITA	Société Internationale de Télécommunications Aéronautiques (France)
SMC	System Monitoring and Control
SMR	Surface Movement Radar
SMS	Safety Management System
S/N	Signal/Noise

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SNOWTAM	NOTAM on Snow conditions
SNMP	Simple Network Management Protocol
SPI	Special Pulse Identification *or* Special Position Identification Pulse (SSR)
SRC	Safety Regulation Commission *(*EUROCONTROL*)*
SSA	System Safety Assessment
SSR	Secondary Surveillance Radar
STC	Sensitivity Time Control
STCA	Short-Term Conflict Alert
SV	Supervisor
SW	Software
SWALs	Software Assurance Levels
SWIM	System Wide Information Management
SWR	Standing Wave Ratio
TACAN	UHF Tactical Air Navigation aid
TAF	Terminal Area Forecast
TCAS	Transponder Collision Avoidance System
TCP	Transmission Control Protocol
TDOA	Time Difference on Arrival
TFT	Thin Film Transistor
TIS	Traffic Information Service
TMA	Terminal Area
TRM	Team Resource Management
TX	Transmitter
UAT	Universal Access Transceiver
UBSS	UNIX Basic System Software
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
UTA	Upper (Traffic) Control Area
VCS	Voice Communications System
VDF	VHF DF Station
VDL	VHF Digital/Data Link
VESDA	Very Early Smoke Detection Alarm
VHF	Very High Frequency
VOLMET	Routine Voice broadcasts for Meteorological Information
VOR	VHF Omnidirectional Radio Range

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VORTAC	VOR and TACAN combination
WAAS	Wide Area Augmentation System (US)
WAM	Wide Area Multilateration
WAN	Wide Area Network
WGS84	World Global System 84
X25	Packet Switched Data Network Protocol

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