

‘Secondary Level’ AMP Competence Descriptions and Related Criteria

The following guidelines relate to the AMP Competence Standards endorsed by EC-LXII in Geneva in June 2010.

Background

EC-LXI in June 2009 had requested the Commission for Aeronautical Meteorology to review and refine the competence requirements in Supplement No.1 to WMO-No.258 (through the ET-ET) and, in coordination with the EC Panel of Experts on Education and Training, submit to EC-LXII a set of ‘top level’ competencies for inclusion in WMO-No. 49, Volume I Technical Regulations.

CAeM-XIV in Hong Kong, China in February 2010 noted the review by the ET-ET (Barbados, Dec 2009) of a draft ‘secondary-level competence description document’ produced as one of the outcomes from the Aeronautical Meteorology Curriculum Development Workshop held in Alanya, Turkey, in October 2009. The session agreed that the aim of this document was to assist Members in mapping their national personnel assessment practices to the ‘top level’ Competence Standards approved by EC-LXII in June 2010.

The Commission suggested that work on the ‘secondary level document’ should be continued including further review at the 24th Session of the EC Panel of Experts on Education and Training in Boulder, USA in March 2010. Following a further period of review and discussion by correspondence, the ET-ET finalized this document in Kelowna, Canada in August 2010 for endorsement by the CAeM MG.

During the development of these descriptions, the ET/ET has worked closely with the Task Team on the Competency Assessment Toolkit set up at CAeM-XIV.

Implicit in the background knowledge and skills is the requirement that Aeronautical Meteorological Forecasters should have already successfully completed the Basic Instruction Package for Meteorologists (BIP-M) requirements, and as endorsed by the sixty-second session of WMO Executive Council (2010) and subject to approval by the Sixteenth WMO Congress, this requirement will become mandatory in December 2016. The BIP-M requirements will usually be satisfied through the successful completion of a bachelors degree in meteorology or a postgraduate programme of study in meteorology (preferably after acquiring a bachelors degree in a science, engineering or computational subject). In instances where this is not the case, educational institutions will have to demonstrate that their programme of study provides the characteristic learning outcomes associated with a bachelors degree course and that nationally agreed academic qualification levels have also been met.

Format of the Descriptions

The text is structured according to the following format:

Position title: Aeronautical Meteorological Forecaster (AMF) or Aeronautical Meteorological Observer (AMO)

Application conditions: (from WMO-No. 49, Volume I)

- A. *for the area and airspace of responsibility,*
- B. *in consideration of the impact of meteorological phenomena and parameters on aviation operations, and*
- C. *in compliance with aviation user requirements, international regulations, local procedures and priorities.*

Top-level competence standard (also from WMO-No. 49, Volume I)

- Competence descriptions for each standard
- Performance criteria for each standard

Background knowledge and skills
Regional variations.

The importance of the preamble to the top-level competence standards is emphasized. There will be considerable variation in the legitimate functions of aeronautical meteorological offices worldwide, and it is not possible to write a document that exactly matches every office's function. Therefore the performance criteria should be applied in a way that is consistent with these variations. For example, it is recognized that meteorological offices in the tropics will not have a responsibility to forecast blowing snow (Performance criterion 2.1). The conditions A, B and C provide for this.

There are plans for regionally coordinated Air Traffic Management projects such as NextGen in the USA and SESAR in Europe. This may soon be followed by similar tendencies in Asia for very dense airspace. Various developments are underway in aeronautical meteorological service delivery in support of the latest development in international civil aviation.

New concepts such as dedicated services for the wider Terminal Area, uplink of data with high refresh rate containing severe weather information such as weather radar- or satellite-based information are likely to complement, if not eventually replace the legacy, product-oriented services as currently prescribed in the ICAO Annex 3. This development will require a regular review of the required competencies of forecasters working either in a traditional Meteorological Watch Office or Aerodrome Meteorological Office, with more stringent criteria likely to be required for experts working at the regional advisory centers.

The role of forecasters will continue to change in response to evolving technology and user requirements and such a change in itself will also likely require high standards of competency and underlying knowledge. The guidelines presented in this document attempt to anticipate as far as possible imminent changes, but a review cycle of not more than 3-5 years as part of the overall Quality Management and Risk Management approach is strongly suggested.

Aeronautical Meteorological Forecaster

The descriptions apply

- A. for the area and airspace of responsibility,
- B. in consideration of the impact of meteorological phenomena and parameters on aviation operations, and
- C. in compliance with aviation user requirements, international regulations, local procedures and priorities.

1. ANALYSE AND MONITOR CONTINUOUSLY THE WEATHER SITUATION

Competence description

Observations and forecasts of weather parameters and significant weather phenomena are continuously monitored to determine the need for issuance, cancellation or amendment/update of forecasts and warnings according to documented thresholds and regulations.

Performance criteria

1. Analyse and diagnose¹ the weather situation as required in forecast and warning preparation.
2. Monitor weather parameters and evolving significant weather phenomena and validate current forecasts and warnings based on these parameters.
3. Appraise the need for amendments to forecasts and updates of warnings against documented criteria and thresholds.

¹ "Analysis" may be defined as answering the question "what is happening?", and "diagnosis" as answering "why is it happening?"

2. FORECAST AERONAUTICAL METEOROLOGICAL PHENOMENA AND PARAMETERS

Competence description

Forecasts of meteorological parameters and phenomena are prepared and issued in accordance with documented requirements, priorities and deadlines.

Performance criteria

1. Forecast the following weather phenomena and parameters:
 - temperature and humidity
 - wind including temporal and spatial variability (wind-shear, directional variability and gusts)
 - QNH
 - cloud (types, amounts, height of base and vertical extent)
 - precipitation (intensity and temporal variations, onset/cessation and/or duration, amount and types), and associated visibilities
 - fog or mist, including onset/cessation and/or duration, and associated reduced visibilities
 - other types of obscuration, including dust, smoke, haze, sand-storms, dust-storms, blowing snow, and associated visibilities
 - hazardous weather phenomena listed in Performance criterion 3.1
 - wake vortex advection and dissipation, as required.

2. Ensure that forecasts are prepared and issued in accordance with ICAO Annex 3, WMO-No.49, regional and national formats, codes and technical regulations on content, accuracy and timeliness.
3. Ensure that forecasts of weather parameters and phenomena are consistent (spatially and temporally) across boundaries of the area of responsibility as far as practicable, whilst maintaining meteorological integrity. This will include monitoring forecasts/warnings issued for other regions, and liaison with adjacent regions as required.

3. WARN OF HAZARDOUS PHENOMENA

Competence description

Warnings are issued in a timely manner when hazardous conditions are expected to occur or when parameters are expected to reach documented threshold values, and updated or cancelled according to documented warning criteria.

Performance criteria

1. Forecast the following hazardous weather phenomena, including spatial extent, onset/cessation, duration, and intensity and its temporal variations:
 - thunderstorms, particularly organized systems, including associated turbulence, in-flight icing, hail, heavy precipitation with poor visibility, electrical phenomena, down-burst/microburst or gust front, tornadic activity
 - turbulence (moderate or greater), including type (orographic, mechanical, convective and clear air turbulence).
 - moderate and severe low-level wind shear
 - aircraft icing (moderate or greater), including accumulation rate, spatial extent, type (rime or opaque, glaze or clear, freezing rain, hoar frost, mixed ice)
 - hazardous phenomena affecting aerodromes such as: strong surface winds including cross-winds and squalls, frost, freezing precipitation, snowfall, lightning, wake vortices
 - sand- and dust storms
 - volcanic ash based on observations and/or advisory products
 - tropical cyclones.
2. Ensure that warnings are prepared and issued in accordance with thresholds for hazardous weather, and with ICAO Annex 3, WMO-No.49, regional and national formats, codes and technical regulations on content, accuracy and timeliness.
3. Ensure that warnings of hazardous weather phenomena are consistent (spatially and temporally) across boundaries of the area of responsibility as far as practicable, whilst maintaining meteorological integrity. This will include monitoring forecasts/warnings issued for other regions, and liaison with adjacent regions as required.

4. ENSURE THE QUALITY OF METEOROLOGICAL INFORMATION AND SERVICES

Competence description

The quality of meteorological forecasts, warnings and related products is ensured at the required level by the application of documented quality management processes.

Performance criteria

1. Apply the organization's quality management system and procedures.
2. Assess the impact of known observational error characteristics (e.g. bias, achievable accuracy of observations and sensing methods) on forecasts and warnings.

3. Validate aeronautical meteorological data, products, forecasts and warnings (timeliness, completeness, accuracy), using real-time checks.
4. Monitor the functioning of operational systems and take remedial actions when necessary.

5. COMMUNICATE METEOROLOGICAL INFORMATION TO INTERNAL AND EXTERNAL USERS

Competence description

User requirements are fully understood and are addressed by communicating concise and complete forecasts/warnings in a manner that can be clearly understood by the users.

Performance criteria

1. Ensure that all forecasts/warnings are disseminated through the authorized communication means and channels to designated user groups.
2. Explain² aeronautical meteorological data and information, deliver weather briefings and provide consultation to meet specific user needs.

² Reference may be made to ICAO Annex 1 English language proficiency requirements when English is required to be used as a medium of communication.

Background knowledge and skills

The background knowledge and skills listed below underpin the performance criteria for AMFs.

- WMO meteorologist requirements of WMO-No.258.
- the generation mechanisms of low-level jet-streams, boundary layer turbulence and gusts, and their effects on aircraft
- the formation and dissipation, characteristics, occurrence and effects of fog and other forms of obscuration, and low-level cloud, and associated diagnostic and prognostic parameters
- mechanisms for generating different types of cloud and precipitation, and local enhancement mechanisms for cloud and precipitation
- volcanic ash cloud displacement and dispersion
- formation mechanisms and characteristics of other aeronautical meteorological phenomena, such as dust-storms, sand-storms, dust devils, waterspouts.
- the International Standard Atmosphere (ISA)
- meteorological hazards to aviation, including thunderstorms and associated phenomena, aircraft icing, turbulence, poor visibility, low-level cloud, tropical cyclones, wind shear and volcanic ash.
- local topography and its effects on weather, such as gap flows, downslope windstorms, orographic turbulence, sea breezes and upslope fog
- the topographic influence on cloud, precipitation, fog and reduced visibility in typical wind and moisture regimes
- areas of likely volcanic activity within the region of responsibility (for offices with responsibility for issuing volcanic ash advice and offices located close to volcanoes).
- interpretation of:
 - radar and satellite imagery to identify fog and stratus, gravity waves in cirrus cloud and jet streams, inference of icing potential in layer cloud, and of volcanic ash and wind-shear.

- numerical weather prediction guidance and other forms of objective guidance, and assimilate them into forecast/warning preparation
- observed parameters when variations result from differences between automatic sensor technologies and manual observing techniques.
- ability to interpret all observational products (e.g. METAR), and encode forecast products (e.g. TAF, SIGMET) into Traditional Alphanumeric Codes (TAC).
- airport climatologies, including occurrence of significant cloud, thunderstorms, precipitation, high winds, low-level windshear, reduced visibility, fog and, where applicable, volcanic ash
- local forecasting guides and techniques, including diagnostic and prognostic parameters, for forecasting significant cloud, thunderstorms, turbulence, aircraft icing, precipitation, high winds, low-level windshear, reduced visibility, fog and, where applicable, volcanic ash
- ability to carry out a routine, high quality self-briefing (which may include a shift hand-over briefing) of the recent and current weather situation, and integrate all available data to produce a consolidated diagnosis
- international, national and local aeronautical forecast/warning/monitoring procedures, directives and instructions
- local diagnostic and forecast tools and aeronautical forecast preparation systems, including basic operating system functions, data processing and visualization technologies
- ability to explain the meteorological and procedural reasons behind a forecast and warning decision.
- the likely impact of forecasts of meteorological parameters and phenomena on aviation operations.
- the significance of warning thresholds on aviation operations, and the ability to describe the likely impact of warnings of hazardous phenomena on these operations.
- applicable TAF verification system(s) and verification statistics.
- latest developments in aeronautical weather monitoring and observing technologies, and aeronautical forecasting techniques in use at the service provider.
- quality management systems
- aviation safety management systems, as required.
- standards (as defined in ICAO Annex 3, WMO-No.49) and Quality Management System procedures (as defined in ISO 9001 standards, national regulations):
 - procedures for checking and identifying errors and omissions
 - how to identify significant differences between factual and forecast data
 - when to ignore information and where to go to resolve points of contention
 - desirable accuracy of forecasts as stipulated in ICAO Annex 3, WMO-No.49 and national regulations
 - priorities and schedules
 - actions to be taken in the event of repeated cases of discrepancies, inconsistencies and malfunctions
 - fall-back procedures in the case of computer failure
 - contingency arrangements in case of emergencies such as fire, bomb alerts and natural disasters.
- relevant ICAO and WMO documents, including ICAO Annex 3, WMO-No.49, WMO-No.306, and ICAO Manual of Aeronautical Meteorological Practice (Doc8896). See Appendix for a list of relevant ICAO and WMO documents.
- ICAO, WMO and national aeronautical meteorological codes and forms of data representation.
- aviation user requirements, including:
 - the effects on aircraft performance of air density, humidity, icing, low-level wind-shear, turbulence and wind, and the meteorological factors related to fuel consumption
 - the requirements for enroute wind, temperature and significant weather forecasts and aerodrome forecasts for pre-flight planning and in-flight re-planning

- meteorological aspects of flight planning; definitions; procedures for meteorological services for international air navigation; types of meteorological information required for Air Traffic Services (ATS), aerodrome control towers, approach/area control, and flight information centers
- low visibility runway operating procedures
- effects of unfavourable meteorological conditions on aeronautical operations, including air traffic disruption, holding and diversions
- meteorological effects on aerodrome ground services, such as snow clearing, the effect of wet runways, and the effect of thunderstorms and strong winds on apron operations
- aerodrome operating minima, the need for alternates and impacts on fuel consumption
- altimeter setting procedures

- common terms relevant to aeronautical meteorology, including:
 - (Special) Visual and Instrument Flight Rules and Conditions
 - Flight Information Region (FIR) / Functional Airspace Block (FAB)
 - final approach, missed approach
 - cruising and transition level, transition layer, transition altitude, Flight Level
 - Minimum Safe Altitude, Indicated Altitude, True Altitude
 - Category II and III operations, Aeronautical Information Publication (AIP)
 - NOTAMs / ASHTAMs
 - ATIS / VOLMET

- the use and interpretation of products from the World Area Forecast System (WAFS); products provided by the Volcanic Ash Advisory Centers (VAACs), Tropical Cyclone Advisory Centers (TCACs) and other such centers.

- means of dissemination of aeronautical meteorological data and information
- local aeronautical meteorological telecommunications

Regional variations

Locally agreed and documented criteria and thresholds.

The range of weather phenomena.

Risk assessment and estimation of forecast uncertainties.

Types and use of forecast guidance.

Designated offices responsible for advice on volcanic ash, tropical cyclones and other phenomena.

Regional regulations.

Boundaries of forecast areas.

Extent, scope and exclusions of QMS implementation.

Communication language(s).

Communications technology for forecast and warning transmission, and for weather briefing.

Aeronautical Meteorological Observer

The descriptions apply

- A. for the area and airspace of responsibility,
- B. in consideration of the impact of meteorological phenomena and parameters on aviation operations, and
- C. in compliance with aviation user requirements, international regulations, local procedures and priorities,

1. MONITOR CONTINUOUSLY THE WEATHER SITUATION

Competence description

Weather parameters are appraised to identify the significant and evolving weather phenomena that are affecting or will likely affect the area of responsibility throughout the watch period.

Performance criteria

1. Analyse and describe the existing local weather conditions.

2. OBSERVE AND RECORD AERONAUTICAL METEOROLOGICAL PHENOMENA AND PARAMETERS

Competence description

Observations of weather parameters and phenomena, and their significant changes, are made according to documented thresholds and regulations.

Performance criteria

1. Perform and record routine and non-routine observations of the following:
 - surface wind direction and speed, including spatial and temporal variations
 - visibility for aeronautical purposes, including spatial and temporal variations
 - RVR, including spatial and temporal variations
 - significant weather phenomena (as defined in ICAO Annex 3)
 - cloud amount, height of base, and type, including spatial and temporal variations
 - vertical visibility
 - temperature and humidity
 - atmospheric pressure; determining QFE and QNH
 - supplementary information, wind shear and special weather phenomena.
2. Interpret automatic observed parameters to ensure that observations remain representative of local conditions when variations result from differences between automatic sensor technologies and manual observing techniques.
3. Ensure that observations are prepared and issued in accordance with ICAO Annex 3, WMO-No.49, regional and national formats, codes and technical regulations on content, representativeness and timeliness.

3. ENSURE THE QUALITY OF THE PERFORMANCE OF SYSTEMS AND OF METEOROLOGICAL INFORMATION

Competence description

The quality of meteorological observations is maintained at the required level by the application of documented quality management processes.

Performance criteria

1. Apply the organization's quality management system and procedures.
2. Check and confirm the quality of meteorological observations before issuance, including relevance of content, time of validity and location of phenomena.
3. In accordance with prescribed procedures:
 - identify errors and omissions in meteorological observations
 - correct and report errors and omissions
 - make and disseminate corrections in a timely manner.

4. COMMUNICATE METEOROLOGICAL INFORMATION TO INTERNAL AND EXTERNAL USERS

Competence description

All meteorological data and information are concise, complete and communicated in a manner that will be clearly understood by the users.

Performance criteria

1. Ensure that all observations are disseminated through the authorized communication means and channels to designated user groups.
2. Present² aeronautical meteorological data and information in a clear and concise manner using suitable terminology.
3. Alert forecasters to observed or imminent significant changes in the weather within the local area.

² Reference may be made to ICAO Annex 1 English language proficiency requirements when English is required to be used as a medium of communication.

Background knowledge and skills

The background knowledge and skills listed below underpin the performance criteria for AMOs.

- the key characteristics of the troposphere and tropopause
 - properties of air pressure, temperature, density and water vapour
 - atmospheric stability, inversions
 - the generation mechanisms of wind
 - fog and cloud formation and dissipation
 - precipitation types and intensities
 - the general circulation of the Earth's atmosphere.
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- the International Standard Atmosphere (ISA)
 - the characteristics, occurrence and effects of meteorological hazards to aviation, including low-level cloud ceiling, poor visibility, thunderstorms and associated phenomena, aircraft icing, freezing precipitation, turbulence, tropical cyclones, wind shear and volcanic ash.

- interpretation of surface weather maps, satellite and radar imagery
- region-specific weather phenomena, and likely weather sequences that are expected to affect the station
- local topography and climatology.
- procedures for performing routine and non-routine aeronautical meteorological observations and reports
- impacts of weather on aircraft and airport operations
- strengths and weaknesses of manual observations and automatic observing systems.
- observer directives, procedures and instructions
- operationally validated sources of weather information
- quality management systems
- aviation safety management systems, as required.
- standards (as defined in ICAO Annex 3, WMO-No.49) and Quality Management System procedures (as defined in ISO 9001 standards, national regulations):
 - procedures for checking and identifying errors and omissions (in automatically and manually derived data)
 - how to identify significant differences between observational and forecast data
 - when to ignore information and where to go to resolve points of contention
 - desirable accuracies of measurement and observation as in ICAO Annex 3, WMO-No.49 and national regulations
 - priority tasks and time constraints
 - actions to be taken in the event of repeated cases of discrepancies, inconsistencies and malfunctions
 - fall-back procedures in the case of computer failure
 - contingency arrangements in case of emergencies such as fire, bomb alerts and natural disasters.
- relevant ICAO and WMO documents, including ICAO Annex 3, WMO-No.49, WMO-No.306, ICAO Manual of Aeronautical Meteorological Practice (Doc8896), and ICAO Manual on Automatic Meteorological Observing Systems at Aerodromes (Doc9837). See Appendix for a list of relevant ICAO and WMO documents.
- ICAO definitions of relevance to meteorology
- WMO Traditional Alphanumeric Codes (TAC) and national aeronautical meteorological codes and forms of data representation.
- how weather information is disseminated at the aerodrome
- local aeronautical meteorological telecommunications
- local Air Traffic Services meteorological requirements
- local flight planning meteorological requirements.

Regional variations

The range of significant weather phenomena.
 Extent of automation of observing and sensing systems.
 Thresholds for significant weather changes.
 Local climatology.
 Extent, scope and exclusions of QMS implementation.
 Regional regulations.
 Communication language(s).
 Available communication technologies.

APPENDIX

REFERENCES : ICAO and WMO Documents

ICAO Annex 1:	Personnel Licensing
ICAO Annex 3:	Meteorological Service for International Air Navigation
ICAO Annex 6:	Operation of Aircraft, Part I – International Commercial Air Transport – Aeroplanes Chapter 4.4.1
ICAO Annex 15:	Aeronautical Information Services
ICAO Doc 4444:	Procedures for Air Navigation Services – Air Traffic Management
ICAO Doc 7030:	Regional Supplementary Procedures
ICAO Doc 7192:	Part F-1 Meteorology for Air Traffic Controllers and Pilots; Training Manual;
ICAO Doc 7488/3:	Manual of the ICAO standard atmosphere
ICAO Doc 7910:	Location Indicators
ICAO Doc 8400:	Procedures for Air Navigation Services – ICAO Abbreviations and Codes
ICAO Doc 8896:	Manual of Aeronautical Meteorological Practice
ICAO Doc 9328:	Manual of Runway Visual Range Observing and Reporting Practice
ICAO Doc 9365:	Manual of All-Weather Operations
ICAO Doc 9377:	Manual on Co-ordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services
ICAO Doc 9691:	Manual on volcanic ash, radioactive material and toxic chemical clouds
ICAO Doc 9766:	Handbook on the International Airways Volcano Watch – Operational Procedures and Contact List
ICAO Doc 9817:	Manual on Low-level Wind Shear
ICAO Doc 9837:	Manual on Automatic Meteorological Observing Systems at Aerodromes
ICAO Doc 9855:	Guidelines on the use of a public Internet for aeronautical applications
ICAO Misc.:	Relevant Air Navigation Plans (ANPs and FASID)
WMO-No. 8:	Guide to meteorological instruments and methods of observation
WMO-No. 9:	Weather reporting, Vol. A – Observing stations
WMO-No. 49:	Technical Regulations; Volume I – General Meteorological Standards and Recommended Practices; Chapter B.4 – Education and training
WMO-No. 49:	Technical Regulations Volume II – Meteorological Service for International Air Navigation; C.3.1 – International standards and recommended practices
WMO-No. 258:	Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology, Vol. I – Meteorology
WMO/TD-No. 1101:	Initial Formation and Specialization of Meteorological Personnel – Syllabus Examples
WMO/TD-No. 1390:	Aviation Hazards
WMO-No. 306:	Manual on Codes – International codes, Part A – Alphanumeric codes, Part B – Binary codes
WMO-No. 731:	Guide on meteorological observation and information distribution systems at aerodromes
WMO-No. 732:	Guide to practices for meteorological offices serving aviation
WMO-No. 782:	Aerodrome reports and forecasts: A user's handbook to the codes.
WMO-No. 904:	Guide to Aeronautical Meteorological Services Cost Recovery.
WMO-No. 1001:	Guide on the Quality Management System for the Provision of Meteorological Service to International Air Navigation