

Implementation Guidance of Aeronautical Meteorological Forecaster Competency Standards

The following guidance is supplementary to the AMP competency Standards endorsed by Cg-16 in Geneva in May 2011. Implicit in the background knowledge and skills for AMF is the requirement that they should, in taking into account the AMF Competency Standard 'conditions A to C', have successfully completed the BIP-M and that this requirement will become mandatory from 1 December 2016. It should however be recognized that national personnel qualification requirements for AMF can be set at a higher level, e.g. a national requirement for an AMF to also be degree qualified. Please also note that the information contained in this guidance material replaces that which previously existed in the publication, 'Supplement No.1 to WMO-No.258.'

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 competency Standard (also from WMO-No. 49, Volume I)

- Competency descriptions for each standard
- Performance criteria for each standard

Background knowledge and skills
Regional variations.

The importance of the preamble to the top-level competency 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 centres.

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.

1. ANALYSE AND MONITOR CONTINUOUSLY THE WEATHER SITUATION

Competency 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

Competency 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*

Competency 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*

Competency 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

Competency 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 for the AMF competencies

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

- Taking into account of the AMF competency Standards conditions A to C, the BIP-M requirements as described in the next revision of WMO-No 49 Volume I. These can currently be found in the Cg-16 PINK06-2_ETR_en_2.doc at <ftp://ftp.wmo.int/Documents/SESSIONS/Cg-XVI/English/Approved%26Corrected/>.
- 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
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- 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 Centres (VAACs), Tropical Cyclone Advisory Centres (TCACs) and other such centres
- 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.