International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Eleventh Meeting of the GREPECAS Aeronautical Meteorology Subgroup (AERMETSG/11)
Lima, Peru, 28 to 30 November 2011

Agenda Item 5: Implementation of MET Quality System in the CAR/SAM Regions

QUALIFICATIONS AND TRAINING OF METEOROLOGICAL PERSONNEL PROVIDING SERVICE FOR INTERNATIONAL AIR NAVIGATION

(Presented by the Secretariat)

SUMMARY

This working paper presents information on the qualification and training of meteorological personnel providing service for international air navigation.

References

- Annex 3 – *Meteorological service for international air navigation*, Seventeenth edition, July 2010.
- *Working arrangements between the International Civil Aviation Organization (ICAO) and the World Meteorological Organization (WMO)* Doc 7475/2, Second edition, January 1963[GB1]and
- Letter to WMO Members and to ICAO Contracting States, WDS/AN/COMP, dated 2 September 2011.

ICAO Strategic Objectives:	*A – Safety* *C - Environmental Protection and Sustainable Development of Air Transport*

1. Introduction

1.1 In accordance with the general provisions of Annex 3 (Chapter 2), the objective of meteorological services for international air navigation shall be to contribute towards the safety, regularity and efficiency of international air navigation by supplying operators, flight crew members, air traffic services units, search and rescue services units, airport managements and others concerned with the conduct or development of international air navigation, with the meteorological information necessary for the performance of their respective functions.

1.2 As per Annex 3, 2.1.5, each Contracting State shall ensure that the designated meteorological authority complies with the requirements of the World Meteorological Organization (WMO) in respect of qualifications and training of meteorological personnel providing service for international air navigation, which are presented in WMO Publication No. 49, Technical Regulations,

Volume I — General Meteorological Standards and Recommended Practices, Chapter B.4 — Education and Training.

2. **Discussion**

2.1 The Sixteenth World Meteorological Congress (May 2011) approved the inclusion, in the WMO Technical Regulations (WMO Publication No. 49), Volume I, of Standards regarding competency for aeronautical meteorological personnel and learning foreseen in the meteorologists basic instruction package (meteorology) (BIP-M), and in the basic instruction package for meteorology technicians (BIP-TM), which were prepared and subsequently supported by the WMO Commission for Aeronautical Meteorology (CAeM), in response to the requirement established in Annex 3, 2.1.5 of the ICAO Convention on International Civil Aviation.

2.2 In this regard, MET service providers providing service to international air navigation must demonstrate that:

a) by 1 December 2013, their aeronautical meteorological personnel comply with the competency standards prescribed in WMO No. 49; and

b) by 1 December 2016, their aeronautical meteorological forecasters satisfy qualifications requirements of the BIP-M.

2.3 The **Appendix** to this working paper presents the WMO Aeronautical Meteorological Personnel Competency Standards (Annex I), the Implementation Guidance of Aeronautical Meteorological Forecaster Competency Standards (Annex II), and the Implementation Guidance of Aeronautical Meteorological Observer Standards (Annex III), as well as a list of frequently asked questions on the application of aeronautical meteorological personnel competency standards (Annex IV) prepared by the WMO.

2.4 In addition, the WMO CAeM has prepared guidance on the best practices to assist MET service providers in the assessment of aeronautical meteorology personnel competency. This material, among many other resources, can be found at the CAeM's professional education and training website: http://www.caem.wmo.int/moodle within the "Regulatory and Reference Material" section. To access this material, users should login as a guest using the following password: ("Login as a guest")

2.5 Adherence to the competency requirements prescribed by WMO is an integral part of a quality management system and, consequently, should be duly documented and registered. As the AERMETSG will appreciate, quality management of meteorological information supplied to aeronautical users becomes an ICAO Standard under Annex 3 provisions as of 15 November 2012.

2.6 The WMO Secretariat, with the assistance of its Members Countries, has conducted a series of short courses on the application of best practices for the assessment of competency in several ICAO Regions, and is available to answer questions on this important issue.

2.7 In view of the foregoing, and an identified urgency for States to ensure compliance with the WMO qualification and training requirements, the Meeting is invited to formulate the following draft conclusion:

DRAFT
CONCLUSION 11/XX **QUALIFICATION AND TRAINING REQUIREMENTS OF METEOROLOGICAL PERSONNEL PROVIDING SERVICE TO INTERNATIONAL AIR NAVIGATION**

That, States in the CAR/SAM Region be urged, as a matter of urgency, to ensure that the designated meteorological authority complies, if not already done so, with the requirements of the World Meteorological Organization (WMO) in respect of qualification and training of meteorological personnel providing service for international air navigation.

Note 1.— The requirements concerning qualification and training of meteorological personnel in aeronautical meteorology are given in WMO Publication No. 49, Technical Regulations, Volume I — General Meteorological Standards and Recommended Practices, *Chapter B.4* — Education and Training.

Note 2.— Enhanced WMO qualification and training requirements (including competency standards) become applicable in WMO Publication No. 49 as of 1 December 2013 and 1 December 2016.

3. **Action by the Meeting**

3.1 The Meeting is invited to:

a) take note of the information presented in this working paper and its Appendix;

b) consider the approval of the draft conclusion of paragraph 2.7; and

c) consider other actions as required.

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APPENDIX

AERONAUTICAL METEOROLOGICAL PERSONNEL

COMPETENCY STANDARDS

WORLD METEOROLOGICAL ORGANIZATION

WDS/AN/COMP, ANNEX I

WMO Cg-XVI (2011) approved Aeronautical Meteorological Personnel Competency Standards

Aeronautical Meteorological Forecaster

An **Aeronautical Meteorological Forecaster,**

A. For the area and airspace of responsibility;

B. In consideration of the impact of meteorological phenomena and parameters on aviation operations;

C. In compliance with aviation user requirements, international regulations, local procedures and priorities.

Should[1], in taking into account conditions A to C, have successfully completed the BIP-M[2] and should[3] be able to:

1. Analyse and monitor continuously the weather situation;

2. Forecast aeronautical meteorological phenomena and parameters;

3. Warn of hazardous phenomena;

4. Ensure the quality of meteorological information and services;

5. Communicate meteorological information to internal and external users.

Aeronautical Meteorological Observer

An **Aeronautical Meteorological Observer,**

A. For the area and airspace of responsibility;

B. In consideration of the impact of meteorological phenomena and parameters on aviation operations;

C. In compliance with aviation user requirements, international regulations, local procedures and priorities.

Should[3], in taking into account conditions A to C be able to:

1. Monitor continuously the weather situation;

2. Observe and record aeronautical meteorological phenomena and parameters;

3. Ensure the quality of the performance of systems and of meteorological information;

4. Communicate meteorological information to internal and external users.

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1 'Should' to become 'shall' in a November 2016 amendment of WMO-No. 49 Volume I;
2 As defined in the revised WMO-No. 49 Volume I;
3 'Should' to become 'shall' in a November 2013 amendment of WMO-No. 49 Volume I.

Implementation Guidance of Aeronautical Meteorological Forecaster Competency Standards

The following guidance is supplementary to the AMP competency Standards endorsed by Cg-XVI 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)

- 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 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 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.

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 diagnose[1] 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.

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.

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

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. Explain[2] aeronautical meteorological data and information, deliver weather briefings and provide consultation to meet specific user needs.

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;
- Latest developments in aeronautical weather monitoring and observing technologies, and aeronautical forecasting techniques in use at the service provider;

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[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.

- 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.

WDS/AN/COMP, ANNEX III

Implementation Guidance of Aeronautical Meteorological Observer Competency Standards

Format of the Descriptions

The text is structured according to the following format:

Position title: 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)

- 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 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 observe blowing snow (Performance criterion 2.1). The conditions A, B and C provide for this.

The role of observers will continue to change in response to evolving technology and user requirements. 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. MONITOR CONTINUOUSLY THE WEATHER SITUATION

Competency 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

Competency 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*

Competency 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*

Competency 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. Present* 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.

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* 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 AMO competencies

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;
- 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.

Frequently Asked Questions

1. *What are competencies and who specifies the competencies required for a specific job?*

Jobs are usually specified in terms of a job description that lists the tasks and responsibilities of the position. The associated competencies (or "competence standards") specify the knowledge, skills and behaviours required to perform that particular job. For example, an Aeronautical Meteorological Observer (AMO) must be able to observe and record aeronautical meteorological phenomena and parameters.

2. *What will be the role of Permanent Representatives in setting academic qualifications?*

One of the outcomes of the Sixteenth WMO Congress is that it is now up to each WMO Member to make its own decision about what classification(s) of staff supply meteorological services to international civil aviation. Permanent Representatives are expected to take the lead in consulting with the appropriate national and regional bodies to define the academic qualifications required by Aeronautical Meteorological Forecasters (AMFs) noting the basic requirement is for the successful completion of the BIP-M taking into account of the AMF competency Standards conditions A to C (see answer to question 8 below). Some Members may wish to impose a higher level than this e.g. Meteorologist, but this is a decision to be taken at the organisational and/or national level.

3. *Who can certify that personnel are competent?*

It is up to each aviation meteorological service provider, based on their national regulations and organizational procedures, to determine who can certify that personnel are competent. It is important that the processes employed are fully integrated into an organization's QMS and personnel development strategy, are carefully documented, and that there is clear evidence that the process is ongoing. For any personnel unable to demonstrate that they satisfy the competencies, remedial action such as coaching, mentoring or further training must be taken.

Experienced personnel should be selected and then trained to assess competence. The Competency Assessment Toolkit (CAT) developed by the CAeM Task Team (TT-CAT) will help with this task.

4. *What records must be kept to show that personnel have the required competencies and qualifications?*

When evidence of compliance with the competence Standards is requested of an aviation meteorological service provider, the provider will be expected to be able to demonstrate that competence Standards have been adapted to local and national circumstances and that all personnel:

(i) Satisfy the relevant requirements of the competency Standards;

(ii) For AMFs, have also successfully completed the requirements of the BIP-M taking into account of the AMF competency Standards conditions A to C (see answer to question 8 below), in compliance with national/regional academic qualification requirements. Members who have already been audited have advised that the process is thorough. The audit teams have wanted to see comprehensive documentation and have asked in-depth questions about the Members' processes and procedures.

5. What will happen if an aviation meteorological service provider is unable to demonstrate by 1 Dec 2013 that their personnel are able to satisfy the competency Standards?

A non-compliance issue should be raised against the associated ICAO requirement (i.e. ICAO Annex 3 Paragraph 2.1.5).

6. How frequently must the competencies of personnel be tested?

The standards do not specify how frequently the competency of personnel should be assessed. This frequency should be determined by review processes of the QMS and other factors such *as* staff recruitment, changes in operating systems, products and services and by the results of earlier competency assessments.

7. Is funding available to develop the competencies?

Members should not expect WMO to provide funding assistance. Aviation meteorological service providers should endeavour to negotiate with the users and authorities concerned an agreeable part of the aviation-specific education and training cost. There are no WMO Regular Budget funds allocated to assist Members with these actions although, through the CAeM TT-CAT and the Expert Team on Education and Training, guidance resources are being made available, together with workshops funded from extra-budgetary resources.

8. What steps should be taken now to ensure that personnel providing meteorological services for international air navigation have the required competencies and qualifications?

a) By 1 Dec 2013

- Adapt the competency Standards to local circumstances using the guidance material available on the CAeM Education and Training website at http://www.caem.wmo.int/moodle/ (all personnel may be at the same level or there may be different competency Standards for different positions and jobs);
- Undertake and document the personnel competency assessments;
- Integrate competency assessment procedures into QMS processes and then review and update in line with QMS principles;
- Provide the appropriate type of upgrade or refresher training for any personnel who are unable to demonstrate evidence of competency in one or more of the competency Standards and reassess as necessary.

b) By 1 Dec 2016

Ensure that all their **Aeronautical Meteorological Forecasters**,

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,

Shall, in taking into account conditions A to C have successfully completed the BIP-M.
