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| WEATHER CLIMATE WATER | **World Meteorological Organization****WORLD METEOROLOGICAL CONGRESS****Nineteenth Session**22 May to 2 June 2023, Geneva | **Cg-19/Doc. 4.1(2)** |
| Submitted by: President of theServices Commission3.IV.2023**DRAFT 1** |

**AGENDA ITEM 4: TECHNICAL STRATEGIES SUPPORTING LONG-TERM GOALS**

**AGENDA ITEM 4.1: Services for societal needs**

# PROPOSED AMENDMENT TO the TECHNICAL REGULATIONS (wmo‑nO. 49), VOLUME I, AND update to THE COMPENDIUM OF WMO COMPETENCY FRAMEWORKS (wmo-nO. 1209) ADDRESSING AERONAUTICAL METEOROLOGICAL PERSONNEL QUALIFICATION and COMPETENCY

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| **Summary** |
| **Document presented by:** President of the Services Commission.**Strategic objective 2020–2023:** 1.4.5.**Financial and administrative implications:** Minimal financial and administrative implications and within the parameters of the Strategic and Operational Plans 2020–2023.**Key implementers:** WMO Members with responsibility to provide aeronautical meteorological services will benefit from the amendment to the WMO Technical Regulations and update to WMO guidance material.**Time frame:** 2024.**Action expected:** To adopt the amendment to the WMO Technical Regulations and update to WMO guidance material. |

# GENERAL CONSIDERATIONS

### Proposed amendment to the [*Technical Regulations, Volume I: General Meteorological Standards and Recommended Practices*](https://library.wmo.int/index.php?lvl=notice_display&id=14073)(WMO-No. 49) and update to the [*Compendium of WMO Competency Frameworks*](https://library.wmo.int/index.php?lvl=notice_display&id=21607) (WMO-No. 1209) addressing aeronautical meteorological personnel qualification and competency

1. The Services Commission (SERCOM) Standing Committee on Services for Aviation (SC-AVI), with assistance from its Expert Team on Education, Training and Competency (ET-ETC), has determined that the existing aeronautical meteorological personnel (AMP) qualification and competency requirements defined in [*Technical Regulations, Volume I*](https://library.wmo.int/?lvl=notice_display&id=14073#.Yt_rP3ZBwuU) (WMO-No. 49) and, in the case of competency, elaborated by guidance in the [*Compendium of WMO Competency Frameworks*](https://library.wmo.int/index.php?lvl=notice_display&id=21607#.Yt_uknZBwuU) (WMO-No. 1209), are not wholly suited to aeronautical meteorological specialisms such as volcanic ash, space weather, and tropical cyclones. Indeed, aeronautical meteorological service providers with the responsibility to maintain a continuous watch over such phenomena in their area of responsibility presently have little or no means to demonstrate how their specialist aeronautical meteorological forecasters (AMF) fully comply with WMO prevailing qualification and competency requirements.

2. Responding to International Civil Aviation Organization (ICAO) Annex 3 provisions, SC-AVI acknowledged that the qualification requirement for AMF, introduced by WMO in 2011, was introduced to serve as a ‘safety net’ in recognition that the introduction of a competency Standard was a new and big step for a majority of WMO Members. In the last decade, the competency frameworks for AMP have been further developed, matured and embraced by WMO Members. With a foreseen transformation in service delivery through this decade and beyond, and the resultant changes anticipated to the roles and responsibilities of AMP, SC-AVI has determined that it is important to ensure that the aeronautical meteorology competency frameworks remain sufficiently agile and responsive to the foreseen changes rather than being restricted by the rigorous application of an academically-based qualification requirement.

3. Consequently, SC-AVI prepared a proposed amendment to Part V of the [*Technical Regulations*, Volume I, *General Meteorological Standards and Recommended Practices*](https://library.wmo.int/?lvl=notice_display&id=14073#.Yt_rP3ZBwuU) (WMO-No. 49) and an update to Section 2.2 of the [*Compendium of WMO Competency Frameworks*](https://library.wmo.int/index.php?lvl=notice_display&id=21607#.Yt_uknZBwuU) (WMO-No. 1209). SC-AVI considered that the proposed changes would provide a more pragmatic and flexible approach for WMO Members to demonstrate evidence of how the underpinning knowledge and skills required to attain the respective AMP competency have been acquired. SC-AVI also recognized that successful completion of the Basic Instruction Package for Meteorologists (BIP-M) and Basic Instruction Package for Meteorological Technicians (BIP-MT) remains an effective way to demonstrate a candidate possesses the underpinning skills and knowledge described in the respective competency framework.

4. It is worthwhile to note that the proposed changes arising from SC-AVI/ET-ETC were consulted with and received broad support from the Capacity Development Panel (CDP) early in 2022. Moreover, the SERCOM-2 session in October 2022 expressed broad support and made improvements to the initial proposal emanating from SC-AVI/ET-ETC. To assist WMO Members in their further understanding of the background and rationale for change, as well as of the benefits to be derived through the adoption of these changes, SC-AVI has prepared a [communications package including “frequently asked questions](https://community.wmo.int/activity-areas/aviation/resources/amp-qual-comp-amendments)”.

**Expected action**

5. Through [Recommendation 2 (SERCOM-2)](https://meetings.wmo.int/SERCOM-2/_layouts/15/WopiFrame.aspx?sourcedoc=/SERCOM-2/English/2.%20PROVISIONAL%20REPORT%20(Approved%20documents)/SERCOM-2-d05-1(3)-AMENDMENT-WMO-49-V1-UPDATE-WMO-1209-approved_en.docx&action=default), the Services Commission provided its endorsement of the proposed amendment to WMO-No. 49, Volume I and update to WMO‑No. 1209. Based on the foregoing, the World Meteorological Congress may wish to adopt Resolution 4.1(2)/1 (Cg-19) accordingly.

# DRAFT RESOLUTION

## Draft Resolution 4.1(2)/1 (Cg-19)

### Proposed amendment to the *Technical Regulations, Volume I, General Meteorological Standards and Recommended Practices* (WMO-No. 49) and update to the *Compendium of WMO Competency Frameworks* (WMO-No. 1209)

THE WORLD METEOROLOGICAL CONGRESS,

**Takes note** of [Recommendation 2 (SERCOM-2)](https://meetings.wmo.int/SERCOM-2/_layouts/15/WopiFrame.aspx?sourcedoc=/SERCOM-2/English/2.%20PROVISIONAL%20REPORT%20(Approved%20documents)/SERCOM-2-d05-1(3)-AMENDMENT-WMO-49-V1-UPDATE-WMO-1209-approved_en.docx&action=default) – Proposed amendment to the [*Technical Regulations, Volume I, General Meteorological Standards and Recommended Practices*](https://library.wmo.int/?lvl=notice_display&id=14073#.Yt_4cXZBwuW) (WMO-No. 49) and update to the [*Compendium of WMO Competency Frameworks*](https://library.wmo.int/index.php?lvl=notice_display&id=21607#.Yt_3LXZBwuV) (WMO-No. 1209);

**Further notes** the proposed amendment to WMO-No. 49, Volume I and update to WMO‑No. 1209 concerning the qualification and competency requirements of aeronautical meteorological personnel (AMP), as contained in [Annexes 1](#_Annex_1_to) and [2](#_Annex_2_to) respectively to this present resolution;

**Adopts** the amendment to the *Technical Regulations, Volume I, General Meteorological Standards and Recommended Practices* (WMO-No. 49), with an applicability date of 1 January 2024;

**Approves** the associated update to the *Compendium of WMO Competency Frameworks* (WMO-No. 1209);

**Requests** the Secretary-General to expeditiously arrange for the publication of the amended *Technical Regulations, Volume I* (WMO-No. 49), and the updated *Compendium of WMO Competency Frameworks* (WMO-No. 1209);

**Requests** the president of the Commission for Weather, Climate, Water and Related Environmental Services and Applications (SERCOM), with the assistance of the Capacity Development Panel (CDP) as necessary, to continue to ensure that the WMO Technical Regulations and guidance pertaining to the qualifications and competency of AMP is periodically reviewed and updated as necessary in accordance with established procedures.

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[Annexes:](#_Annex_to_draft_3) 2

## Annex 1 to draft Resolution 4.1(2)/1 (Cg-19)

## Amendment to the *Technical Regulations, Volume I, General Meteorological Standards and Recommended Practices,* (WMO-No. 49)

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| Editorial Note 1. — *The following proposal is based on the 2021 update of the 2019 edition of WMO-No. 49, Volume I available on the WMO e-Library* [*here*](https://library.wmo.int/index.php?lvl=notice_display&id=14073).Editorial Note 2. — *The text of the amendment is arranged to show deleted text with a line through it and new text with underline, as shown below:*

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**PART V. QUALIFICATIONS AND COMPETENCIES OF PERSONNEL INVOLVED IN THE PROVISION OF METEOROLOGICAL (WEATHER AND CLIMATE) ~~, AND~~ HYDROLOGICAL AND RELATED ENVIRONMENTAL SERVICES**

1. **QUALIFICATIONS AND COMPETENCIES**

1.1 **General**

1.1.1 The qualifications and competencies required of personnel involved in the provision of meteorological, climatological, hydrological, ~~climatological,~~ relevant environmental and related services should be established by Members in accordance with sections 1.2–1.8.

Note~~s~~:

~~1. A specific qualification is typically acquired once and remains valid throughout a person’s career.~~ Qualification in this context refers to the completion of formal learning, or courses of study, which provides the underlying skills and knowledge required to support competency.

~~2. Qualifications and competencies for personnel in additional service areas will be developed in due course and subsequently included in this chapter.~~

1.1.2 Members should, based on the relevant national, regional and/or global requirements, determine the necessary level of qualification(s) required for each category of operational personnel.

~~1.1.2~~1.1.3 Members should keep records of ~~the~~ applicable qualifications of all personnel involved in the provision of meteorological, climatological, hydrological, ~~climatological~~ and related environmental services, in accordance with quality management good practices and/or applicable requirements.

~~1.1.3 Members should decide, in light of their national circumstances, whether higher or more specific qualification requirements than those described in sections 1.2–1.8 should be established for certain categories of operational personnel.~~

1.1.4 Competency of Members’ personnel should be demonstrated through job performance and assessed through competency assessment procedures, as appropriate.

Note: Guidance on competency implementation procedures is provided in *Guide to Competency*(WMO-No. 1205).

1.1.5 Members should establish competency assessment procedures for different categories of operational personnel; competency assessments should be repeated at regular intervals defined by the quality management practice of each Member.

1.1.6 Members should implement WMO competencies for personnel taking due account of their local conditions, regulations, requirements and procedures.

Note: Only ~~T~~top-level competencies ~~only~~ are included in the Technical Regulations, while more detailed second-level competencies are provided in additional guidance material, as noted. National adaptations of the WMO competencies will require careful consideration of the applicability of second-level information.

1.1.7 Members should ensure that their operational personnel undertake continuous professional development to maintain competence.

1.2 **Personnel providing aeronautical meteorological services**

1.2.1 ***Qualifications***

1.2.1.1 **Members shall ensure, taking into consideration the area and airspace of**

**responsibility~~; the impact of meteorological and other relevant environmental phenomena and parameters on aviation operations;~~, aviation user requirements~~;~~, international regulations and local procedures and priorities, that ~~an aeronautical meteorological forecaster has successfully completed~~ the level of qualification(s) necessary to underpin the required competencies of operational aeronautical meteorological forecasters and observers is consistent with the relevant educational frameworks, background skills and knowledge requirements described in the Basic Instruction Package for Meteorologists and the Basic Instruction Package for Meteorological Technicians, respectively, as defined in Appendix A.**

Notes:

1. Aeronautical meteorological forecasters and observers in this context includes personnel with responsibility for providing an aeronautical meteorological service at the national, regional or global level.

2. National and/or regional bodies may require additional and/or higher levels of qualification(s) for operational aeronautical meteorological personnel.

3. Aeronautical meteorological service delivery specialisms such as (but not limited to) volcanic hazards and space weather may require the successful completion of additional and/or alternative qualification frameworks to underpin the required competencies of the personnel delivering operational services in such specialist areas.

~~1.2.1.2 Members should decide whether their national circumstances require specific qualifications of aeronautical meteorological observers.~~

1.2.2 ***Competencies***

Note: ~~See the education and training section at~~ [~~https://www.wmo.int/aemp/implementation\_areas~~](https://www.wmo.int/aemp/implementation_areas) ~~for access to additional guidance, including second-level competency information.~~ The competency standards for aeronautical meteorological personnel are maintained by the ~~Commission for Aeronautical Meteorology~~ WMO Standing Committee on Services for Aviation (SC-AVI) and are published in the *Compendium of WMO Competency Frameworks (WMO-No. 1209)*. Refer to the SC-AVI Moodle training portal[[1]](#footnote-2) for access to aeronautical meteorology training and guidance material sourced from around the world.

1.2.2.1 **Aeronautical meteorological forecaster**

**Members shall ensure that for the area and airspace of responsibility, given the impact of meteorological and other relevant environmental phenomena and parameters on aviation operations, and in compliance with aviation user requirements, international regulations and local procedures and priorities, an aeronautical meteorological forecaster is able to:**

**(a)  Analyse and monitor continually the weather and other relevant environmental situations;**

**(b)  Forecast ~~aeronautical~~ meteorological and other relevant environmental phenomena and parameters;**

**(c)  Warn of hazardous ~~weather~~ meteorological and other relevant environmental phenomena;**

**(d)  Ensure the quality of meteorological and other relevant environmental information and services supplied to users;**

**(e)  Communicate meteorological and other relevant environmental information to internal and external users.**

Note: Other relevant environmental situations, phenomena, parameters and information in this context may include (but not be limited to) the presence of volcanic ash, the release of radioactive material or toxic chemicals into the atmosphere and space weather.

1.2.2.2 **Aeronautical meteorological observer**

**Members shall ensure that for the area and airspace of responsibility, given the impact of meteorological or other relevant environmental phenomena and parameters on aviation operations, and in compliance with aviation user requirements, international regulations and local procedures and priorities, an aeronautical meteorological observer is able to:**

**(a) Monitor continually the weather or other relevant environmental situations;**

**(b) Observe and record ~~aeronautical~~ meteorological or other relevant environmental phenomena and parameters;**

**(c) Ensure the quality of the observing system performance and of meteorological or other relevant environmental information supplied to users;**

**(d) Communicate meteorological or other relevant environmental information to internal and external users.**

Note: Other relevant environmental situations, phenomena, parameters and information in this context may include (but not be limited to) the presence of volcanic ash and space weather.

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## Annex 2 to draft Resolution 4.1(2)/1 (Cg-19)

**Update to the *Compendium of WMO Competency Frameworks* (WMO-No. 1209)**

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| Editorial Note 1. — *The following proposal is based on the 2019 edition of WMO-No. 1209 available on the WMO e-Library* [*here*](https://library.wmo.int/index.php?lvl=notice_display&id=21607).Editorial Note 2. — *The text of the amendment is arranged to show deleted text with a line through it and new text with underline, as shown below:*

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2.2 **COMPETENCY STANDARDS FOR AERONAUTICAL METEOROLOGICAL PERSONNEL**

The following guidance supplements the competency standards for aeronautical meteorological personnel endorsed by the World Meteorological Congress at its sixteenth session, in May 2011, and laid out in the *Technical Regulations* (WMO-No. 49), Volume I, Part V.

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| Editorial Note. – *The foregoing reference to the sixteenth session of the World Meteorological Congress, in May 2011, will need to be replaced by a reference to the nineteenth session of the World Meteorological Congress, in May/June 2023.* |

The competency standards listed below apply to aeronautical meteorological forecasters and observers, taking into consideration the following conditions:

(a) The area and airspace of responsibility;

(b) The impact of meteorological and/or other relevant environmental phenomena and parameters on aviation operations;

(c) Compliance with aviation user requirements, international regulations, local procedures and priorities.

**Regional variations**

The importance of the conditions above is emphasized. There will be considerable variation in the legitimate functions of aeronautical meteorological offices and centres worldwide, and it is not possible to write a document that exactly matches every office~~'s~~ or centre's function(s). Therefore, the performance criteria should be applied in a way that is consistent with these variations. For example, it is recognized that aeronautical meteorological offices in the tropics will not be responsible for forecasting blowing snow (performance criterion 2.1). The conditions (a), (b) and (c) provide for this.

It is intended that the responsibility for meeting the top-level competency standards will, in the first instance, rest with the organization to which the aeronautical meteorological personnel belongs. The responsibility of the individual will then be to meet (or exceed) the particular competencies which apply to his or her specific job within the organization (usually specified in terms of a job description).

Note: In this context, the word ‘organization’ is being used to denote the aeronautical meteorological service provider of the WMO Member concerned. The aeronautical meteorological service provider may be a national meteorological and hydrological service (NMHS) or a non-NMHS entity, as designated by the meteorological authority of the WMO Member concerned.

In some organizations, the competencies may be collectively satisfied by a team or by several groups. In such cases, the organization is responsible for ensuring that each individual does his or her part of the job to the required standard so that the top-level competency standards are met.

The role of aeronautical meteorological personnel will continue to change in response to evolving technology and user requirements, and that in itself will also likely require high standards of competency and underlying knowledge definition. The guidelines presented here attempt to anticipate imminent changes as far as possible, but a review cycle of not more than 3–5 years is strongly recommended as part of the overall quality management and risk management approach.

The organization is responsible for managing a programme of competency assessments to ensure that competency standards are maintained. It is important that the programme is integrated into the organization’s quality management system.

~~An implicit requirement in the background knowledge and skills of aeronautical meteorological forecasters is that they have successfully completed the Basic Instruction Package for Meteorologists (BIP-M), as described in the~~ *~~Technical Regulations~~* ~~(WMO-No. 49) Volume I, Part V, taking into account the conditions (a) to (c) mentioned above. It should, however, be recognized that national qualification requirements for aeronautical meteorological forecasters can be set at a higher level certified, for example, by a degree.~~

The level of qualification(s) necessary to underpin the required competencies of operational aeronautical meteorological forecasters and observers is to be consistent with the relevant educational frameworks, background skills and knowledge requirements described in the Basic Instruction Package for Meteorologists (BIP-M) and the Basic Instruction Package for Meteorological Technicians (BIP-MT), respectively. Information on the BIP-M and BIP-MT is described in the *Technical Regulations* (WMO-No. 49), Volume I, *General Meteorological Standards and Recommended Practices*, Part V, Qualifications and Competencies of Personnel Involved in the Provision of Meteorological (Weather and Climate), Hydrological and Related Environmental Services.

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| Editorial Note. – *The foregoing referenced title of Part V will need to be validated in light of a corresponding proposed amendment to WMO-No. 49, Volume I.* |

The aeronautical meteorological service provider is expected to record evidence that the aeronautical meteorological personnel, responsible for the provision of its services, have completed the necessary formal learning or courses of study to demonstrate they possess the background skills and knowledge as described in the relevant competency framework.

The WMO Standing Committee on Services for Aviation (SC-AVI) Moodle ~~website~~ training portal[[2]](#footnote-3) ~~of the WMO Commission for Aeronautical Meteorology~~ is a resource designed to provide aeronautical meteorology training and guidance material sourced from around the world. The ~~website’s~~ portal’s content covers both operational and non-operational aspects of aeronautical meteorology, including quality management, regulatory issues, conferences, seminars and workshops, as well as source material in different languages. The ~~site~~ portal has played a key role in assisting organizations with changes such as the implementation of competency assessment for aeronautical meteorological personnel. The ~~website~~ portal includes frequently asked questions and discussion forums, where ~~members~~ registered users can ask questions, participate in discussions and share resources and expertise.

~~1.2.1~~2.2.1 **Aeronautical Meteorological Forecaster**

An aeronautical meteorological forecaster should be able to perform the tasks specified under the following top-level competency standards:

1. Analyse and monitor continually the weather and other relevant environmental situations;

2. Forecast ~~aeronautical~~ meteorological and other relevant environmental phenomena and parameters;

3. Warn of hazardous meteorological and other relevant environmental phenomena;

4. Ensure the quality of meteorological and other relevant environmental information and services supplied to users;

5. Communicate meteorological and other relevant information to internal and external users.

Notes:

1. Other relevant environmental situations, phenomena, parameters and information in this context may include (but not be limited to) the presence of volcanic ash, the release of radioactive material or toxic chemicals into the atmosphere and space weather.

2. An aeronautical meteorological forecaster in this context may include (but not be limited to) a person with responsibility to provide aeronautical meteorological service at an aerodrome meteorological office (which may or may not be located at an aerodrome), a meteorological watch office, a world area forecast centre, a volcanic ash advisory centre, a tropical cyclone advisory centre or a space weather centre.

**COMPETENCY 1: ANALYSE AND MONITOR CONTINUALLY THE WEATHER AND OTHER RELEVANT ENVIRONMENTAL SITUATIONS**

**Competency description**

Observations and forecasts of weather ~~and significant weather phenomena~~, in particular significant weather, and other relevant environmental phenomena and parameters are continually monitored during hours of operation to determine the need for issuance, cancellation or amendment/update of forecasts, warnings and alerts according to documented thresholds and regulations.

**Performance criteria**

1. Analyse and diagnose[[3]](#footnote-4) the weather and other relevant environmental situations as required in forecast, warning and alert preparation;

2. Monitor weather ~~parameters and evolving significant weather phenomena~~, in particular significant weather, and other relevant environmental phenomena and parameters, and validate current forecasts, warnings and alerts based on these parameters;

3. Appraise the need for amendments to forecasts and updates of warnings and alerts against documented criteria and thresholds.

**Background knowledge and skills**

 Mechanisms generating different types of cloud and precipitation, and local mechanisms enhancing cloud and precipitation;

 Topographic influences on cloud, precipitation, fog and visibility, in typical wind and moisture regimes;

 Interpretation of:

- Radar, lidar, wind profiler 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 (NWP) guidance and other forms of objective guidance, to be incorporated into forecasts, warnings and alerts;

- Observed parameters when variations result from differences between automatic sensor technologies and manual observing techniques;

 The International Standard Atmosphere (ISA);

 ~~Aeronautical w~~Weather and other relevant environmental monitoring and observing technologies, and ~~aeronautical~~ forecasting techniques in use at the service provider;

 Common terms relevant to aeronautical meteorology, including:

- (Special) Visual and instrument Flight rules and conditions;

- Flight Information Region (FIR) and, where used, Functional Airspace Block (FAB);

- Final approach, missed approach;

- Cruising and transition level, transition layer, transition altitude, flight level;

- Minimum safe altitude (MSA), indicated altitude, true altitude;

- Category I, II and III aerodrome operations, Aeronautical Information Publication (AIP);

- NOTAMs/ASHTAMs;

- ATIS/VOLMET;

• International Civil Aviation Organization (ICAO) location indicators and/or WMO synoptic station numbers, particularly for aerodromes or stations that lie within and near the area of responsibility.

**COMPETENCY 2: FORECAST ~~AERONAUTICAL~~ METEOROLOGICAL AND OTHER RELEVANT ENVIRONMENTAL PHENOMENA AND PARAMETERS**

**Competency description**

Forecasts of ~~weather~~ meteorological and other relevant environmental phenomena and parameters are prepared and issued in accordance with documented requirements, priorities and deadlines.

**Performance criteria**

1. Forecast the following ~~weather~~ meteorological and other relevant environmental phenomena and parameters:

 Temperature and relative humidity;

 Wind including temporal and spatial variability (wind shear, directional variability and gusts);

 QNH;

 Cloud (type, amount, height of cloud base and vertical extent);

 Precipitation (type, amount, intensity and temporal variations, onset and cessation or duration) and associated visibility;

 Fog or mist, including onset and cessation or duration, and associated reduced visibility;

 Other types of obscuration, including dust, smoke, haze, sandstorms, dust storms, blowing snow and associated visibility;

 Hazardous ~~weather~~ meteorological and other relevant environmental phenomena listed under Competency 3 below;

 Wake vortex advection and dissipation, as required;

2. Ensure that forecasts are prepared and issued in accordance with ICAO Annex 3 to the Convention on International Civil Aviation (hereafter ICAO Annex 3), the *Technical Regulations* (WMO-No. 49), Volume II, regional and national formats, codes and technical regulations on content, accuracy and timeliness;

3. Ensure that forecasts of ~~weather~~ meteorological and other relevant environmental phenomena and parameters are consistent (spatially and temporally) across boundaries of the area of responsibility as far as practicable, while maintaining meteorological integrity. This will include monitoring forecasts, warnings and alerts issued for other locations or regions~~, and~~ as well as liaising with adjacent locations or regions as required.

**Background knowledge and skills**

 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;

 Formation mechanisms and characteristics of other aeronautical meteorological phenomena, such as dust storms, sandstorms, dust devils and funnel clouds (tornadoes or waterspouts);

 Local topography and its effects on weather, such as gap flows, downslope windstorms, orographic turbulence, sea breezes and upslope fog;

 Ability to interpret all observational products (for example, METAR) and encode forecast products (for example, Terminal Aerodrome Forecasts (TAF)) into Traditional Alphanumeric Codes (TAC) or other required formats;

 Aerodrome climatology, including frequency of occurrence of significant cloud, thunderstorms, precipitation, strong winds, low-level wind shear, reduced visibility, fog and other phenomena;

 Local forecasting guides and techniques, including diagnostic and prognostic parameters, for forecasting significant cloud, thunderstorms, turbulence, aircraft icing, precipitation, strong winds, low-level wind shear, reduced visibility, fog and other phenomena;

 International, national and local aeronautical forecast, warning and 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;

 Relevant ICAO and WMO documents, including ICAO Annex 3, the *Technical Regulations* (WMO-No. 49), Volume II, the *Manual on Codes* (WMO-No. 306) and the ICAO *Manual of Aeronautical Meteorological Practice* (Doc 8896);

 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 en route wind, temperature and significant weather forecasts and aerodrome forecasts for pre-flight planning and in-flight ~~replanning~~ 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 centres;

- Low-visibility runway operating procedures;

- Effects of unfavourable meteorological and other relevant environmental conditions on ~~aeronautical~~ aviation 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.

**COMPETENCY 3: WARN OF HAZARDOUS METEOROLOGICAL AND OTHER RELEVANT ENVIRONMENTAL PHENOMENA**

**Competency description**

Warnings are issued in a timely manner when hazardous ~~meteorological and other relevant environmental~~ phenomena are occurring, expected to occur or when parameters are expected to reach documented threshold values. They are updated or cancelled according to documented warning criteria.

**Performance criteria**

1. Forecast the following hazardous ~~weather~~ meteorological and other relevant environmental phenomena, including spatial extent, onset and 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, downburst and microburst or gust front and tornadic activity (funnel cloud as tornado or waterspout);

 Turbulence (moderate or greater) including type (orographic, mechanical, convective and clear air turbulence (CAT));

 Moderate and severe low-level wind shear;

 Aircraft icing (moderate or greater) including accumulation rate (if known), spatial extent, type (rime or opaque, glaze or clear, freezing rain, hoar frost, mixed ice, ingested high-altitude ice crystals);

 Height of cloud base and/or surface visibility below aerodrome minima, affecting take-off, landing and approach procedures;

 Hazardous phenomena affecting aerodromes such as strong surface winds including cross-winds and squalls, frost, freezing precipitation, snowfall, lightning and wake vortices;

 Sandstorms and dust storms;

 Volcanic ash on the basis of observations, reports and/or advisory products;

 Tropical cyclones;

 Radioactive cloud;

2. Ensure that warnings are prepared and issued in accordance with thresholds for hazardous meteorological and other relevant environmental phenomena, and with ICAO Annex 3, *Technical Regulations* (WMO-No. 49), Volume II, regional and national formats, codes, and technical regulations on content, accuracy and timeliness;

3. Ensure that warnings of hazardous ~~weather~~ meteorological and other relevant environmental phenomena are consistent (spatially and temporally) across boundaries of the area of responsibility as far as practicable, while maintaining meteorological integrity. This will include monitoring forecasts and warnings issued for other locations and regions~~, and~~ as well as liaising with adjacent locations or regions as required.

**Background knowledge and skills**

 Knowledge of volcanic eruptions, volcanic ash cloud displacement, ~~and~~ dispersion and/or re-suspension;

 Areas of likely volcanic activity, especially within the region of responsibility (for offices with responsibility for issuing volcanic ash advisories and warnings and offices located close to or downwind of volcanoes);

 Meteorological hazards to aviation, including thunderstorms and associated phenomena, aircraft icing, turbulence, low-visibility, low-level cloud, tropical cyclones, wind shear and volcanic ash;

 The generation mechanisms of low-level jet streams, boundary layer turbulence and gusts, and their effects on aircraft performance;

 Ability to interpret all observational products (for example, METAR), and encode forecast products (for example, TAF) into TAC or other required formats;

 Aerodrome climatology, including occurrence of significant cloud, thunderstorms, precipitation, strong winds, low-level wind shear, reduced visibility, fog and other phenomena;

 Local forecasting guides and techniques, including diagnostic and prognostic parameters, for forecasting significant cloud, thunderstorms, turbulence, aircraft icing, precipitation, strong winds, low-level wind shear, reduced visibility, fog and other phenomena;

 International, national and local aeronautical forecast, warning and 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;

 The significance of warning thresholds on aviation operations, and the ability to describe the likely impact of warnings of hazardous ~~weather~~ meteorological and other relevant environmental phenomena on these aviation operations;

 Relevant ICAO and WMO documents, including ICAO Annex 3, the *Technical Regulations* (WMO-No. 49), Volume II, the *Manual on Codes* (WMO-No. 306), and the ICAO *Manual of Aeronautical Meteorological Practice* (Doc 8896);

 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 en route wind, temperature and significant weather forecasts and aerodrome forecasts for pre-flight planning and in-flight ~~replanning~~ re-planning;

- Meteorological aspects of flight planning; definitions; procedures for meteorological services for international air navigation; types of meteorological information required for ATS, aerodrome control towers, approach and area control, and flight information centres;

- Low-visibility runway operating procedures;

- Effects of unfavourable meteorological and other relevant environmental conditions on ~~aeronautical~~ aviation operations, including air traffic disruption, holding and diversions;

- Meteorological and other environmental effects on aerodrome ground services, such as volcanic ash and snow ~~clearing~~ clearance, the effect of wet runways, and the effect of thunderstorms and strong winds on runway and apron operations;

- Aerodrome operating minima, the need for alternates and impacts on fuel consumption;

- Altimeter setting procedures.

**COMPETENCY 4: ENSURE THE QUALITY OF METEOROLOGICAL AND OTHER RELEVANT ENVIRONMENTAL INFORMATION AND SERVICES SUPPLIED TO USERS**

**Competency description**

The quality of meteorological and other relevant environmental forecasts, warnings, alerts and related ~~products~~ services 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 (for example, bias and achievable accuracy of observations and sensing methods) on forecasts, warnings and alerts;

3. Validate ~~aeronautical~~ meteorological and other relevant environmental data and information, ~~products,~~ forecasts, warnings and alerts (timeliness, completeness, accuracy) using real-time checks;

4. Monitor the functioning of operational systems and take remedial actions when necessary.

**Background knowledge and skills**

 International, national and local ~~aeronautical~~ forecast, warning and 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;

 Applicable ~~TAF~~ forecast verification ~~system(s)~~ scheme(s) and verification statistics;

 Quality management systems;

 Aviation safety management systems, as required;

 Standards (as defined in ICAO Annex 3 and the *Technical Regulations* (WMO-No. 49), Volume II) and quality management system procedures (as defined in ISO 9001 standards and national regulations):

- Procedures for checking, ~~and~~ identifying and correcting errors and omissions;

- Methods for identifying significant differences between factual and forecast data;

- Knowing when to ignore information and where to go to resolve points of contention;

- Desirable accuracy of forecasts as stipulated in ICAO Annex 3, the *Technical Regulations* (WMO-No. 49), Volume II, and national regulations;

- Priorities and schedules;

- Actions to be taken in the event of recurrent discrepancies, inconsistencies and malfunctions;

- Fall-back procedures in the case of computer or other such system failure;

- Contingency arrangements in case of emergencies such as fire alarms, bomb alerts and natural disasters.

**COMPETENCY 5: COMMUNICATE METEOROLOGICAL AND OTHER RELEVANT ENVIRONMENTAL INFORMATION TO INTERNAL AND EXTERNAL USERS**

**Competency description**

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

**Performance criteria**

1. Ensure that all forecasts, warnings and alerts are disseminated through the authorized communication means and channels to designated user groups;

2. Explain[[4]](#footnote-5) ~~aeronautical~~ meteorological and other relevant environmental data and information to users in a clear and concise manner using suitable terminology, and provide briefings and consultations that meet specific user needs.

**Background knowledge and skills**

 Ability to carry out a routine, high-quality self-briefing, which may include a shift handover briefing, of the recent and current weather situation, and to integrate all available data to produce a consolidated diagnosis;

 Ability to explain the meteorological and procedural reasons behind a forecast, ~~and~~ warning or alert decision;

 ~~The l~~Likely impact of forecasts of meteorological and other relevant environmental parameters and phenomena on aviation operations;

 ~~The u~~Use and interpretation of ~~products~~ information issued by World Area Forecast Centres (WAFCs), Volcanic Ash Advisory Centres (VAACs), Tropical Cyclone Advisory Centres (TCACs) and other designated centres;

 Means of dissemination of ~~aeronautical~~ meteorological data and information to users;

 ~~Local~~ Use of aeronautical meteorological telecommunications.

**REGIONAL VARIATIONS**

 Locally agreed and documented criteria and thresholds;

 The range of ~~weather~~ meteorological and other relevant environmental 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 and local regulations;

 Boundaries of forecast areas;

 Extent, scope and exclusions of quality management system implementation;

 Communication language(s);

 Communication technology for forecast, ~~and~~ warning and alert transmission, and for ~~weather~~ flight briefing.

2.2.2 **Aeronautical Meteorological Observer**

**Competency standards**

An aeronautical meteorological observer should be able to perform the tasks specified under the following top-level competency standards.

1. Monitor continually the weather or other relevant environmental situation;

2. Observe and record ~~aeronautical~~ meteorological or other relevant environmental phenomena and parameters;

3. Ensure the quality of the observing system performance and of meteorological or other relevant environmental information supplied to users;

4. Communicate meteorological or other relevant environmental information to internal and external users.

Notes:

1) Other relevant environmental situation, phenomena, parameters and information in this context may include (but not be limited to) the presence of volcanic ash.

2) An aeronautical meteorological observer in this context may include (but not be limited to) a person with responsibility to provide an aeronautical meteorological service at an aeronautical meteorological station or a State volcano observatory.

**COMPETENCY 1: CONTINUALLY MONITOR THE WEATHER OR OTHER RELEVANT ENVIRONMENTAL SITUATION**

**Competency description**

Weather or other relevant environmental phenomena and parameters are continually monitored during hours of operation to identify the significant and evolving weather or other relevant environmental phenomena that are affecting or will likely affect the area of responsibility (typically but not exclusively the aerodrome and its vicinity).

**Performance criterion**

Analyse and describe the current local weather or other relevant environmental conditions.

**Background knowledge and skills**

 Key characteristics of the troposphere and tropopause;

 Properties of air pressure, temperature, density and water vapour;

 Atmospheric stability, inversions;

 Generation mechanisms of wind;

 Fog and cloud formation and dissipation;

 Precipitation types and intensity;

 The general circulation of the Earth's atmosphere;

 The International Standard Atmosphere (ISA);

 Characteristics, occurrence and effects of meteorological or other relevant environmental hazards to aviation, including but not limited to low cloud, low 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, and seamless prediction systems’ outputs;

 Region-specific weather or other relevant environmental phenomena and likely weather sequences that are expected to affect the station;

 Nowcasting for severe weather or other relevant environmental phenomena;

 Local topography and climatology, including local reference points;

 ICAO location indicators and WMO synoptic station numbers, particularly for aerodromes and stations that lay within and close to the area of responsibility.

**COMPETENCY 2: OBSERVE AND RECORD ~~AERONAUTICAL~~ METEOROLOGICAL OR OTHER RELEVANT ENVIRONMENTAL PHENOMENA AND PARAMETERS**

**Competency description**

Observations of weather or other relevant environmental phenomena and parameters, and their significant changes, are recorded according to documented thresholds and regulations.

**Performance criteria**

1. As applicable, ~~P~~perform and record routine and non-routine (special) observations of the following:

 Surface wind direction and speed, including spatial and temporal variations;

 Visibility for aeronautical purposes, including spatial and temporal variations;

 Runway visual range (RVR), including spatial and temporal variations;

 Present weather phenomena (as defined in ICAO Annex 3);

 Cloud amount, cloud type and height of cloud base, including spatial and temporal variations;

 Vertical visibility;

 Air temperature and dewpoint temperature;

 Atmospheric pressure; determining QFE and QNH;

 Supplementary information concerning significant meteorological or other environmental conditions, particularly those in the approach and climb-out areas such as wind shear;

2. Interpret weather or other environmental parameters derived from automatic ~~weather~~ observing systems, such as lidar and weather radar, to ensure that observations remain representative of local conditions when differences occur between automatic sensor technologies and manual observing techniques;

3. Ensure that observations are prepared and issued in accordance with ICAO Annex 3, the *Technical Regulations* (WMO-No. 49), Volume II, regional and national formats, codes and technical regulations on content, representativeness and timeliness.

**Background knowledge and skills**

 Procedures for performing routine and non-routine (special) aeronautical meteorological observations and reports;

 The impact of ~~weather~~ meteorological or other relevant environmental conditions on aircraft performance and airport operations;

 Strengths and weaknesses of manual observations and automatic ~~weather~~ observing systems;

 Observer directives, procedures and instructions;

 Validated sources of ~~weather~~ meteorological or other relevant environmental information;

 Quality management systems;

 Aviation safety management systems, as required;

 Relevant ICAO and WMO documents, including ICAO Annex 3, the *Technical Regulations* (WMO-No. 49), Volume II, the *Manual on Codes* (WMO-No. 306), the ICAO *Manual of Aeronautical Meteorological Practice* (Doc 8896), and the ICAO *Manual on Automatic Meteorological Observing Systems at Aerodromes* (Doc 9837);

 ICAO definitions of relevance to meteorology;

 WMO Traditional Alphanumeric Codes (TAC),~~and~~ national aeronautical meteorological codes and other forms of data representation.

**COMPETENCY 3: ENSURE THE QUALITY OF THE OBSERVING SYSTEM PERFORMANCE AND OF METEOROLOGICAL OR OTHER RELEVANT ENVIRONMENTAL INFORMATION SUPPLIED TO USERS**

**Competency description**

The quality of meteorological or other relevant environmental observations 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. Check and confirm the quality of meteorological or other relevant environmental 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 or other relevant environmental observations;

 Correct and report errors and omissions;

 Make and disseminate corrections in a timely manner.

**Background knowledge and skills**

 Standards (as defined in ICAO Annex 3 and in the Technical Regulations (WMO-No. 49), Volume II) and quality management system procedures (as defined in ISO 9001 standards and national regulations);

 Procedures for checking,~~and~~ identifying and correcting errors and omissions (in automatically- and manually-derived data);

 Methods for identifying significant differences between observational and forecast data;

 Knowing when to ignore information and where to go to resolve points of contention;

 Desirable accuracies of measurement and observation as in ICAO Annex 3, the *Technical Regulations* (WMO-No. 49), Volume II, and national regulations;

 Priority tasks and time constraints;

 Action to be taken in the event of recurrent discrepancies, inconsistencies and malfunctions;

 Fall-back procedures in the case of computer or other such system failure;

 Contingency arrangements in case of emergencies such as fire alarms, bomb alerts and natural disasters.

**COMPETENCY 4: COMMUNICATE METEOROLOGICAL OR OTHER RELEVANT ENVIRONMENTAL INFORMATION TO INTERNAL AND EXTERNAL USERS**

**Competency description**

All meteorological or other relevant environmental 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[[5]](#footnote-6) ~~aeronautical~~ meteorological or other relevant environmental data and information in a clear and concise manner using suitable terminology that will be clearly understood by the users;

3. Alert forecasters to observed or imminent significant changes in the ~~weather~~ meteorological or other relevant environmental conditions within the ~~local~~ area of responsibility.

**Background knowledge and skills**

 Knowing how ~~weather~~ meteorological or other relevant environmental information is disseminated within and beyond the ~~aerodrome~~ area of responsibility;

 ~~Local~~ Use of aeronautical meteorological telecommunications;

 ~~Local~~ Air Traffic Service meteorological requirements applicable to the area of responsibility;

 ~~Local f~~Flight planning meteorological requirements applicable to the area of responsibility;

 Specifications related to flight documentation, briefing and consultations applicable to the area of responsibility.

**REGIONAL VARIATIONS**

 The range of significant ~~weather~~ meteorological or other relevant environmental phenomena;

 Extent of automation of observing and sensing systems;

 Thresholds for significant ~~weather~~ changes in meteorological or other relevant environmental conditions;

 Local climatology;

 Extent, scope and exclusions of quality management system implementation;

 Regional regulations;

 Communication language(s);

 Available communication technologies.

2.3 **EDUCATION AND TRAINING PROVIDERS**

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1. <https://aviationtraining.wmo.int/> [↑](#footnote-ref-2)
2. [~~http://www.caem.wmo.int/moodle/~~](http://www.caem.wmo.int/moodle/) <https://aviationtraining.wmo.int/> [↑](#footnote-ref-3)
3. "Analysis" may be defined as answering the question "what is happening?", and "diagnosis" as answering "why is it happening?" [↑](#footnote-ref-4)
4. In accordance with any language proficiency requirements stipulated by the national regulator. [↑](#footnote-ref-5)
5. In accordance with any language proficiency requirements stipulated by the national regulator. [↑](#footnote-ref-6)