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| WEATHER CLIMATE WATER | **World Meteorological Organization**  **COMMISSION FOR WEATHER, CLIMATE, WATER AND RELATED ENVIRONMENTAL SERVICES AND APPLICATIONS**  **Second Session** 17 to 21 October 2022, Geneva | **SERCOM-2/Doc. 5.1(5)** |
| Submitted by: Chair  21.X.2022  **APPROVED** |

**AGENDA ITEM 5: TECHNICAL REGULATIONS AND OTHER TECHNICAL MATTERS**

**AGENDA ITEM 5.1: Recommended amendments to Technical Regulations (WMO-No. 49), including Manuals and Guides**

**Review of BIP-M and BIP-MT (Part VI and Appendix A of Vol. I) of the Technical Regulations (WMO-No. 49)**



# DRAFT RECOMMENDATION

## Draft Recommendation 5.1(5)/1 (SERCOM-2)

### Review of BIP-M and BIP-MT ([Part VI and Appendix A of Vol. I) of the Technical Regulations](https://library.wmo.int/doc_num.php?explnum_id=10955/#page=55) (WMO-No. 49)

THE COMMISSION FOR WEATHER, CLIMATE, WATER AND RELATED ENVIRONMENTAL SERVICES AND APPLICATIONS,

**Recalling** [Resolution 32 (Cg-XVI)](https://library.wmo.int/doc_num.php?explnum_id=3429#page=251) – Definition of a Meteorologist and Meteorological Technician,

**Further recalling** [Resolution 32 (EC-70)](https://library.wmo.int/doc_num.php?explnum_id=4981#page=109) – Review plan for the Basic Instructional Package for Meteorologists (BIP-M) and the Basic Instructional Package for Meteorological Technicians (BIP-MT), which requested the Secretary-General, working with EC-PEET (Executive Council Panel of Experts on Education and Training), which is replaced with EC-CDP (Capacity Development Panel), to review BIP-M and BIP-MT, with particular attention to scientific advancements, skills required for identifying and communicating user impacts, utilization of upstream seamless data and products, management development, and socioeconomic and other relevant societal issues,

**Noting** that the [Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology](https://library.wmo.int/index.php?lvl=notice_display&id=10770) (WMO-No. 1083), Volume I – Meteorology, published in 2015, has now been reviewed by a core expert team by taking into account views of EC-CDP, WMO Technical Departments, Technical Commissions, WMO Regional Training Centres (RTCs), WMO Education and Training (ETR) Collaborating Partners within the WMO Global Campus initiative,

**Further noting** that the EC Capacity Development Panel (CDP) has recommended EC to approve the reviewed WMO-No. 1083 and the amendments to Technical Regulations (WMO-No. 49) accordingly,

**Recommends** the Executive Council to:

(1) Approve the revised [Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology, Volume I – Meteorology](https://filecloud.wmo.int/share/s/CFbdOX7fQgCjKwEmh5L6tg) (WMO-No. 1083), through the draft Resolution provided in [Annex 1](#_Annex_1_to) to the present recommendation;

(2) Recommend to the World Meteorological Congress the adoption of the amendments of BIP-M and BIP-MT (Part VI and Appendix A of WMO-No. 49, Vol. I)throughthe draft recommendation provided in the [Annex 2](#_Annex_2_to) to the present recommendation;

**Invites** the Commission for Observation, Infrastructure and Information Systems (INFCOM) to agree to the present recommendation.

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## Annex 1 to draft Recommendation 5.1(5)/1 (SERCOM-2)

**Draft Resolution ##/1 (EC-76)**

THE EXECUTIVE COUNCIL,

**Recalling** [Resolution 32 (Cg-XVI)](https://library.wmo.int/doc_num.php?explnum_id=3429#page=251) and [Resolution 32 (EC-70)](https://library.wmo.int/doc_num.php?explnum_id=4981#page=109),

**Having considered** draft Recommendation 5.1(5)/1 (SERCOM-2) and draft Decision 6.8(6)/1 (INFCOM-2),

**Having agreed** draft Recommendation 5.1(5)/1 (SERCOM-2),

**Approves** the revised [Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology, Volume I – Meteorology](https://filecloud.wmo.int/share/s/CFbdOX7fQgCjKwEmh5L6tg) (WMO-No. 1083).

## Annex 2 to draft Recommendation 5.1(5)/1 (SERCOM-2)

**Draft Recommendation** **##/1 (EC-76)**

THE EXECUTIVE COUNCIL,

**Recalling** [Resolution 32 (Cg-XVI)](https://library.wmo.int/doc_num.php?explnum_id=3429#page=251) and [Resolution 32 (EC-70)](https://library.wmo.int/doc_num.php?explnum_id=4981#page=109),

**Having considered** draft Recommendation 5.1(5)/1 (SERCOM-2) and Decision 6.8(6)/1 (INFCOM-2),

**Having agreed** draft Recommendation 5.1(5)/1 (SERCOM-2),

**Recommends** to the World Meteorological Congress the adoption of the amendments of BIP-M and BIP-MT (Part VI and Appendix A of WMO-No. 49, Vol. I) as provided in the annex to the present recommendation.

## Annex to draft Recommendation ##/1 (EC-76)

**Amendments to WMO-No. 49, Vol. I, Part VI and Appendix A**

**PART VI. EDUCATION AND TRAINING OF METEOROLOGICAL PERSONNEL**

**1. EDUCATION AND TRAINING REQUIREMENTS**

**1.1 General**

1.1.1 Each Member **shall** ensure that, in the fulfilment of its national and international responsibilities as prescribed in other chapters of these *Technical Regulations*, the personnel involved are educated and trained to ~~the~~ standards recognized by WMO for their respective duties. The education and training requirements **shall** apply both to initial recruitment and to continuing professional development and be in line with advances in science and technology, changing service requirements and responsibilities, and the ongoing need for refresher training.

Note: The education standards are outlined below and job specific competencies are included in the relevant chapters of these *Technical Regulations*.

1.1.2 Members should maintain records of the education and training of their personnel as part of their quality management system (QMS), for their human resource development activities and for auditing purposes, where appropriate, in accordance with the *Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology* (WMO-No. 1083), Volume I.

**1.2 Categories of personnel**

The meteorological personnel **shall** be classified as follows:

(a) Meteorologist;

(b) Meteorological ~~t~~Technician.

Note: The definitions of “~~m~~Meteorologist” and “~~m~~Meteorological ~~t~~Technician” are given in the Definitions section of this volume.

**1.3 The Basic Instruction Package for Meteorologists**

The Basic Instruction Package for Meteorologists (BIP-M) establishes a common understanding of the abilities required for individuals to be recognized as Meteorologists, as defined in Appendix A. BIP-M is presented in its entirety in the *Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology* (WMO-No. 1083), Volume I~~,~~ which contains guidance on how to implement the learning outcomes presented in Appendix A. BIP-M **shall** be used by Members to ensure that the meteorological personnel in the category Meteorologist are provided with ~~a robust and broad range of knowledge of atmospheric phenomena and processes, together with skills related to the application of this knowledge.~~ the underlying knowledge to acquire skills common to all professionals in this category, that they can use as a platform to develop the necessary competencies for specific roles and continue to learn throughout their careers.

**1.4** **The Basic Instruction Package for Meteorological Technicians**

The Basic Instruction Package for Meteorological Technicians (BIP-MT)establishes a common understanding of the abilities required for individuals to be recognized as Meteorological Technicians, as defined in Appendix A. BIP-MT is presented in its entirety in the *Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology* (WMO-No. 1083), Volume I, which contains guidance on how to implement the learning outcomes presented in Appendix A. BIP-MT~~,~~ **shall** be used by Members to ensure that the meteorological personnel in the category Meteorological Technician are provided with ~~basic knowledge of atmospheric phenomena and processes, together with skills related to the application of this knowledge.~~ the underlying knowledge to acquire skills common to all professionals in this category, that they can use as a platform to develop the necessary competencies for specific roles and continue to learn throughout their careers.

**1.5** **Meteorological education and training facilities**

1.5.1 Members should endeavour to provide national facilities, or participate in regional facilities, for the education and training of their personnel.

1.5.2 As not all national training facilities are recognized as regional training facilities, the criteria given in Appendix B to this volume apply to each institution designated as being part of a WMO Regional Training Centre (RTC). Each of those institutions is referred to as an RTC component.

Note: In recognizing, reconfirming and managing an RTC component, the regional association, the Permanent Representative of the host country, the Director of the RTC component and the Coordinator of the RTC with multiple components take shared responsibility for the performance and ongoing status of the institution(s) as an RTC. Guidance on the roles and responsibilities of each of the parties is provided in *Guide to the Management and Operation of WMO Regional Training Centres and Other Training Institutions* (WMO-No. 1169).

**Regional association**

– Prioritize education and training needs of the regional association and communicate them to the RTCs at least every four years;

– Keep abreast of the activities and plans of each RTC and its components through the annual report they provide;

– Provide RTCs, Members and the Secretary-General with feedback on whether the RTCs are meeting the needs of the regional association;

– Contribute to quadrennial reviews of the RTCs arranged by the Executive Council in order to address the extent to which the RTCs are meeting the identified education and training needs of the regional association;

– At each session of the regional association, recommend RTCs to the WMO Executive Council for possible confirmation, based on performance against the established criteria;

– Promote the activities and use of the RTCs by members of the regional association;

– Seek funding and resource opportunities to support and expand the work of the RTCs in addressing the education and training needs of the regional association.

**Permanent Representative of the host country**

– Inform the Secretary-General and the regional association of the contact details of the Coordinator of an RTC and the Director of an RTC component and of any changes thereto;

– Where the RTC is made up of multiple components, ensure ongoing communication and coordination between the components to maximize education and training opportunities for Members;

– Facilitate coordination between the RTC and the regional association concerned regarding regional education and training needs, funding and resource opportunities;

– Promote the resourcing of the RTC through support from government and other national and international funding bodies;

– Provide the regional association and the Secretary-General with annual reports about the RTC’s activities in the previous 12 months and its plans for the next 12 months with an outlook for future years;

– Collaborate with other Permanent Representatives hosting RTCs to promote collaboration between the RTCs;

– Oversee and act as an advocate for the RTC to (a) comply with national and WMO standards and guidelines and (b) keep pace with evolving technological and educational developments.

**Director of an RTC component**

– Monitor and plan the activities of the RTC component in accordance with the expressed education and training needs of the regional association;

– For vocational training activities, use processes within the RTC component that are consistent with ISO 29990:2010, *Learning services for nonformal education and training – Basic requirements for service providers*;

– Monitor the skills and capabilities of the RTC staff informing the appropriate authorities of the requirements to develop and maintain the professional and training expertise of staff and to ensure the availability and maintenance of an adequate infrastructure for training and for information and communications technology;

– Submit to the Permanent Representative annual reports about the activities of the RTC component in the previous 12 months and plans for the next 12 months with an outlook for future years;

– Inform Members, through regular communication, of the benefits of the services offered by the RTC component and provide them with easy access to the RTC’s education and training programme and contact information;

– Work with other RTC components to (a) coordinate activities and (b) share resources and experience in addressing regional education and training needs;

– Seek additional funding and resource opportunities to expand the ability of the RTC component to address the regional education and training needs.

**Coordinator of an RTC with multiple components**

– Coordinate the overall activities of the RTC components in accordance with the expressed education and training needs of the regional association;

– Coordinate preparation of annual reports about the RTC’s activities in the previous 12 months and plans for the next 12 months with an outlook for future years, for submission to the Permanent Representative;

– Coordinate arrangements for (a) promoting and providing information about the RTC’s services to Members through regular communication, and (b) the sharing of resources and experience among the RTC components in addressing regional education and training needs;

– Ensure that the RTC components collaborate and that each is apprised of the other’s education and training activities;

– Support the RTC components in seeking additional funding and resource opportunities to expand the ability of the RTC to address the regional education and training needs.

**1.6** **Status of meteorological personnel**

Each Member should ensure that meteorological personnel referred to in 1.1.1 above are accorded status, conditions of service and general recognition within that country commensurate with the technical and other qualifications required for the fulfilment of their respective duties.

**APPENDIX A. BASIC INSTRUCTION PACKAGES**

*(See Part V, 1.2.1.1, and Part VI, 1.3 and 1.4)*

**1. BASIC INSTRUCTION PACKAGE FOR METEOROLOGISTS**

**1.1 Overarching attributes and skills ~~General~~ of Meteorologists**

1.1.1 To satisfy the requirements of the Basic Instruction Package for Meteorologists, Members shall ensure that ~~the meteorological personnel achieve the following learning outcomes:~~ ~~m~~Meteorologists are able:

(a) ~~The acquisition of knowledge concerning physical principles and atmospheric interactions, methods of measurement and data analysis, behaviour of weather systems (through the synthesis of current weather data with conceptual models), and the general circulation of the atmosphere and climate variations;~~ To combine available sources of relevant observational data in a systematic way to produce coherent analyses of the state of the atmosphere at the spatial and temporal scales under consideration.

(b) ~~The ability to apply knowledge based on the use of scientific reasoning to solve problems in atmospheric science and to participate in the analysis, prediction and communication of the impacts of weather and climate on society.~~ To generate reasonable hypotheses for the evolution of the atmosphere in the region of interest in terms of relevant dynamic and physical processes and in terms of conceptual models.

(c) To predict the evolution of the state of the atmosphere and the degree of uncertainty in those predictions, combining relevant numerical model products with physical and dynamical thinking and empirical methods to a level of precision that is appropriate to the spatial and temporal scales under consideration and the known sources of uncertainty.

(d) To compare predictions with observations, using qualitative or quantitative methods to assess hypotheses and to ensure the quality of services, including through evidencing changes needed in hypotheses, products and services.

(e) To clearly and accurately communicate relevant information with colleagues, customers and other stakeholders using a range of media in a manner that reflects uncertainty and impacts.

(f) To determine the sensitivities of society to weather and climate phenomena, drawing on other disciplines where necessary, to ensure that the identification and warning of weather and climate impacts are central to the ~~m~~Meteorologists’ work.

(g) To evaluate their work outputs against relevant standards, take corrective action if needed, and contribute to the development of work systems and processes.

(h) To reflect on their learning and working practices, critically evaluate their performance and use a range of approaches to continuously develop their professional knowledge and competence*.*

~~Note: It is intended that satisfying the requirements of the Basic Instruction Package for Meteorologists will provide meteorological personnel with the knowledge, skills and confidence to develop their expertise and with a basis for further specialization.~~

**1.1.2 To satisfy the pre-requisite mathematics and physics requirements of the Basic Instructional Package for Meteorologists, Members shall ensure that ~~m~~Meteorologists are able:**

(a) To interpret and apply the mathematical language, concepts and techniques used in introductory meteorological literature and teaching materials.

(b) To use their mathematical knowledge to make logical and reasoned problem-solving decisions; to recognize incorrect reasoning; and to communicate their reasoning clearly using the language of mathematics.

(c) To apply and interpret the basic statistical measures used to summarize meteorological data and forecast output and to analyse errors.

(d) To represent physical and meteorological situations mathematically, understanding the relationship between the real world and the mathematical model and making reasonable interpretations of results.

(e) To use basic physical laws to solve problems related to mechanics, thermodynamics, wave motion and electromagnetic radiation.

Note: It is intended that satisfying the requirements of the Basic Instruction Package for Meteorologists will provide meteorological personnel with the knowledge, skills and confidence to develop their expertise and with a basis for further specialization.

**1.1.~~2~~ 3** **Members shall ensure that ~~m~~Meteorologists wishing to work in areas such as weather analysis and forecasting, climate modelling and prediction, and research and development, undertake further education and training to meet the specialized job competencies in these areas. In addition, Members shall ensure that ~~m~~Meteorologists enhance their knowledge and skills by participating in continuous professional development throughout their careers.**

Note: The requirements of the Basic Instruction Package for Meteorologists ~~will usually be satisfied through the successful completion of a university degree in meteorology or a postgraduate programme of study in meteorology following a university degree that includes the foundation topics in mathematics and physics – such topics are typically covered in science, applied science, engineering or computational courses. Where this is not the case, educational institutions will have to demonstrate that their programme of study provides the characteristic learning outcomes associated with a university degree course.~~ may be satisfied in a number of ways, such as: completion of a university degree in meteorology; completion of postgraduate study or a programme at an RTC or NMHS training centre in meteorology, having already completed studies in the pre-requisite mathematics and physics; accessing education and training from institutions as part of WMO Global Campus. What matters is that providers of education and training can evidence how their programmes of study aids students in achieving the learning outcomes defined above.

**1.1.4~~3~~** **Members should take the lead in consulting with the appropriate national and regional bodies to define the academic qualifications required of ~~m~~Meteorologists in their country. Members should also work with their national education and training establishments to ensure that meteorological graduates achieve all the learning outcomes of the Basic Instruction Package for Meteorologists as part of the academic qualification.**

**1.2 Essential ~~C~~ components of the Basic Instructional Package for Meteorologists**

Note: The aim is to ensure that a ~~m~~Meteorologist has the underlying knowledge and expertise that supports the learning outcomes associated with physical meteorology, dynamic meteorology~~, and numerical~~ weather ~~prediction~~ systems and services, ~~synoptic and mesoscale meteorology, and climatology~~ and climate science and services.

***~~1.2.1~~******~~Foundation topics~~***

**~~Members shall ensure that a meteorologist is able to:~~**

~~(a) Demonstrate the knowledge of mathematics and physics that is required to successfully complete the meteorological components of the Basic Instruction Package for Meteorologists;~~

~~(b) Demonstrate the knowledge of other sciences and related topics that complements the meteorological expertise covered in the Basic Instruction Package for Meteorologists;~~

~~(c) Analyse and utilize data, and communicate and present information.~~

***1.2.~~2~~1*** ***Physical meteorology***

**Members shall ensure that a ~~m~~Meteorologist is able ~~to~~:**

(a) ~~Explain the structure and composition of the atmosphere, the processes affecting the radiative transfer in the atmosphere and global energy balance, and the causes of optical phenomena in the atmosphere;~~ To use their knowledge of atmospheric composition and radiative transfer to explain the structure of the atmosphere, global energy balance and the greenhouse effect, and common optical phenomena.

(b) ~~Apply the laws of thermodynamics to atmospheric processes, use a thermodynamic diagram to assess the properties and stability of the atmosphere, identify the effect of water on thermodynamic processes and explain the processes leading to the formation of water droplets, clouds, precipitation and electrical phenomena;~~ To use the laws of thermodynamics to explain the stable stratification of the atmosphere and the effects of adiabatic and non-adiabatic processes, including the effects of water; to use a thermodynamic diagram to assess the properties and stability of the atmosphere.

(c) ~~Use knowledge of turbulence and surface energy exchanges to explain the structure and characteristics of the atmospheric boundary layer and the behaviour of contaminants;~~ To summarize the micro-physical processes involved in the formation of clouds, precipitation and electrical phenomena and use a thermodynamic diagram to diagnose and predict these phenomena.

(d) ~~Compare, contrast and explain the physical principles used in conventional instruments to make surface and upperair measurements of atmospheric parameters, and explain the common sources of error and uncertainty and the importance of applying standards and using best practices;~~ To use knowledge of turbulence and surface fluxes to explain the structure and characteristics of atmospheric boundary layers and the behaviour of contaminants.

(e) ~~Describe the range of meteorological data obtained from remotesensing systems, explain how radiation measurements are made and the processes by which atmospheric data are derived from those measurements, and outline the uses and limitations of remotesensing data.~~ To select instruments to observe surface and upper-air atmospheric phenomena, considering their physical principles of operation, sources and characteristics of error and uncertainty, and quality-control practices in use.

(f) To use relevant Earth- and space-based remote sensing to observe atmospheric and surface phenomena qualitatively and quantitatively; to explain how radiation measurements are made, how they are turned into atmospheric data, and what the uses and limitations of these data are.

***1.2.~~3~~2*** ***Dynamic meteorology***

**Members shall ensure that a ~~m~~Meteorologist is able ~~to~~:**

(a) ~~Explain the physical basis of the equations of motion in terms of forces and frames of reference, apply scale analysis to identify the dynamic processes in balanced flows, describe the characteristics of balanced flows, and use the equations of motion to explain quasigeostrophy, ageostrophy, and the structure and propagation of waves in the atmosphere;~~ To outline the application of the concepts of force, acceleration and frames of reference to a physics of atmospheric dynamics, as exemplified in the equations of motion.

(b) ~~Describe and explain the scientific basis, characteristics and limitations of numerical weather prediction for short, medium and longrange forecasting, and explain the applications of numerical weather prediction.~~ To apply conceptual models derived from dynamic meteorology to explain and predict the evolution of the atmosphere in the area of interest.

(c) To evaluate the extent to which conceptual models resemble reality.

(d) To use numerical model outputs to represent phenomena of interest based on knowledge of the characteristics of the modelling system, the spatial and temporal scales under consideration and the need to represent uncertainty.

***1.2.3~~4~~******~~Synoptic and mesoscale meteorology~~ Weather systems and services***

**Members shall ensure that a ~~m~~Meteorologist is able ~~to~~:**

(a) ~~Use physical and dynamical reasoning to describe and explain the formation, evolution and characteristics (including extreme or hazardous weather conditions) of synopticscale weather systems in midlatitude and polar regions and in tropical regions, and assess the limitations of theories and conceptual models of these weather systems;~~ To apply conceptual models of synoptic, mesoscale and convective-scale phenomena to integrate observed and forecast data into coherent structures; to explain the formation, evolution and characteristics of these phenomena using knowledge of physical and dynamical meteorology.

(b) ~~Use physical and dynamical reasoning to describe and explain the formation, evolution and characteristics (including extreme or hazardous weather conditions) of convective and mesoscale phenomena, and assess the limitations of theories and conceptual models of these phenomena;~~ To detect situations where real-world weather systems deviate from the conceptual models using knowledge of the models’ limitations and suggest reasons for the deviations.

(c) ~~Monitor and observe the weather situation, and use realtime or historical data, including satellite and radar data, to prepare analyses and basic forecasts;~~ To predict occurrences of extreme or hazardous weather conditions associated with synoptic, mesoscale or convective-scale phenomena and monitor observed data to verify the predictions.

(d) ~~Describe service delivery in terms of the nature, use and benefits of the key products and services, including warnings and assessment of weatherrelated risks.~~ To generate analyses and basic forecasts using observed and forecast real-time or historical data, including the monitoring and observing of the weather.

(e) To summarize the role of national meteorological services and other providers using knowledge of society’s needs, the impacts of severe weather, the products and services used to meet users’ needs and the processes used to manage quality.

***1.2.~~5~~4*** ***~~Climatology~~ Climate science and services***

**Members shall ensure that a ~~m~~Meteorologist is able ~~to~~:**

(a) ~~Describe and explain the Earth’s general circulation and climate system in terms of the physical and dynamical processes that are involved, and describe the key products and services based on climate information and their inherent uncertainty and use;~~ To apply conceptual models of the Earth’s global circulation, climate system and the interactions between the land, ocean, atmosphere and cryosphere to explain the mean state of the climate.

(b) ~~Apply physical and dynamical reasoning to explain the mechanisms responsible for climate variability and climate change (including the influence of human activity); describe the impacts in terms of possible changes to the global circulation, primary weather elements and potential effects on society; outline the adaptation and mitigation strategies that might be applied; and describe the application of climate models.~~ To interpret products and services based on climate information, taking into account their inherent uncertainty.

(c) To describe the observed variability in the climate system and the causes and impacts of that variability; to use this knowledge to interpret products such as climate predictions and monthly to seasonal forecasts.

(d) To communicate the results of monthly, seasonal and climate predictions based on an understanding of probability, uncertainty and predictability at different scales and the sensitivities of the audience.

(e) To explain the long-term changes occurring in the climate system using knowledge on how these changes are observed, what the drivers for change are, including feedback within the system, what the potential impacts of climate change are, and what adaptation and mitigation strategies are possible.

~~A.~~**2 BASIC INSTRUCTION PACKAGE FOR METEOROLOGICAL TECHNICIANS**

**2.1** **~~General~~ Overarching attributes and skills of Meteorological Technicians**

**2.1.1** **To satisfy the requirements of the Basic Instruction Package for Meteorological Technicians, Members shall ensure that ~~the~~ ~~m~~Meteorological ~~personnel achieve the following learning outcomes: t~~Technicians are able:**

(a) ~~The acquisition of basic knowledge concerning physical principles and atmospheric interactions, methods of measurement and data analysis, a basic description of weather systems, and a basic description of the general circulation of the atmosphere and climate variations;~~ To apply basic knowledge of meteorology, geography and related sciences to observe and monitor the atmosphere.

(b) ~~The ability to apply basic knowledge to observe and monitor the atmosphere and interpret commonly used meteorological diagrams and products.~~ To interpret available sources of observational data and commonly used meteorological diagrams and products to produce coherent descriptions of the state of the atmosphere at the spatial and temporal scales under consideration.

(c) To identify, analyse and resolve the issues involved in setting up and maintaining meteorological instrumentation in the area of responsibility.

(d) To communicate with colleagues, customers and other stakeholders using a range of media with relevance, clarity and precision.

(e) To determine the sensitivities of society to weather and climate phenomena, drawing on other disciplines where necessary, to ensure that the impacts of weather and climate on people and society are central to their work.

(f) To evaluate their work outputs against relevant standards, take corrective action if needed and contribute to the development of work systems and processes.

(g) To reflect on their learning and working practices, critically evaluate their performance and use a range of approaches to continuously develop their professional knowledge and competence*.*

**2.1.2** **To satisfy the pre-requisite mathematics and physics requirements of the Basic Instructional Package for ~~m~~Meteorological ~~t~~Technicians, Members shall ensure that Meteorological Technicians are able:**

(a) To demonstrate the knowledge of mathematics and physics required to successfully complete the meteorological components of the BIP-MT.

Note: It is intended that satisfying the requirements of the Basic Instruction Package for Meteorological Technicians will provide meteorological personnel with the knowledge, skills and confidence to develop their expertise and with a basis for further specialization.

**2.1.~~2~~3** **Members shall ensure that ~~m~~Meteorological ~~t~~Technicians wishing to work in areas such as weather observation, climate monitoring, network management, and provision of meteorological information and products to users, undertake further education and training to meet the specialized job competencies in these areas. In addition, Members shall ensure that ~~m~~Meteorological ~~t~~Technicians enhance their knowledge and skills by participating in continuous professional development throughout their careers.**

Note: The requirements of the Basic Instruction Package for Meteorological Technicians will be usually satisfied through the successful completion of a postsecondary programme of study at an establishment such as a training institution of a National Meteorological and Hydrological Service or college of further education.

**2.2** **Essential ~~C~~ components of the Basic Instruction Package for Meteorological Technicians**

Note: The aim is to ensure that a ~~m~~Meteorological ~~t~~Technician has the underlying knowledge and expertise that supports the learning outcomes associated with basic physical and dynamic meteorology, basic synoptic and mesoscale meteorology~~., basic climatology, and meteorological instruments and methods of observation.~~

***2.2.1*** ***~~Foundation topics~~ Basic geography, oceanography and hydrology***

**Members shall ensure that a ~~m~~Meteorological ~~t~~Technician is able ~~to~~:**

(a) ~~Demonstrate the knowledge of mathematics and physics that is required to successfully complete the meteorological components of the Basic Instruction Package for Meteorological Technicians;~~ To describe the basic geographical, oceanographical, and hydrological features of the region of responsibility.

~~(b) Demonstrate the knowledge of other sciences and related topics that complements the meteorological expertise covered in the Basic Instruction Package for Meteorological Technicians;~~

~~(c) Analyse and utilize data, and communicate and present information.~~

***2.2.2*** ***Basic physical and dynamic meteorology***

**Members shall ensure that a ~~m~~Meteorological ~~t~~Technician is able ~~to~~:**

(a) ~~E~~ To explain the basic physical and dynamical processes that take place in the atmosphere~~;~~.

(b) ~~E~~ To explain the physical principles used in instruments to measure atmospheric parameters.

***2.2.3*** ***Basic synoptic and mesoscale meteorology***

**Members shall ensure that a ~~m~~Meteorological ~~t~~Technician is able ~~to~~:**

(a) ~~D~~ To describe the formation, evolution and characteristics of synoptic-scale and mesoscale tropical, mid-latitude and polar weather systems, ~~and~~ to analyse weather observations~~;~~.

(b) ~~D~~ To describe the forecast process and the use made of the associated products and services.

***2.2.4*** ***~~Basic~~ Global and local climatology***

**Members shall ensure that a ~~m~~Meteorological ~~t~~Technician is able ~~to~~:**

(a) ~~Describe the general circulation of the atmosphere and the processes leading to climate variability and change;~~To describe the global circulation of the atmosphere, the climates in the region of responsibility, and key climate products and services.

(b) ~~Describe the use made of products and services based on climate information.~~To outline the basic concepts behind climate variability and climate change.

***2.2.5*** ***Cloud formation***

**Members shall ensure that a ~~m~~Meteorological ~~t~~Technician is able:**

(a) To describe the formation and characteristics of the main cloud and precipitation types.

***2.2.~~5~~6*** ***Meteorological parameters, instruments and methods of observation***

**Members shall ensure that a ~~m~~Meteorological ~~t~~Technician is able ~~to~~:**

(a) ~~Explain the physical principles used in instruments to measure atmospheric parameters;~~To describe how weather phenomena are measured from ground-, air- and space-based instruments.

(b) ~~Make basic weather observations.~~ To make a basic weather observation based on the evaluation and interpretation of data from ground-, air- and space-based instruments.

***2.2.7*** ***Basic climate-data quality control***

**Members shall ensure that a ~~m~~Meteorological ~~t~~Technician is able:**

(a) To describe and apply climate-data quality control procedures.

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