

	TANZANIA CIVIL AVIATION AUTHORITY AIR NAVIGATION SERVICES INSPECTORATE	Revision: 1
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1.0 PURPOSE

1.1 This Advisory Circular (AC) is issued to provide general information and guidance on the development of a training programme for technical staff providing Aeronautical Meteorological services for air navigation.

2.0 REFERENCES.

- 2.1 Tanzania Civil Aviation (Air Navigation services) Regulations.
- 2.2 ICAO Annex 3 – Meteorological Services for International Air Navigation
- 2.3 Doc 8896 – Manual of Aeronautical Practice;
- 2.4 WMO Documents 258-Guidelines for Education and training of personnel in Meteorology and operational hydrology

3.0 GUIDANCE AND PROCEDURES

3.1 General

3.1.1 Meteorological services for air navigation shall be provided by the designated Meteorological Authority. Details of the services provided are included in the Manual of ANS Standards, Part I Section 3. A suitable number of meteorological offices, watch offices and other meteorological stations shall be established to provide information required for operational planning, flight operations, the protection of aeronautical equipment on the ground and for various other aeronautical uses.

3.1.2 The information provided includes observations and reports of actual weather conditions at aerodromes and forecasts. This information is made available at aerodrome meteorological offices and is disseminated as appropriate to aeronautical users including operators, flight crew members, air traffic services units, search and rescue units, airports and others concerned with the conduct, or development of air navigation.

3.1.3 The Authority is hereby recommending a systematic approach in the provision of training to technical staff engaged in provision of meteorological services for air navigation.

3.2 Categories of personnel to be trained

- 3.2.1 The following categories of personnel are covered by this circular
- a) Aeronautical Meteorological Observers

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- b) Aeronautical Meteorological Forecasters

3.2.2 Minimum Academic Qualification

- a) Aeronautical Meteorological Observers; a person who has completed the basic Instruction Package for Meteorological Technicians (BIP-MT)
- b) Aeronautical Meteorological Forecasters: a person who holds a university level degree or equivalent,; has acquired an appropriate level of knowledge of mathematics, physics, chemistry and computer science and has completed the Basic Instruction Package for Meteorologists (BIP-M)

3.3 Approved training organizations

3.3.1 A number of organizations provide training in aviation meteorology. The CAA shall provide oversight to organizations providing training to personnel involved in the provision of meteorological service for air navigation.

3.4 Requirements for training

3.4.1 Aeronautical Meteorological Forecaster

Basic education and training of meteorological personnel engaged in the provision of meteorological forecast for aeronautical purposes is similar to that of all meteorological personnel engaged in operational weather forecasting. However, for AMF, the weather forecasting instruction should be supplemented by special courses in aviation knowledge and procedures for meteorological service to International air navigation. Particular emphasis is to be placed on study, analysis and forecasting of influence of the atmosphere on the operation of aircraft. Particular hazardous weather phenomena to be considered include; low visibility and /or low cloud at aerodromes, low level wind shear, turbulence (including clear-air-turbulence), icing, thunderstorms, tropical cyclones, upper winds and temperature, jet streams, tropopause and volcanic ash. The time taken to acquire this aeronautical meteorology specialization will primarily depend on the prior meteorological training and experience of the individual trainee. As a guide , an experienced forecaster from an alternative specialization would likely require around 60hours tuition combined with some two to six week's supervised on the job experienced in order to perform completely as an aeronautical forecaster.

However, for a trainee with little forecasting experience, the aeronautical specialization would likely require a minimum of around 240hours tuition combined

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with some three to nine month's supervised on the job experience. In order to gain the maximum benefit of the on the job experience, this period should encompass situations where the trainee will be exposed to both hazardous and non- hazardous weather conditions.

Alternatively, some nations could assess competency of aeronautical meteorological Forecasters before they would be assigned to the position of aeronautical meteorological Forecasters. Passing this assessments could be regarded as a proof of fulfilling competency requirements, irrespective of the length of the training period (which may fall outside the above recommended number of tuition hours).

3.4.2 Knowledge and Skills requirements in Weather Forecasting forecasters

working in meteorological offices serving International air navigation must have the knowledge and skills to maintain an appropriate weather watch to analyze the weather situation and prepare and communicate weather forecasts. The guidance below is recommended by WMO and CAA;

a) Atmospheric processes and phenomena; know and be able to explain the main atmospheric processes and phenomena from the planetary to local scales; and know the region-specific weather phenomena, and be able to interpret the major meso-local scale particularities of the atmospheric dynamics over the assigned area.

b) Analysing and monitoring the weather; analyse and interpret synoptic charts, diagrams and graphics, integrate all available data to produce a consolidated diagnosis, perform real -time weather monitoring, utilizing all available remote sensing technologies such as radar surveillance and satellite imagery, constantly monitor the actual weather evolution, particularly the severe weather aspects associated with micro climates in the assigned

c) weather forecasting; know and be able to apply weather forecasting principles, methods and techniques, understand the operation of NWP models, and be able to utilize their strengths while being aware of their weaknesses. verify, interpret and use NWP output, adding value to model or guidance forecasts where appropriate.

d) user-specific forecasts and warnings; elaborate and distribute regional/local and user specific forecasts, verify the ongoing forecasts, identify errors and amend erroneous forecasts as appropriate, issue warnings, and provide reliable emergency services. comprehend users' needs and risk- taking limitations.

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e) information technology and data processing; know and be able to use the operational system technology and understand and be able to apply basic operating system functions, data processing and visualization technology.

3.4.3 Specific knowledge and skills for aeronautical Forecaster

in addition to the general weather analysing and forecasting skills, an aeronautical forecaster is required to have skills in diagnosing and forecasting aviation specific phenomena, knowledge and skills in the use of aviation specific codes and practices, as well as an appreciation of the impact of their forecasts on aviation operations.

Those recommended by CAA, are summarized below;

a) weather phenomena; understand the weather phenomena hazardous to aviation, and their analysis and forecasting ; understanding which meteorological parameters are crucial for safety and regular operations of aviation groups.

b) Aviation specific phenomena. Enable to forecast aircraft icing, turbulence, wind shear, volcanic ash dispersal, other hazardous phenomena.

c) weather monitoring; perform continuous monitoring of weather phenomena relevant to aviation including the use of reports from aircraft where available, understand the evolution of weather phenomena observed at the aerodrome, carry out the required observations and measurements.

d) Meteorological codes; know all aeronautical meteorological codes, and criteria applied for warnings and change groups in TAF and TREND

e) Satellite and radar interpretation; know how to interpret satellite and radar imagery, including analysis of evolution of convective system, frontal systems and tropical cyclones, location of fog and stratus, gravity waves in cirrus cloud and jet-streams, and detection of icing potential in layer cloud, and of volcanic ash and wind-shear.

f) weather forecasting; know and apply standards methods, techniques, and other numerical tools for forecasting low clouds, winds (including gusts) , fogs and reduced visibility, thunderstorms, heavy precipitation, hail, tropical cyclones, and volcanic ash cloud, displacement, and know and apply customary algorithms and methods to forecast icing, mountain waves and turbulence(including clear-air turbulence)

g) Local forecaster's responsibilities; Perform proficiently the local forecaster's responsibilities, including the evaluation and dissemination of aerodrome warnings and short period forecasts, and understand and appreciate competently the local users' operational requirements.

h) Special air-reports; be able to assess special air-reports and , if appropriate, issue the corresponding SIGMET message.

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- i) International Programmes; understand the functioning, interpretation and use of products from the World Area Forecast System (WAFS), understand the functioning, interpretation and use of products provided by the Volcanic Ash Advisory Centres (VAACs) and the requirements of the International Airways Volcano Watch (IAVW); understand the functioning of the Tropical cyclone Advisory Centers (TCACs), and cooperate operationally with air traffic services units.
- j) Aviation operations; know meteorological aspects of flight planning, definitions, procedures for meteorological services for international air navigation. Air Traffic Services (AIS) and aeronautical telecommunications.
- k) WMO and CAA documentation; Familiarize with the documents contained in the reference list.

3.4.4 Competency Requirements in Aeronautical Meteorology

In addition to the knowledge requirements set out above, a practising forecaster should have developed appropriate 'job competencies'. These comprise the characteristics that should be displayed on a day-to-day basis. They demonstrate not only that a forecaster can apply the knowledge identified in section 3.4.2 and 3.4.3 above, but also that the knowledge has been adapted to the local area. Additional to this, job competencies also demonstrate whether the forecaster has understood the special requirements of the area of operations, and can interpret which elements of the job competencies are of high and which are of lower importance. That balance will change depending on the region.

Job competency will vary from country to country and job to job but the following are the minimum generic competencies that should be demonstrated by all aeronautical forecasters;

- a) Perform weather watch and monitoring, including the ability to detect and forecast hazards relevant to aviation community, in accordance with CAA regulations and WMO requirements.
- b) Derive forecast and warning products to the standards required by the user community.
- c) Communicate effectively, using appropriate language, with aeronautical users, including oral briefings to pilots and dispatchers as necessary.
- d) Tailor meteorological products and services to aviation operations, in accordance with local aviation procedures and regulatory requirements.

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3.4.5 Syllabus Framework for Aeronautical Meteorological Forecasters.

The training of new aeronautical meteorological forecasters is set out in detail in the Guide lines. The following syllabus is intended to be used to both confirm that the training of existing aeronautical forecasters is adequate and to help identify any gaps or omission so that they may be corrected and the integrity of air safety maintained. The following list is recommended by CAA, it enumerates the topics that should be covered; however, bearing in mind that this syllabus provides the underpinning skills and knowledge for the competencies, the order of presentation and the extent to which the topics are addressed may vary from one country to another depending on local conditions.

- a) Aircraft icing;
- Theory of formation of icing; processes and dependence upon temperature, drop size, liquid-water content, airframe configuration and aircraft speed.
 - Types of icing, clear ice, rime ice, hoar frost and mixed ice.
 - Ice accretion rates; association with cloud types; thunderstorms; freezing precipitation; orographic and frontal lifting effects.
 - ICAO criteria for reporting icing.
 - Methods of diagnosing and forecasting the risk of icing, and means of avoiding icing areas.
- Operational problems associated with icing: formation and effects of in-flight icing on different types of aircraft; formation or deposition on parked aircraft; formation of in-flight icing in engines.
- b) Turbulence
- Turbulence near the ground; mechanical turbulence; convective turbulence; effects of boundary-layer turbulence on take-offs and landings; turbulence related to clouds, fronts and thunderstorms.
 - High-level Clear Air Turbulence (CAT); association with wind shear, jet streams, stability and tropopause inversion.
 - Mountain wave turbulence (both boundary layer and high-level).
 - Gravity waves.
 - Wake vortex.
 - ICAO criteria for reporting turbulence and mountain waves.
 - Methods of diagnosis and forecasting the risk of turbulence.
 - Operational problems associated with turbulence; means of avoiding turbulence areas

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- c) Other hazardous phenomena,
- Reduced surface visibility; fog types and their formation and dissipation; and other weather phenomena causing reduced surface visibility.
 - Low-level clouds; operational problems associated with low-level clouds in the terminal area and en-route.
 - Thunderstorms; associated phenomena; types: air-mass and severe thunderstorms.
 - Use of weather/Doppler radar for detecting and forecasting hazardous phenomena.
 - Wind shear; operational problems associated with wind shear in the approach and landing phases of flight.
 - Tropical cyclones; operational problems associated with tropical cyclones.
 - Volcanic ash; operational problems associated with volcanic ash.
- d) meteorological services for international air navigation ;
- Air navigation plans; the associated facilities and implementation document (FASID).
 - WAFS; and World Area Forecast Centres (WAFCs) and their functions.
 - Warnings for volcanic ash; VAACs and their functions; and IAVW.
 - Warnings for tropical cyclones; TCACs and their functions. • Meteorological offices and their functions; trend forecasts and TAF; wind shear and aerodrome warnings.
 - Meteorological watch offices; scope of meteorological watch; SIGMET and AIRMET information.
 - Aeronautical meteorological stations; their functions; local routine and special reports, METAR and SPECI.
 - Information for operators and flight crew members prior to departure, display of meteorological information and flight documentation.
 - Information for aircraft in flight, VOLMET broadcasts and D-VOLMET.
 - Information for and from air traffic services; types of meteorological information required by ATS; transmission of aircraft meteorological reports by ATS.
 - Forms of meteorological messages; local routine and special reports; METAR and SPECI, TAF and amendments thereto; trend forecasts; route and area forecasts (including GAMET); SIGMET and AIRMET

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information; tropical cyclone and volcanic ash advisory; units of measurements.

- Information for search and rescue.
- Aeronautical climatological information.

e) Meteorological aspects of flight planning:

- Meteorological basis for flight planning: great circle track; composite tracks; wind components; minimum time tracks; D-value; drift angle.
- Requirements for en-route and aerodrome forecasts and reports; use of forecasts from the WAFS; direct supply of information to operators for centralised operational control.
- Preparation of area and route forecasts.
- Briefing of flight crews and operational personnel

f) Air traffic services:

- Visual and Instrument Flight Rules (VFR/IFR); and Visual and Instrumental Meteorological Conditions (VMC/IMC).
 - Flight Information Service, Automatic Terminal Information Service (ATIS).
 - Low Visibility Procedures (LVP)
- Air Traffic Control Service; terrain clearance; cruising level system; vertical separation minima; horizontal separation.
- Functions of Area Control Centre, Approach Control Unit, Aerodrome Control Tower and Flight Information Centre; holding and approach procedures.
- Search and Rescue Services.
- CNS/ATM systems.
- Air reporting; position reporting and meteorological reporting procedures, Automatic Dependent Surveillance (ADS).
- Co-ordination between ATS units and the meteorological service; meteorological observations performed by ATC.
- Transition levels, layers and altitudes; the lowest usable flight level en-route.
- Category II and III operations; role of runway visual range and height of cloud base.

g) Aerodromes:

- Aerodrome lighting; its relation to operations in lower visibility conditions and to runway visual range (RVR) assessment.

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- Effects of meteorological parameters on aerodrome ground services; snow (snow clearing), precipitation (the effect of wet runways on braking action).
 - Parameters related to meteorology required by aerodrome authorities; aerodrome reference temperature, state of the runway, local climatological conditions (their effects on noise and atmospheric emissions by aircraft operations).
 - Aerodrome capacity management and its relation to operations in poor weather conditions.
- h) Operation of aircraft:
- Aerodrome operating minima; minima applicable to the regular and alternate international aerodromes
 - Approach systems: visual and instrumental.
 - Categories of operations.
 - Altimeter setting procedures; the ICAO Standard Atmosphere.
 - Basic flight navigation, the principal aids to navigation basic aerodynamics; methods of determining wind in flight. .
 - Effects of meteorological parameters and phenomena on aircraft performance and fuel consumption.
 - Special requirements of general aviation (IGA) and helicopter operations
- i) Aeronautical information services:
- Aeronautical Information Publication (AIP); Aeronautical Information Circular (AIC); meteorological elements required.
 - NOTAM/ASHTAM/SNOWTAM.
 - ICAO Abbreviations and Codes.
 - Information concerning the meteorological service aeronautical charts.
- j) Aeronautical telecommunications
- Organization of aeronautical telecommunications; procedures applicable to the preparation of meteorological messages.
 - Operation of the Aeronautical Fixed Service (AFS); Aeronautical Fixed Telecommunication Network (AFTN); Aeronautical Telecommunications Network (ATN).
 - Message headings, addressing of messages, priorities of messages; regional aeronautical MET telecommunication procedures (AMBEX, ROBEX).

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- Satellite distribution system for information relating to air navigation (SADIS) and international satellite communications system (ISCS).
- k) ICAO definitions and terms (as defined in ICAO Annex 3, Chapter 1):
- Air-report, meteorological report, briefing, forecast, observation, GAMET area forecast, SIGMET and AIRMET information.
 - Visibility (for aeronautical purposes); prevailing visibility; runway visual range.
 - Altitude, elevation, height, density altitude, pressure altitude, flight level, cruising level, transition altitude, transition level, transition layer.
 - Operator, operator’s local representative, pilot-in-command.
 - Flight information region, terminal area, controlled airspace, advisory airspace, control zone, ATS route, airway, advisory route, air traffic control service, air traffic advisory service, flight information service, alerting service; aerodrome control tower, area control centre, approach control unit.
 - Aerodrome, instrument runway, landing area, movement area, obstacle free zone, final approach, circling approach, initial visual approach, missed approach; take-off and initial climb-out phase.
 - "Service"; "provide", "issue", "make available", "supply"; "designated meteorological authority", "meteorological service provider".

3.5 Aeronautical meteorological observers

The basic education and training of meteorological personnel engaged in meteorological observing for aeronautical purposes are similar to that of all meteorological personnel engaged in all operational weather observing.

3.5.1 Knowledge and skills requirements in weather observing

In order to carry out these duties and tasks, observers need to constantly monitor the local meteorological conditions;

- a) Surface observations. Make surface meteorological observations; observe and record the parameters that make up a meteorological message; encode the observations in the standard format; transmit coded information.

- (b) Weather watch. Analyse observations in the local area and be in a position to identify probable significant changes in weather at the station; know and understand the region-specific weather phenomena; be aware of likely weather sequences that are expected to affect the station.

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(c) Weather alert. Understand a basic weather briefing or forecast, so as to be able to identify changes from the expected evolution at the station; alert the duty forecaster and external users to observed changes in the weather within the local area.

(d) Product distribution. Distribute data and information; disseminate messages to users; issue routine and non-routine reports in accordance with normal working practice; answer questions from users.

(e) Equipment maintenance. Carry out routine maintenance of observing/office equipment; operate and maintain automated weather stations, as appropriate.

3.5.2 Specific knowledge and skills for aeronautical observing

In addition to the general observing skills, an aeronautical observer is required to constantly monitor the meteorological conditions at the aerodrome and its vicinity; and to have skills and knowledge in the use of aviation specific codes and practices as well as an appreciation of the impact of their observations on aviation operations.

(a) Aeronautical observations. Knowledge of the procedures for the making of routine and special observations and reports (*).

(b) Hazardous phenomena. Elementary knowledge of the phenomena hazardous to aviation.

(c) Meteorological aspects of flight planning. Knowledge of the technical regulations .

(d) Reporting, coding, and dissemination of weather information. Knowledge of the technical regulations .

(e) Definitions. Knowledge of the aeronautical definitions .

(f) Procedures for meteorological services for international aviation .

(g) Air traffic services. Knowledge of the technical regulations .

(h) Operation of aircraft. Elementary knowledge of the operations .

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- (i) Aeronautical telecommunications. Elementary knowledge of the general organization of aeronautical telecommunications
- (j) WMO and ICAO documentation. Knowledge of the documents

3.5.3 Competency requirements in aeronautical observing

Following training, it is usual for observers to undergo a period of on-the-job training at an aviation observing office before being permitted to operate unsupervised. During this period of training, observers develop the job competencies;

- (a) Make and disseminate aeronautical weather observations in accordance with ICAO and WMO regulations.
- (b) Identify hazardous aviation conditions and their likely impact on aircraft operations.
- (c) Describe the impact of a range of meteorological conditions on aviation operations and procedures.
- (d) Assist the aeronautical aviation forecaster.

3.5.3 Syllabus framework for AMO

The following syllabus is intended to be used to both confirm that the training of existing aeronautical observers is adequate and to help identify any gaps or omissions so that they may be corrected and the integrity of air safety maintained

- (a) Observing techniques:
 - Surface wind direction and speed; wind variations.
 - Visibility; definition of visibility for aeronautical purposes.
 - RVR, spatial and temporal variations, methods of assessment;
 - Vertical visibility.
 - Cloud amount, height and type; spatial and temporal variations;
 - Pressure; determining QFE and QNH;
 - Meteorological observing equipment calibration standards and maintenance procedures
- (b) Hazardous phenomena:
 - Aircraft icing; icing types; formation, accretion rates and association of icing with clouds, freezing precipitation, orographic and frontal lifting.

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- Turbulence; turbulence near the ground, high-level turbulence (CAT).
- Reduced surface visibility.
 - Low-level clouds.
- Thunderstorms; associated phenomena.
- Tropical cyclones.
- Wind shear.
- Volcanic ash.

(c) Meteorological aspects of flight planning:

- Meteorological requirements for en-route and aerodrome forecasts and reports.
- Interpretation of area, route and terminal forecasts.
- Preparation of material for briefing of flight crews.

(d) Reporting, coding and dissemination of weather information.

- Meteorological codes related to observations and forecasts; METAR, SPECI, SYNOP, PILOT, TEMP, TAF and ROFOR.
- Dissemination of weather information at the aerodrome; special needs of ATC units.
- Plain language forms of meteorological messages. Local routine and special reports.

(e) ICAO definitions and terms:

- Meteorological report, observation.
- Visibility (for aeronautical purposes), runway visual ranges.
- Altitude, elevation, height, aerodrome elevation, flight-level, transition level.
- Aerodrome meteorological minima, instrument runway, landing area.
- Landing forecast, aerodrome forecast, GAMET area forecast.
- SIGMET and AIRMET information; briefing; routine and special air-report.
- Operator, pilot-in-command.

(f) Meteorological services for international aviation:

- Meteorological offices and meteorological watch offices; their functions.
- Aeronautical meteorological stations; their functions.
- Local routine and special observations and reports, METAR and SPECI.

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- Aircraft observations and reports; their ground-to-ground dissemination.
- Responsibilities of ICAO and WMO in aeronautical meteorology.

(g) Air traffic services:

- Meteorological information required by air traffic services units; duplicate displays required in ATS units.
- Category II and III operations; role of runway visual range and height of cloud base information.
- Low Visibility Procedures (LVP).

(h) Operation of aircraft:

- Flight planning.
- Navigation and landing aids.
- Effects of meteorological parameters on aircraft performance and fuel consumption.
- Altimeter setting procedures, standard atmosphere.
- Effects of meteorological phenomena on aerodrome ground services.

(i) Aeronautical telecommunications:

- Organization of aeronautical telecommunications.
- Aeronautical fixed service (particularly AFTN and ATN), and any special broadcasts and/or regional telecommunications networks applicable to the region concerned.
- Message headings, addressing of messages, priorities of messages and any appropriate regional procedures.
- ICAO abbreviations and codes.

3.4.3 On-the-Job Training

3.4.3.1 The designated Meteorological Authority shall ensure that performance based OJT programmes are conducted before any individual can be approved to carry out specified duties.

3.4.3.2 The designated Meteorological Authority shall engage qualified OJT instructors to carry out specialized training in the field.

3.4.4 Refresher training

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3.4.4.1 The designated Meteorological Authority shall determine the type of refresher training necessary to meet operational requirements in line with the services described in regulation 41 of the Civil Aviation (Air Navigation Services) Regulations and in the AC. Additionally, in order to cope with changing technology and operating procedures, it is necessary that the designated Meteorological Authority provides personnel with courses of instruction designed to bring knowledge and skills up to date.

3.4.4.2 Refresher courses may range from in-house to fully fledged training in specialized training organizations.

3.4.5 Recurrent training

3.4.5.1 The designated Meteorological Authority shall determine the type of recurrent training necessary to meet operational requirements in line with the Civil Aviation (Air Navigation Services) Regulations.

3.4.5.2 The designated Meteorological Authority shall determine the type of recurrent training necessary to meet operational requirements in line with the services described in regulation 41 of the Civil Aviation (Air Navigation Services) Regulations and in this AC.

3.4.5.3 Recurrent training will be provided to ensure that the technical staff remain current and that there is no need to retrain personnel following a long period of not practicing.

3.5 Training records

3.5.1 The designated Meteorological Authority shall ensure that training records, including OJT are properly kept for inspection by the CAA as may be required.

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3.5.2 The training records shall include certificates, OJT tasks performed and any other documents related to training and approval of jobs performed.



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