



NAMIBIAN CIVIL AVIATION AUTHORITY

Advisory Pamphlet (AP)

ANSSO-MET-AP174/05

05/2020

CALIBRATION OF METEOROLOGICAL INSTRUMENTS

1. **Explanation of Advisory Pamphlets (AP) system.** The Namibian Civil Aviation Authority (NCAA) issues advisory pamphlets to inform the aviation public in a systematic way of non-regulatory material. Unless incorporated into a regulation by reference, the contents of an advisory circular ~~are~~^{is} not binding on the public. Advisory pamphlets are issued in a numbered-subject system corresponding to the subject areas of the Namibian Civil Aviation Regulations (NAMCARs).
2. **Advisory Pamphlets** are intended to provide information and guidance to illustrate a means but not necessarily the only means of complying with the Regulations, or to explain certain Regulatory requirements by providing interpretative and explanatory material. Where an AP is referred to in a 'Note' below the regulation, the AP remains as guidance material.

APs should always be read in conjunction with the referenced regulations

3. **Reproduction of Advisory Pamphlets.** Advisory pamphlets may be reproduced in their entirety or in part without permission from the Civil Aviation Authority.

Effective date: 28 May 2020



Reinhard Gärtner (Mr.)
Interim Executive Director of Civil Aviation



CALIBRATION OF METEOROLOGICAL INSTRUMENTS

1. Purpose

- 1.1 This Advisory Pamphlet (AP) provides information and guidance relating to the calibration of meteorological instruments for air navigation.
- 1.2 The calibration of instruments established shall comprise procedures and processes necessary to provide calibration and maintenance of the instruments providing information to the users.

2. Background

- 2.1 It is necessary to calibrate instruments prior to their deployment in order to ensure high-quality observational data.
- 2.2 Comparison and calibration must also be performed periodically to track instrument performance and enable appropriate correction.
- 2.3 This calibration and comparison require a system of standard meteorological instruments.
- 2.4 The NAM-CARs Parts 174 requires the designated MET service provider to establish procedures for the periodic, inspection and calibration of each facility listed in their manual.
- 2.5 NAM-CARs Part 174 further requires the designated MET service provider to ensure that the established inspection, testing and calibration systems are in accordance with the provisions of Part 174 and the national standards prescribed in NAMCATS Part 174.
- 2.6 Below are the extracts from the Civil Aviation Regulations Part 174 – Meteorology to which this Advisory Pamphlet apply.

3. Extracts from NAM-CARS, PART 174

174.03.11 Verification, periodic inspection, testing and calibration

- (1) A MET service provider must establish procedures for:
 - (a) routine verification of meteorological information it provides,
 - (b) periodic inspection of each meteorological office listed in the manual of procedure;
 - (c) the periodic inspection, testing and calibration of each facility listed in their manual.

- (2) The procedures established in accordance with sub-regulation (1) must ensure that:
- (a) the systems required for the routine verification of meteorological information have the capability and integrity necessary for verifying the meteorological information; and
 - (b) appropriate inspection equipment and systems are available to personnel for the inspection of each meteorological office; and
 - (c) appropriate inspection, measuring and test equipment and systems are available to personnel for the inspection, testing and calibration of each facility; and
 - (d) the inspection, measuring and test equipment and systems have the precision and accuracy necessary for the inspections, measurements and tests being carried out; and
 - (e) all meteorological sensing facilities are calibrated and configured so that the environmental sensors fitted or incorporated yield, as far as possible, reliable, accurate and representative meteorological information.

4. Extracts from NAM-CATS-MET

174.03.7 Facility Requirements

1. MET facility requirements

- 1.1 MET facilities intended for provision of meteorological information for air navigation must comply with the standards prescribed in this Part and the related standards prescribed by the World Meteorological Organisation.
- 1.2 Automatic meteorological sensors must be capable of operating continuously and unattended for extended periods of time. The instruments must be able to re-start automatically after a power failure and must not require any human intervention to return to normal operation.
- 1.3 Satisfactory documentation must be provided to cover installation, starting up, normal use, periodical maintenance, field calibration, troubleshooting and repair of the instruments and in this regard, the supplier of the instruments must provide training on the use and maintenance of the instruments it supplies.

- 1.4 The meteorological instruments must be capable of monitoring their own operation. Alternatively, the automatic meteorological observing system must be able to monitor the instruments. Incorrect information must not be transmitted in the case of instrument failure or external influences, e.g. snow blocking the lens of a sensor.
- 1.5 The meteorological instruments must maintain their specified accuracies within routine maintenance and calibration intervals.
- 1.6 Calibration of the meteorological instruments must be possible to carry out in the field, or the instruments must be easy to remove and transport to a calibration facility. The manufacturer must specify a recommended calibration interval or long-term stability of the equipment. The manufacturer must document calibration procedures for the instruments to be calibrated in the field and provide any special tools necessary.
- 1.7 The instruments must be safe to install, operate, calibrate and maintain.
- 1.8 Equipment installed outdoors must be capable of operating in the meteorological conditions normally expected to occur at the aerodrome.
- 1.9 Meteorological instruments must function reliably with the electrical power available at the aerodrome.
- 1.10 Meteorological instruments must have appropriate electromagnetic compatibility (EMC) characteristics for operation in an aerodrome environment. The instruments must not interfere with or be adversely affected by other electronic equipment present.
- 1.11 Meteorological instruments must comply with applicable local requirements for electrical safety.
- 1.12 The sensors must provide data interfaces suitable for the data collection system used. The interfaces must not cause any degradation of specified performance (resolution, accuracy, reporting interval).
- 1.13 Sensors operated unattended must provide diagnostic information via the data interface, or sufficient information for the system to evaluate the condition of the sensor. Instruments which will be maintained and repaired in the field must provide a suitable local user interface. The interfaces must be suitable for the communication infrastructure of the aerodrome, directly or with suitable converters. The actual

requirements need to be determined locally. The sensor supplier must have a certified and regularly audited quality management system, e.g. according to ISO 9001.

CALIBRATION OF METEOROLOGICAL INSTRUMENTS

1. Guidance and Procedures

1.1 General

- 1.1.1. National meteorological standards established by each National Meteorological Service serve as the basic standards for operational use.
- 1.1.2. Some of these national standards have their own traceability to international or WMO standards, while others are established independently.
- 1.1.3. National meteorological standards are regarded as references, as they are traceable to other higher standards including national ones.

1.2 Establishment of a National Meteorological Standard for instruments

- 1.2.1 Individual Members should establish a standard for meteorological instruments.
- 1.2.2 Each instrument in the system must meet the operational accuracy requirements laid down by Commission for Instruments and Methods of Observation (CIMO) as a minimum.
- 1.2.3 Operational instruments should be corrected periodically with reference either to national meteorological standards or working standards at local calibration centers.
- 1.2.4 CIMO recommends that individual Members ask Regional Instrument Centres (RICs) for technical advice to establish their own standard instrument systems.

1.3 Facilities used for comparison and calibration

- 1.3.1 The accuracy of national meteorological standards and working standards must be of an equivalent or higher level than that provided by CIMO.

- 1.3.2 As it is difficult to carry out comparison and calibration with high accuracy in the open air (where atmospheric conditions may change more quickly than instruments can respond to them), calibration chambers in which temperature, humidity and pressure can be stably maintained are used for these tasks.
- 1.3.3 CIMO recommends the use of travelling standards for comparison between reference standards and working standards. Travelling standard equipment must be rigid enough to endure transportation and be stable enough that its performance does not change after transportation.

1.4 Design requirements for meteorological equipment

- 1.4.1 These requirements provide minimum standards for meteorological equipment at Namibian aerodromes producing METAR reports.
- 1.4.2 The A-MET Provider should ensure that appropriate consideration and provision for service continuity of observing equipment has been made, including any necessary support facilities, such as backup power supply etc.
- 1.4.3 If backup sensors are available, the procedures for use, operational limitations and maximum period of use must be documented by the A-MET Provider.
- 1.4.4 Sensor siting shall not encroach the obstacle limitation surface or obstacle free zones.
- 1.4.5 Notwithstanding the constraints listed in paragraph 1.4.4, the exposure of the sensor should minimise the effects of all obstructions.
- 1.4.6 The tower used to mount the wind sensor is not considered an obstruction to the sensor collection system but, with the exception of the temperature, dew point, and pressure sensors, it should be at least 3 m away from all other meteorological sensors. Sensors should be located as far as practicable from any source likely to significantly affect the quality of the data.
- 1.4.7 The display shall present a clear and unambiguous indication of the operational status of the sensor system to the user, in a format applicable to the proposed installation.
- 1.4.8 Where possible, the equipment should be self-monitoring and provide a suitable indication of equipment status and serviceability.
- 1.4.9 Where equipment is not self-monitoring, a failure of the equipment should be obvious.

1.5 Surface wind speed and direction equipment

- 1.5.1 For METAR reports, sensors shall be positioned to represent the wind flow at 10 m above the surface.
- 1.5.2 The wind speed and direction measuring equipment shall provide an accurate and representative measurement of wind speed and direction.
- 1.5.3 Wind direction data should be oriented with respect to True North.
- 1.5.4 With wind speeds in excess of 2 knots, the wind direction system shall be capable of producing an overall accuracy better than plus or minus 10 degrees.
- 1.5.5 The sensor shall be sampled at a minimum rate of four times every second. Where wind systems measure the gust, the equipment shall calculate the 3 second gust as a rolling average of the wind speed samples.
- 1.5.6 The equipment shall be capable of producing 2 and 10-minute rolling averages of the wind speed and direction. The algorithms used to produce such averages shall be defined.
- 1.5.7 The average direction displayed shall take regard of the numerical discontinuity at North.
- 1.5.8 Alternative anemometry, meeting the above requirements and located on the aerodrome may be used as a backup to the wind information.
- 1.5.9 Exceptionally, a hand-held anemometer may be used for a METAR report. Such instrumentation should be used in accordance with manufacturer's recommended procedures.
- 1.5.10 Readings taken at ground level should be corrected to a height of 10 m.

1.6 Pressure measurement equipment

- 1.6.1 Pressure sensor derived values are of critical importance to aviation safety and operations. Great care shall be taken to ensure that pressure sensor siting is suitable and provides accurate data.
- 1.6.2 The equipment shall be installed so that the sensor measurements are suitable for the operational purpose and free of external influences.
- 1.6.3 If the equipment is not installed at the same level as the notified aerodrome elevation, it shall be given a correction factor, in order to produce values with respect to the reference point.

- 1.6.4 Where required, the manufacturer's recommended venting method shall be employed to isolate the sensor from the internal environment.
- 1.6.5 The pressure sensor shall be installed on the aerodrome, usually in a weatherproof facility (building, shelter, enclosure, etc.).
- 1.6.6 Siting that will cause pressure variations due to air flow over the venting interface should be avoided.
- 1.6.7 The measurement system shall provide a pressure reading to an accuracy of ± 0.5 hectopascals, or better over the following range:

Tolerance values of sensors and equipment

Variable	In tolerance operating range	Recoverable range
Pressure	900 to 1050 hPa	850 to 1200 hPa

- 1.6.8 Observing systems that determine pressure automatically shall be designed in such a way as to draw the attention of the operator to a change of 1.0 hectopascal or more in the 'as read' pressure from the previous reading to 1 decimal place, (e.g. 998.4 hPa to 997.4 hectopascal).

1.7 Temperature and dew point measurement

- 1.7.1 The sensors should be mounted at a height of 1.25 to 2 m, above an earth or grass surface away from buildings and other structures likely to influence the reading.
- 1.7.2 The sensors shall be exposed in an instrument housing, which provides protection from atmospheric radiation and water droplets either as precipitation or fog. Consideration should be given to siting sensors away from exhausts of building heating and equipment cooling systems.
- 1.7.3 The equipment shall be capable of measurement to an accuracy better than plus or minus 1.0 degrees Celsius for air temperature and dew point, over the following range:

Tolerance values of sensors and equipment

Variable	In tolerance operating range	Recoverable range
Temperature	minus 25°C to plus 50°C	minus 30°C to plus 70°C
Humidity	5 to 100% RH condensing	0 to 100% RH condensing

- 1.7.4 Dew point shall be displayed for temperatures below zero; frost point should not be displayed.
- 1.7.5 Temperature and dew point measurements shall be measured to a resolution of 0.1 degrees Celsius.
- 1.7.6 Electronic sensor(s) shall be sampled at minimum of once per minute.

1.8 Cloud base recorder systems

- 1.8.1 When automated equipment is used for the measurement of the height of cloud base, height of cloud base display(s) should be located in the appropriate aerodrome control tower.
- 1.8.2 The display(s) in the aerodrome control tower and the display(s) used by the aerodrome meteorological observers should relate to the same sensor, and where separate sensors are required, the displays should clearly identify the area monitored by each sensor.
- 1.8.3 A cloud base recorder can provide valid measurements of the height of cloud elements within the view of the sensor, but this is limited by the detection system's coverage of the sky.
- 1.8.4 For this reason, sensors used to measure cloud are considered to be an aid to an observer rather than a direct source of information for the METAR.
- 1.8.5 The observer needs to assess the output of the sensors and give a final judgement on the variation of the element over the aerodrome that should be included in the observation.
- 1.8.6 The sensor shall be positioned in accordance with the manufacturer's specifications and is normally mounted on a platform or pedestal. The sensor should be located as far as practicable from other light sources that might affect the measurement.

- 1.8.7 The performance of the cloud base recorder is limited by the view of the sensor. However, the equipment shall be capable of measurement to the following accuracy limits from the surface to 5000 ft above ground level:
- Cloud height ± 30 ft up to and including 300 ft; $\pm 10\%$ above 300 ft
- 1.8.8 The cloud base recorder shall measure to a resolution of 100 ft.
- 1.8.9 The sensor(s) shall be sampled at a minimum of once per minute.

1.9 Visibility measuring systems

- 1.9.1 A visibility measuring system can provide valid measurements of the visibility within the range of the sensor.
- 1.9.2 For this reason, sensors used to measure visibility are considered to be an aid to an observer rather than a direct source of information for the METAR.
- 1.9.3 The observer needs to assess the output of the sensors and give a final judgement on the variation of the element over the aerodrome that should be included in the observation.
- 1.9.4 The sensor shall be positioned in accordance with the manufacturer's specifications and is normally mounted on a mast at a height of approximately 2.5 m.
- 1.9.5 The sensor should be located as far as practicable from other light sources that might affect the measurement.
- 1.9.6 The performance of the measuring system is limited by the view of the sensor. However, the equipment shall be capable of measurement to the following accuracy limits to a range of 15 km:
- Visibility ± 50 m up to and including 550 m; $\pm 10\%$ between 600 m and 1500 m; $\pm 20\%$ above 1500 m.
- 1.9.7 The visibility measuring system shall measure to a resolution of 50 m.