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| **WORLD METEOROLOGICAL ORGANIZATION****\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****COMMISSION FOR BASIC SYSTEMS****THE INTER-PROGRAMME EXPERT TEAM ON WIGOS FRAMEWORK IMPLEMENTATION (IPET-WIFI)****SUB-GROUP ON REGULATORY MATERIAL*****(First Session)*** Geneva, Switzerland, 14 to 15 April 2016 | CBS/IPET-WIFI/SG-RM-Doc. 5.1.REV1 \_\_\_\_\_\_\_\_\_ITEM: 5Original: ENGLISH ONLY |

**DRAFT TEXT ON AIRCRAFT METEOROLOGICAL STATIONS FOR MANUAL ON THE GOS**

*(Submitted by CBS ET-ABO)*

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| **SUMMARY AND PURPOSE OF DOCUMENT**This document contains draft material on Aircraft Meteorological Stations for the Manual on the GOS that has been drafted by CBS ET-ABO, for review by SG-RM during the session and subsequent submission to ICT-IOS-9 for their endorsement. |

**ACTION PROPOSED**

 The Meeting is invited to review the draft text contained in the document, to propose any changes required, and to approve the text for submission to ICT-IOS-9.

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Draft of Updated to Section 2.5, Manual on the GOS

Draft History

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| **Version** | **Author** | **Changes Made** | **Date** |
| V1 D1 | ET-ABO/SG-RM | Initial outline and draft produced at meeting of SG-RM. | December 2015 |
| V1D2 | Dean Lockett | Significant update to original version first version incorporating the structure and content of the draft guidance material developed by ET-ABO/SG-RM | 19 Jan 2016 |
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| V1D5 | Dean Lockett | Added clause numbering | 1 Mar 2016 |
| V1D6 | IPET-WIFI/SG-RM and Dean Lockett | Revision by SG-RM and response to comments by DL. Simplification of structure. | 13 Apr 2016 |

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2.5 Aircraft Meteorological Stations

Note: The structure of section 2.5 now departs from the standard structure which comprised sub-sections "General", "Location and composition" and "Frequency and timing of observations". This is a transitional step towards the eventual migration to the Manual on WIGOS, where the structure may be modified further.

## General

Note: Aircraft based observations might be made or obtained from commercial passenger, military, private business, unmanned or other aircraft, utilising either existing or purpose-deployed sensors, systems and/or avionics software.

* + 1. Members shall arrange for meteorological observations to be made, and reported on the WMO Information System (WIS), by aircraft of its national registry operating on national and international air routes.

Notes:

1. In general, three categories of aircraft based observations are described within [REF Guide to the GOS, Section 3.4] and from which Members should consider utilising as a source of such observations:
2. WMO aircraft based observations
3. ICAO aircraft based observations
4. Other aircraft based observations
5. Each of these sources of aircraft based observations and the systems from which they can be obtained are described in detail in [REF Guide to the GOS, Section 3.4].Information on aircraft observations and reports that can be derived from aircraft observations under ICAO provisions may be found in the Technical Regulations (WMO-No. 49), Volume II — Meteorological Service for International Air Navigation, Part 1.
	* 1. Members should participate in the WMO Aircraft Meteorological Relay (AMDAR) observing system.

Notes:

1. Guidance on AMDAR programme development and operation is provided in [REF Guide to the GOS, Section 3.4, section 2.1 AMDAR Observing System Development and Operation]
2. Aircraft based observations from the AMDAR system can be supplemented by observations derived from ICAO regulated Aircraft Reports and 3rd party ABO systems as described in [REF Guide to the GOS, Section 3.4, sections 2.2 and 2.3].

## Requirements

* + 1. Members shall determine, obtain, maintain and endeavour to meet national and international requirements for aircraft based observations in support of the WMO Integrated Global Observing System (WIGOS).
		2. Members should seek to ensure that their civil aviation authorities comply with ICAO requirements for the provision of Aircraft Reports in support of International Air Navigation, as defined in the [REF WMO Technical Regulations (WMO-No. 49), Volume II — Meteorological Service for International Air Navigation, Part 1].
		3. Members should seek to ensure that their civil aviation authorities comply with ICAO provisions for the availability on the GTS of meteorological information derived from ICAO Aircraft Reports, by forwarding these Aircraft Reports to ICAO World Area Forecast Centres (WAFCs) on the Aviation Telecommunications Network.

Note: Several sources of ICAO aircraft based observations (referred to by ICAO as Aircraft Reports) are to be made available to WMO Members under the regulations of ICAO governing its Contracted States. Such Aircraft Reports are to be forwarded by the civil aviation authorities of ICAO Contracted States to WAFCs, who are responsible for ensuring their availability to WMO for transmission on the WMO GTS. Aircraft Reports are discussed in detail in ICAO Doc. 8896, Ch. 7.7.

* + 1. Members shall endeavour to obtain aircraft based observations to meet requirements for upper air data in support of the WMO World Weather Watch Programme and all relevant WMO Application Areas.

Notes:

1. Aircraft based observations reported by Members should consist of at least the following variables, with desirable and optional variables as indicated:
* (static) air temperature
* wind speed
* wind direction
* pressure altitude
* latitudelongitude
* time of observation
* turbulence: mean, peak and event-based Eddy Dissipation Rate (EDR) - desirable
* geometric altitude - desirable
* humidity - desirable
* turbulence: derived equivalent vertical gust (DEVG) - optional
1. For more details and further requirements on the measurement processes and data processing associated with these and additional optional variables, see [REF WMO AOSFRS, CIMO IOM Report No. 115, Chapter 3].
2. For more details on instruments and methods of observation associated with aircraft based observations, see [REF CIMO Guide, Part II, Chapter 3].
3. In addition to meeting requirements for measurement resolution and accuracy of reported variables, aircraft based observations should be made so as to best meet temporal and spatial and also timeliness requirements for provision of vertical profiles and horizontal observations of variables, which are taken as the participating aircraft are ascending and descending and in level flight respectively.
4. For more details on requirements for observations in support of WIGOS and the WMO World Weather Watch Programme, see [REF Manual on WIGOS, Section 2.2.4]
5. For more detailed guidance on the provision of aircraft based observations in support of requirements for upper air observations, see [REF Guide to the GOS, Chapter 3.4, Section 1.5].
	* 1. In the operation of AMDAR observing systems, Members shall consult and, where relevant, adhere to documented WMO requirements and specifications.

Note: some relevant specifications include:

* The AMDAR Onboard Software Functional Requirements Specifications [REF AOSFRS], which provides a standard for the meteorological functionality of AMDAR software applications and air-ground data formats.
* The AEEC Data Link Ground System Standard and Interface Specification (ARINC 620) [REF ARINC 620 Supplement 8], which provides a specification of the Meteorological Report version 1 to 6 uplink and downlink messages under the ACARS protocols.
* WMO-No. 8, [REF CIMO Guide, Part II, Chapter 3].
	+ 1. Members should include measurement of humidity or water vapour and turbulence as additional components of their AMDAR programmes.

## Observations Data Management

* + 1. Members shall ensure that agreements are put in place with partner airlines and operators for the operation of aircraft based observing systems and supporting the provision of aircraft based observations on the WIS.

Note: such agreements will ensure that aircraft based observations can be made available to all WMO Members on the WMO Information Sytem.

* + 1. Members shall ensure that a permanent digital record is maintained of all reported aircraft based observations and associated metadata transmitted on the WMO GTS.
		2. Members should archive measurements or observations at resolution high enough so that reported observations can be retrieved, recreated or reconstructed.

Note: More details on Data Management Aspects are available in the [REF Manual on the GDPFS, Vol. 1, Global Aspects, Part III].

Note: More information on data processing and data levels is provided in the [REF Guide to the GOS, Part V, Reduction of Level I Data].

Note: More detailed guidance on aircraft based observational data management can be found in [REF Guide to the GOS, Chapter 3.4, Section 1.9].

## Quality Management

* + 1. Members that receive, process and transmit aircraft based observations on the WIS shall as a minimum comply with the requirements for quality control of these data as defined within the following manuals:
* [REF Manual on WIGOS, Sections 2.6 and 3.6]
* [REF Manual on GDPFS, Part II, Annex II.1, Minimum Standards for Quality Control of Data for Use in the GDPFS]

Note: Further information on quality control of aircraft based observational data, can be found in [REF Guide to the GOS, Chapter 3.4, Section 1.8 and Annex I, Guidance on Quality Control of Aircraft Based Observations].

* + 1. WMO Members shall develop and implement policy and procedures for quality monitoring and quality assessment of aircraft based observations that they transmit on the GTS.

Note: Further information on quality monitoring of aircraft based observational data, can be found in [REF Guide to the GOS, Chapter 3.4, Annex II, Guidance on Quality Monitoring of aircraft based Observational Data].

* + 1. Members should ensure that aircraft based observing systems operated in collaboration with partner airlines and other operators comply with all practices and guidance that impact on observational data quality provided in [REF Guide to the GOS Section 3.4, Section 2].
		2. Members shall develop procedures for the analysis of and response to available monitoring information.

Note: responses include taking prompt and appropriate corrective action for systematic observing system defects and issues identified that adversely affect the quality of aircraft based observations transmitted on the WMO GTS.

* + 1. Members that receive and process aircraft based observational data from any source and provide such data on the WMO GTS, shall appoint a representative from their organization to take on the role of the national WMO Focal Point on Aircraft Based Observations.

Note: The Focal Point is responsible for receiving, utilising and acting upon information from WMO or other Members relating to the quality of their aircraft based observational data. This will include the timely rectification of related faults and errors and, when required, the removal of such data from transmission on the GTS until such time as the fault is rectified.

Note: More detailed guidance on aircraft based observations and observing systems quality management can be found in [REF Guide to the GOS, Chapter 3.4, section 1.7]

* + 1. Members shall ensure that data quality control processing shall be applied to AMDAR observational data variables in accordance with the data validation procedures as specified in the AMDAR Onboard Software Functional Requirements Specification (AOSFRS) [REF, AOSFRS].

## Provision of Aircraft Based Observations on the WIS

* + 1. Members that receive and process aircraft based observational data from any source, including AMDAR, ICAO aircraft observations and other aircraft based observing systems shall submit such data to the WIS in accordance with the following regulations:
* [REF WMO Technical Regulations, Volume II];
* [REF WMO Manual on the GTS]; and
* [REF WMO Manual on Codes].

Note: Guidance on the encoding and provision of aircraft based observation on the WMO GTS can be found in [REF Guide to the GOS, Section 3.4, Section 1.9 and Annex III].

* + 1. Members shall ensure that they have the capacity to identify and remove poor quality data from further transmission on the WIS until such time as the data quality is restored.

Notes:

1. A key source of advice on aircraft based observational data quality is from the WMO Lead Centre on Aircraft Based Observations or from other WMO Members
2. The WMO Lead Center on Aircraft Data is responsible for quality monitoring of aircraft based observations and the dissemination of monitoring information to WMO Members.
3. The World Meteorological Centre, Washington, has the role of Lead Centre for Aircraft Data with the data monitoring processes carried out by the National Centres for Environmental Prediction, Central Operations, US National Weather Service. Current requirements for the monitoring of aircraft data by monitoring Centres are defined in the [REF Manual on the Global Data-Processing and Forecasting System (GDPFS) Part II, Attachment 9, Section 5 on Aircraft Data].
	* 1. Members shall use the monitoring information and reports provided by the WMO Lead Center for Aircraft Data as an integrated component of the quality management of their aircraft based observations and their aircraft based observing systems.

## Observational Metadata Requirements and Management

* + 1. Members that receive, process and make available aircraft based observational data from any source shall ensure that they maintain a database of related metadata.

Note: relevant metadata includes that relating to the following observational aspects and elements of their observational data:

* Models and types of aircraft;
* When and where possible, onboard sensors and their siting, calibration and operational issues and faults;
* Specific software and algorithms used to process data to generate the reported variables; and
* Metadata related to quality control processes, data communication practices, data processing and delivering centres.
	+ 1. Members that submit aircraft based observations on the GTS shall maintain and provide internationally required metadata relating to these data.

Note: specific details of relevant metadata can be found in [REF Guide to the GOS, Section 3.4, Annex IV Guidance on aircraft based Observations Metadata Maintenance and Provision].

Note: General provisions for the requirements for provision of observational metadata can be found in the [Manual on WIGOS, Section 2.5].

Note: More detailed guidance on aircraft based observational metadata management can be found in [REF Guide to the GOS, Chapter 3.4, Section 1.10]

## Maintenance and Incident and Change Management

* + 1. Members shall ensure that changes to the programme or schedule of reporting of aircraft based observations are planned, implemented and notified in accordance with [REF Manual on WIGOS, Sections 2.4 and 3.4].
		2. Members shall ensure that all maintenance activities, their duration and interruptions to provision of observations are recorded within the observations metadata record.
		3. Members shall flag or remove as necessary observational data whose quality is reduced by maintenance activities, incidents or changes.

Note: general provisions which apply to the management of incidents and changes in Members' aircraft based observing systems are within [REF Manual on WIGOS, Sections 2.4 and 3.4] and within the [REF Manual on the GTS, Part II, Chapter 5].

* + 1. Members shall ensure that suitable policy and procedures for the management of incidents associated with aircraft based observing system operation are developed, documented and maintained.

Note: one aim of such procedures is to ensure that incidents adversely affecting the quality or timeliness of aircraft based observations are rectified in a timely manner.

Note: It is recommended that Members report such incidents to the relevant WMO Lead Center on Aircraft Observations and to WMO Focal Points on aircraft based Observations through the relevant communications channels.

* + 1. Members shall in collaboration with their partner airlines, develop and agree on policy and procedures for the detection, advisement and rectification of issues and errors associated with the quality and operational performance of airline sensors, systems and infrastructure upon which their aircraft based observing systems depend.
		2. Members shall develop, implement and document plans, policy and procedures for routine maintenance of the aircraft based observing system.

Note: such plans will ensure standards for operational performance are maintained.

Note: Plans and procedures for routine maintenance should include provisions for maintenance of all aircraft based observing system components and sensors, related infrastructure and materials.

Note: Maintenance documentation and related metadata should be made available to relevant users and stakeholders.

* + 1. Members should utilise a centralised system for the monitoring of the status and health of aircraft based observing systems as an integrated component of the maintenance regime.

## International and Regional Planning and Capacity Development

* + 1. Members should provide support for the continued development and enhancement of aircraft based observations and WMO aircraft based observing systems.

Note: Support may be provided through the following actions:

* Continued financial support to the WMO AMDAR Trust Fund in line with the related WMO Congress resolutions.
* Contribute staff resources to the membership of relevant WMO Technical Commission and Regional Association work teams and groups.
* Endeavour to obtain and provide aircraft based observations on the WMO GTS.
* In collaboration with WMO Regional Associations, endeavour to support regional and international development and maintenance of operational AMDAR observing systems in line with national, regional and global requirements for observations.

Note: [REF WMO Cg-XVII, Resolution 22, Global Observing System], urges Members: *(4) To continue providing contributions to the AMDAR Trust Fund for the support of technical developments and capacity-building related to AMDAR*.

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**Current Content of Existing Manual on GOS**

2.5 Aircraft Meteorological Stations

General

2.5.1 Each Member shall arrange for observations to be made by aircraft of its registry operating on international air routes and for the recording and reporting of these observations.

Note: Further information on aircraft observations and reports may be found in the Technical Regulations (WMO-No. 49), Volume II — Meteorological Service for International Air Navigation, Part 1, [C.3.1.j 5.

2.5.2 Members accepting responsibility for collecting aircraft reports for synoptic purposes shall promptly make these available, in agreed code forms, to other Members.

2.5.3 Members should give special consideration to the use of an automated aircraft meteorological observing and reporting system.

2.5.4 Aircraft reports shall, at a minimum, satisfy the requirements of International Air Navigation (for details see the Technical Regulations (WMO-No. 49), Volume II — Meteorological Service for International Air Navigation, Part 1, [C.3.1.1 5).

Location and composition

2.5.5 The following aircraft observations shall be made:

(a) Routine aircraft observations during en-route and climb-out phases of the flight; and

(b) Special and other non-routine aircraft observations during any phase of the flight.

2.5.6 Routine air reports shall contain the following meteorological elements:

(a) Air temperature;

(b) Wind direction and speed;

(c) Turbulence;

(d) Aircraft icing;

(e) Humidity (if available).

In addition, reports of any volcanic activity observed by the flight crew shall be included.

2.5.7 Special aircraft reports shall be made whenever any of the following conditions are observed:

(a) Severe turbulence;

(b) Severe icing;

(c) Severe mountain wave;

(d) Thunderstorms, with or without hail, that are obscured, embedded, widespread or in squall lines;

(e) Heavy duststorm or heavy sandstorm;

(f) Volcanic ash cloud;

(g) Pre-eruption volcanic activity or a volcanic eruption;

In addition, in the case of transonic and supersonic flights:

(h) Moderate turbulence;

(i) Hail;

(j) Cumulonimbus clouds.

2.5.8 Routine aircraft observations should be made at the designated air traffic services/meteorological (ATS/MET) reporting points.

Note: Lists of designated ATS/MET reporting points are prepared by and available from International Civil Aviation Organization (ICAO) Regional Offices.

Frequency and timing of observations

2.5.9 When automated observing and reporting systems are available, routine observations should be made every 15 minutes during the en-route phase and every 30 seconds during the first 10 minutes of the flight.

2.5.10 When voice communications are used, routine observations shall be made during the en-route phase in relation to those air traffic services reporting points or intervals:

(a) At which the applicable air traffic services procedures require routine position reports; and

(b) Which are those separated by distances corresponding most closely to intervals of one hour of flying time.

2.5.11 Observations shall be made by all aircraft of meteorological conditions encountered during the take-off or approach phases of flight, not previously reported to the pilot-in- command, which in his opinion are likely to affect the safety of other aircraft operations.

2.5.12 Observations shall also be made by aircraft:

(a) If a meteorological office providing meteorological service for a flight makes a request for specific data; or

(b) By agreement between a Meteorological Authority and an operator.