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Doc 8896

Manual of Aeronautical Meteorological Practice

Twelfth Edition, 2019



Approved by and published under the authority of the Secretary General

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

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FOREWORD

1. The first edition of the *Manual of Aeronautical Meteorological Practice*, published in response to recommendations made by the Meteorology and Operations Divisional Meeting¹ (Paris, 1964), was intended as a guide for use by pilots and other aeronautical personnel on meteorological procedures, codes, symbols and abbreviations. It also contained a multilingual list of terms and phrases commonly used in meteorological briefings.
2. A second edition was prepared in 1977 to reflect, in particular, the many changes in procedures and terminology recommended by the Eighth Air Navigation Conference and the Meteorology Divisional Meeting² (1974).
3. As demand for the manual continued to grow and because further important changes to meteorological procedures had taken place, particularly in connection with the recommendations for the establishment of a world area forecast system (WAFS) made by the Communications/Meteorology Divisional Meeting³ (Montréal, 1982), a third edition was prepared. That edition was rewritten aiming to meet the needs of operational aeronautical meteorologists, particularly those at the working level, as well as the needs of pilots and other aeronautical personnel.
4. As a consequence of an extensive amendment proposal to Annex 3 — *Meteorological Service for International Air Navigation* developed by the Communications/Meteorology/Operations (COM/MET/OPS) Divisional Meeting⁴ (1990) including, in particular, provisions regarding the transition to the final phase of the WAFS, aerodrome observations, reports and forecasts, SIGMET information, etc., a fourth edition of the manual was published.
5. The fifth edition was the direct result of Amendment 70 to Annex 3, applicable from 1 January 1996, which constituted a comprehensive update of the provisions, in particular, those related to air-reporting and the observation and reporting of wind shear. In addition, new provisions concerning information on weather phenomena hazardous to low-level flights (AIRMET and GAMET messages) were introduced.
6. The sixth edition reflected the substantial changes made to Annex 3 in Amendments 71 and 72.
7. The seventh edition took account of the substantial changes which were introduced in Annex 3 by Amendment 73, which was developed by the Meteorological Divisional Meeting (2002)⁵ and became applicable in November 2004. In view of the fact that all of the technical specifications and templates had been regrouped in Part II of Annex 3 by subject matter, it was no longer considered necessary to reproduce these templates in this manual. Furthermore, material related to coordination between aeronautical meteorological services and air traffic services, search and rescue and aeronautical information services units was eliminated since these issues were extensively covered in the *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services* (Doc 9377).

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1. Held jointly with the Third Session of the Commission for Aeronautical Meteorology (CAeM) of the World Meteorological Organization (WMO).
 2. Held, in part, jointly with the Extraordinary Session (1974) of the body mentioned in Note 1.
 3. Held jointly with the Seventh Session of the body mentioned in Note 1.
 4. Held jointly with the Ninth Session of the body mentioned in Note 1.
 5. Held jointly with the Twelfth Session of the body mentioned in Note 1.

(v)

8. The eighth edition incorporated all the changes included in Amendment 74 to Annex 3. Furthermore, explanations of the terms “MET authority”, “MET inspectorate”, “MET regulator” and “MET service provider” were introduced, guidance related to issuance of SIGMET was expanded and the chapter related to meteorological service for operators and flight crew members was re-organized and clarified.
9. The ninth edition reflected the substantial changes made to Annex 3 by Amendment 75 (2010).
10. The tenth edition incorporated changes resulting from Amendment 76 (2013) including clarification of the terminology used for meteorological offices.
11. The eleventh edition incorporated changes resulting from Amendment 77 to Annex 3, which was developed by the Meteorological Divisional Meeting (2014)⁶ and became applicable in November 2016. It introduces digital format for volcanic ash and tropical cyclone advisories and AIRMET information, and the provision of METAR/SPECI, TAF and SIGMET information in digital format.
12. The twelfth edition introduced space weather centres and the requirement to disseminate OPMET information using ICAO meteorological information exchange model (IWXXM)⁷ geography markup language (GML) form, introduced in Amendment 78 to Annex 3.
13. Amendment 1 to the twelfth edition introduces necessary updates to the IWXXM elements to distinguish between traditional alphanumerical codes (TAC) and IWXXM versions of OPMET information. It contains revisions on the exact pressure levels of the upper wind and upper-air temperature forecasts prepared by the WAFS. It also updates the guidelines for aerodrome meteorological offices regarding the provision of feedback on WAFS forecasts.
14. The body of the manual is based primarily on Annex 3, summarized and enlarged upon where necessary. The appendices provide information on other subjects such as location of instruments at aerodromes and use of meteorological information by operators and flight crew members.
15. It should be stressed that the material in this manual is intended for guidance only. It is not intended to replace relevant national instructions or explanatory material, nor is it intended to cover the many non-aeronautical uses of meteorological information. Nothing in this manual should be taken as contradicting or conflicting with Annex 3 provisions or any other Standards, Recommended Practices, procedures or guidance material published by ICAO or WMO. It should also be noted that in this manual the words “shall” and “should” are not used in a regulatory sense as in ICAO or WMO regulatory documents.
16. Comments concerning this manual should be addressed to:

The Secretary General
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Quebec, Canada H3C 5H7

⁶ Held conjointly with the Fifteenth Session of the body mentioned in Note 1.

⁷ A data model for representing aeronautical meteorological information.

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Chapter 1

METEOROLOGICAL SERVICE FOR INTERNATIONAL AIR NAVIGATION

1.1 GENERAL

1.1.1 Meteorological service for international air navigation is provided by meteorological authorities designated by States. Details of the meteorological service to be provided for international aviation are determined by each State in accordance with the provisions of Annex 3 and with regional agreements which apply to specific areas designated as air navigation regions by ICAO. Each State also establishes a suitable number of meteorological offices and stations, i.e. aerodrome meteorological offices, meteorological watch offices (MWOs) and aeronautical meteorological stations. Aerodrome meteorological offices and aeronautical meteorological stations provide information required for operational planning, flight operations, the protection of aeronautical equipment on the ground, and for various other aeronautical uses. The information provided includes observations and reports of actual weather conditions at aerodromes and forecasts; it is made available at aerodrome meteorological offices and is disseminated as appropriate to aeronautical users, including operators, flight crew members, air traffic services (ATS) units, search and rescue services units, airport management and others concerned with the conduct or development of international air navigation.

1.1.2 Forecasts of en-route conditions, except forecasts for low-level flights issued by aerodrome meteorological offices, are prepared by world area forecast centres (WAFCs) (see 1.5). This ensures the provision of high-quality and uniform forecasts for flight planning and flight operations. It also permits MWOs to concentrate on keeping watch on weather conditions in their flight information regions (FIRs) and permits aerodrome meteorological offices to concentrate on local aerodrome forecasting, to keep watch over local (aerodrome) conditions and to issue warnings of weather conditions that could adversely affect operations and facilities at the aerodrome (e.g. aerodrome and wind shear warnings).

1.1.3 SIGMET and AIRMET information concerning the occurrence of specified en-route weather and other phenomena in the atmosphere which may affect the safety of aircraft operations is issued by MWOs (see 1.3). In the specific cases of tropical cyclones and volcanic ash, in addition to SIGMET, advisory information is issued by designated tropical cyclone advisory centres (TCACs) and volcanic ash advisory centres (VAACs) (see 1.6 and 1.7). Furthermore, advisory information is provided on space weather phenomena by designated space weather centres (see 1.9).

1.1.4 The responsibility for the provision of meteorological service to international air navigation mentioned in 1.1.1 rests with the meteorological authority designated by each State in accordance with Annex 3, 2.1.4. The meteorological authority ("MET authority") may wish to provide the service or may arrange for the provision of the service by other providers on its behalf.

1.1.5 Terms additional to MET authority are being defined in the framework of the State Safety Oversight System. In particular, use of the terms "MET inspectorate", "MET regulator" and "MET service provider" has raised questions. The following list attempts to clarify these terms which are neither specified nor used in Annex 3:

- a) The MET authority refers to an administrative entity or the State relevant authority empowered with the oversight function to ensure that meteorological services comply with the local law and regulations. It has the power to exercise authority through the promulgation and amendment of regulation, as well as supervise and enforce such capabilities;

- b) the “MET inspectorate” refers to the body of inspectors responsible for conducting safety oversight for the “MET authority” over the “MET service provider” in the State concerned;
- c) the “MET regulator” can be considered to be simply another term for the “MET authority”, i.e. the body responsible for the facilities and services to be provided in accordance with Annex 3. This term is used to highlight the regulatory aspects of its functions; and
- d) the “MET service provider” is the entity that is providing the facilities and services to be provided in accordance with Annex 3. In the context of safety oversight audits, the term “entity providing the MET service” is sometimes used to designate the “MET service provider”.

There are no provisions currently in place that would prevent the “MET inspectorate” to be part of the same organization as the “MET authority”. Furthermore, in accordance with Annex 3, the “MET service provider” could be either within the “MET authority” or, alternatively, within an independent organization. However, in some States or regions (e.g. under the European Single Sky), the legislation stipulates that the “MET regulator” (i.e. the “MET authority”) and the “MET service provider” must be separated, at least, functionally. When the “MET service provider” is part of the same organization as the “MET authority”, it is preferable that the oversight function be carried out by an external, independent “MET inspectorate”. In such cases, the “MET inspectorate” could be an independent MET expert involved in the International Organization for Standardization (ISO) certification audit of the “MET service provider”, or part of the ministry overseeing the “MET authority” or the civil aviation authority (CAA), provided that such a CAA-based inspectorate is a third-party, independent body with qualified meteorological personnel. Such arrangements would avoid any conflict of interest between inspection and service provision. Irrespective of the administrative arrangements, it is considered important that the “MET inspectorate” have close coordination with the entity responsible for the more general safety oversight (located in most cases within the CAA).

1.1.6 In order to meet the objectives of meteorological service for international air navigation and provide users with the assurance that the service, including the meteorological information provided, complies with the aeronautical requirements, the meteorological authority must establish and implement a properly organized quality system. It is recommended that such a system be developed in accordance with the ISO 9000 series of quality assurance standards. The system is to be certified by an approved organization.

Note.— Specific guidance on this subject is contained in the Manual on the Quality Management System for the Provision of Meteorological Service for International Air Navigation (Doc 9873), published jointly with the World Meteorological Organization (WMO).

1.1.7 Properly educated and trained personnel should be employed in the provision of meteorological service to international air navigation. It is, therefore, an important responsibility of the meteorological authority to ensure that widely recognized standards are applied to the qualifications, competencies, education and training of all of the personnel involved in the provision of meteorological service to international air navigation. With respect to meteorological personnel, the requirements of the WMO should be applied.

Note 1.— The requirements concerning the qualifications, competencies, education and training of meteorological personnel in aeronautical meteorology are given in the Technical Regulations (WMO-No. 49), Volume I — General Meteorological Standards and Recommended Practices, Part V — Qualifications and Competencies of Personnel Involved in the Provision of Meteorological (Weather and Climate) and Hydrological Services, Part VI — Education and Training of Meteorological Personnel and Appendix A — Basic Instruction Packages.

Note 2.— Qualifications, competencies, education and training in aeronautical meteorology of aeronautical personnel (e.g. pilots, air traffic control personnel, flight dispatch officers), required by the aeronautical authorities concerned, must comply with the relevant ICAO documents (i.e. Training Manual (Doc 7192), Part F-1 — Meteorology for Air Traffic Controllers and Pilots).

1.2 AERODROME METEOROLOGICAL OFFICES AND OTHER METEOROLOGICAL OFFICES

1.2.1 Meteorological offices designated to provide meteorological service for aerodromes serving international air navigation are called aerodrome meteorological offices. An aerodrome meteorological office may or may not be located at an aerodrome. An aerodrome meteorological office should be associated with an aerodrome control tower or approach control unit for the provision of meteorological information. The aerodrome meteorological offices issue aerodrome forecasts (as TAF) and trend forecasts in accordance with regional air navigation agreement. In addition to maintaining a continuous survey of meteorological conditions over the aerodrome(s) under their responsibility, preparing forecasts of local meteorological conditions, aerodrome warnings and wind shear warnings, aerodrome meteorological offices also provide briefing, consultation and flight documentation or other meteorological information, and display weather charts, reports, forecasts, meteorological satellite images and information derived from ground-based weather radar or a radar network. Much of the information is obtained from WAFCs or from other meteorological offices (which may be located in a different country). Furthermore, aerodrome meteorological offices supply operational meteorological (OPMET) information to aeronautical users and exchange such information with other aerodrome meteorological offices. This also includes the exchange of OPMET information required by regional air navigation agreement. In addition, where necessary, aerodrome meteorological offices supply information regarding pre-eruption activity, volcanic ash eruptions or the presence of volcanic ash in the atmosphere to their associated ATS units, the aeronautical information services (AIS) units and the MWO concerned, as agreed between the ATS, AIS and meteorological authorities concerned. However, not all international aerodromes have an aerodrome meteorological office, and for such aerodromes the relevant air navigation plans (ANPs), Part V of Volume II, Table MET II-2 indicate the name and location of the meteorological office designated to supply OPMET information concerning the aerodrome to operators, ATS units and others concerned.

1.2.2 Owing to local circumstances, it may be convenient for the duties of an aerodrome meteorological office associated with an aerodrome to be shared between two or more aerodrome meteorological offices. In this instance, the division of responsibility should be determined by the meteorological authority in consultation with the appropriate ATS authority.

1.3 METEOROLOGICAL WATCH OFFICES (MWOs)

1.3.1 States having accepted responsibility for providing ATS within an FIR or control area (CTA) have to either designate an MWO to serve that FIR/CTA or arrange for another State to designate an MWO on its behalf (see 1.3.2). An MWO must be associated with an FIR or CTA for the provision of meteorological information. The MWOs designated in accordance with regional air navigation agreement are listed in the relevant ANP, Part V of Volume II, Table MET II-1, to indicate the overall plan for providing meteorological service for the FIR/CTA within each ICAO region. They maintain a continuous watch over meteorological conditions affecting flight operations within their areas of responsibility, issue information on the occurrence or expected occurrence of specified hazardous en-route weather and other phenomena in the atmosphere which may affect the safety of aircraft and low-level aircraft operations (SIGMET and AIRMET information, respectively) and supply this and other weather information to their associated ATS units, usually an area control centre (ACC) or a flight information centre (FIC). In addition, MWOs exchange SIGMET information issued by other MWOs as required by regional agreements. The AIRMET information issued should be transmitted to MWOs in adjacent FIRs and to other MWOs or aerodrome meteorological offices, as agreed between the meteorological authorities concerned. In addition, in accordance with regional agreements, AIRMET information should be transmitted to international OPMET databanks and to the centres designated by regional agreements for the operation of the aeronautical fixed service (AFS) Internet-based services (see Chapter 4). In preparing SIGMET and AIRMET information, MWOs normally make use of special air-reports, and satellite and radar data.

1.3.2 If a State arranges for another State to designate an MWO on its behalf, such arrangements could be either on a bilateral (i.e. involving two States) or on a multilateral basis (i.e. involving at least three States). Increasing number of States consider consolidating the provision of MET watch services to a limited number of MWOs for two main reasons, i.e. in view of enhancing:

- a) safety (whenever the duties of a deficient MWO, unable to fulfil its obligations, are transferred to a fully operational MWO in another State); and
- b) efficiency (decreasing the number of MWOs unavoidably reduces costs).

1.3.3 However, such arrangements call for close cooperation between the States concerned (e.g. enhanced exchange of relevant MET information) and require that the delegation of the service of an FIR/CTA to an MWO in another State be formally agreed upon and recorded by all the States concerned, and properly reflected in the relevant ANP, Part V of Volume II, Table MET II-1.

1.3.4 MWOs also supply the information received on pre-eruption volcanic activity, volcanic eruptions and volcanic ash clouds, for which SIGMET information has not already been issued, to their associated ACC(s)/FIC(s), and in accordance with regional agreements, to the VAACs concerned. It is also the responsibility of MWOs to supply information received concerning a release of radioactive materials into the atmosphere within the area of their responsibility to their associated ACC(s)/FIC(s) and to the relevant AIS units, as agreed between the ATS, AIS and meteorological authorities concerned. This information is usually obtained from the WMO regional specialized meteorological centre which specializes in the provision of computer-generated dispersion model products for radiological environmental emergency response.

1.3.5 Owing to local circumstances, it may be convenient for the duties of an MWO associated with an FIR/CTA to be shared between two or more MWOs. In this instance, the division of responsibility should be determined by the meteorological authority in consultation with the appropriate ATS authority.

1.3.6 Appreciating that States are required to implement a properly organized quality system comprising procedures, processes and resources necessary to provide for the quality management of meteorological information to be supplied to users, and that States with one or more MWOs must ensure that the MWO(s) maintain continuous watch over meteorological conditions affecting flight operations within its(their) area(s) of responsibility, States (through their meteorological authorities) could decide to establish contingency modes of operation to be activated during the temporary interruption to the operation of an MWO. Such contingency modes of operation could include the delegation of some or all of the functions of the primary MWO to another MWO or an aerodrome meteorological office within the State (where such other offices exist) or in another State until such time as the primary MWO returns to normal operation.

1.4 AERONAUTICAL METEOROLOGICAL STATIONS

1.4.1 The actual weather observations at aerodromes and offshore structures are made at aeronautical meteorological stations. The specific types of observations and related reports are disseminated either locally, or to other meteorological offices and stations, as required, in accordance with regional air navigation agreement.

1.4.2 In the areas prone to volcanic eruptions, aeronautical meteorological stations and other meteorological stations make observations regarding volcanic activity and volcanic eruptions. These observations form the basis for the issuance of volcanic activity reports. Details on the content and dissemination of such reports are given in 2.5.

1.5 WORLD AREA FORECAST CENTRES (WAFCs)

The two WAFCs (ANP, Volume I, Part V) are components of the world area forecast system (WAFS), which is designed to supply aerodrome meteorological offices, meteorological authorities and other users with forecasts of global upper winds, upper-air temperatures, tropopause heights and temperatures, maximum winds, humidity, cumulonimbus clouds, icing, and in-cloud and clear air turbulence in the GRIB code form for direct input into meteorological and/or flight planning computers. The WAFS also supplies global forecasts of significant weather in the BUFR code form.

Note.— Further information on the WAFS is given in Appendix 1.

1.6 TROPICAL CYCLONE ADVISORY CENTRES (TCACs)

TCACs (ANP, Volume I, Part V) are meteorological centres designated by regional agreements based on advice from WMO. Seven TCACs have been designated by ICAO and they maintain a 24-hour watch during the period of operations corresponding to the tropical cyclone season in their area of responsibility. They monitor the development of tropical cyclones in their areas of responsibility using geostationary and polar-orbiting satellite data and other meteorological information sources (e.g. numerical weather prediction models). TCACs provide MWOs, international OPMET databanks established by regional air navigation agreement, the AFS Internet-based services and, as necessary, other TCACs with advisory information regarding the position of the centre of the tropical cyclone, its forecast direction and speed of movement, central pressure and maximum surface wind near the centre of the cyclone. The advisory information is to be used by MWOs in support of the issuance of SIGMET information on tropical cyclones. The information is readily available to aeronautical users, e.g. through the AFS Internet-based services.

1.7 VOLCANIC ASH ADVISORY CENTRES (VAACs)

1.7.1 VAACs (ANP, Volume I, Part V) are meteorological centres designated by regional agreements based on advice from the WMO. Nine VAACs have been designated by ICAO and they maintain a 24-hour watch. In case of interruption of the operation of a VAAC, its functions are to be carried out by another VAAC or another meteorological centre, as designated by the VAAC provider State concerned. VAACs monitor relevant satellite data and, where available, relevant ground-based and airborne data, to detect volcanic ash in the atmosphere. Subsequently, VAACs run volcanic ash numerical dispersion models to forecast the movement of a volcanic ash cloud. VAACs maintain contact with State volcano agencies in their respective areas of responsibility in order to obtain expert and timely information on significant pre-eruption volcanic activity and volcanic eruptions of concern to international air navigation. As a result, the VAACs provide, as required, MWOs, ACCs, FICs, NOTAM offices, WAFCs, international OPMET databanks established by regional agreements, the AFS Internet-based services and other VAACs with advisory information regarding the lateral and vertical extent and forecast movement of volcanic ash in the atmosphere following volcanic eruptions. The advisory information is to be used by MWOs in support of the issuance of SIGMET information on volcanic ash clouds. The information is readily available to aeronautical users, e.g. through the AFS Internet-based services.

Note.— Relevant ground-based and airborne data includes data derived from Doppler weather radar, ceilometers, LIDAR and passive infrared sensors.

1.7.2 VAACs form part of the ICAO International airways volcano watch (IAVW). The international arrangements set up within the IAVW are aimed at monitoring volcanic ash in the atmosphere and providing warnings to aircraft of volcanic ash and associated volcanic activity.

Note.— Detailed information on the IAVW can be found in the Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (Doc 9691) and in the Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List (Doc 9766).

1.8 STATE VOLCANO OBSERVATORIES

A number of States that have active volcanoes in their territories maintain a network of volcano observatories to monitor active or potentially active volcanoes within the State concerned. The selected volcano observatories that are required to provide information on significant pre-eruption volcanic activity and volcanic eruptions to the IAVW (see 1.7.2) are designated by regional agreements and listed in the ANP, Volume I, Part V for the ICAO regions concerned.

1.9 SPACE WEATHER CENTRES (SWXCs)

1.9.1 SWXCs are designated by ICAO as global and/or regional centres based on advice from the WMO. They maintain a 24-hour watch; in case of SWXC interruption, its functions are to be carried out by another SWXC or another centre, as designated by the SWXC provider State concerned. SWXCs monitor relevant ground-based, airborne, and space-based observations in view of detecting, and predicting when possible, the existence of space weather phenomena in their areas of responsibility. They provide advisory information regarding the extent, severity and duration of space weather phenomena that have an impact in the following areas:

- a) high-frequency (HF) radio communications;
- b) communications via satellite;
- c) GNSS-based navigation and surveillance; and
- d) radiation exposure at flight levels.

1.9.2 SWXCs supply the advisory information to ACCs, FICs and aerodrome meteorological offices, other SWXCs and international OPMET databanks, international NOTAM offices and the AFS Internet-based services. The advisory information is readily available to aeronautical users, e.g. through the AFS Internet-based services.

Note.— Guidance on the provision of space weather advisory information, including the ICAO-designated provider(s) of space weather advisory information, is provided in the Manual on Space Weather Information in Support of International Air Navigation (Doc 10100).

Chapter 2

METEOROLOGICAL OBSERVATIONS AND REPORTS

2.1 GENERAL

2.1.1 Observations of meteorological conditions are made by means of instruments and visual estimation and are used for landing and take-off, en-route navigation and flight performance, and as a basis for forecasting. Those observations used primarily for aircraft operations are called “operational meteorological (OPMET) information” while those used primarily for forecasting purposes are considered to be “basic meteorological data”. OPMET information includes aerodrome reports, landing forecasts, aerodrome forecasts, special aircraft observations, SIGMET and AIRMET information, tropical cyclone, volcanic ash and space weather advisories and WAFS forecasts. Basic meteorological data include synoptic surface and upper-air observations, satellite images, weather radar observations and routine aircraft observations. OPMET information is described in detail below.

Note.— The total costs related to the provision of OPMET information can be recovered from international civil aviation through air navigation charges, while the costs related to the provision of basic meteorological data are to be allocated between aeronautical and non-aeronautical users. Detailed guidance related to cost allocation is given in the Manual on Air Navigation Services Economics (Doc 9161).

2.1.2 At many locations, observations are made by use of fully automatic observing equipment. The equipment normally forms part of an integrated automatic system, with displays at local aeronautical meteorological station(s), aerodrome meteorological office(s) and/or other meteorological office(s), briefing facilities and air traffic services (ATS) units. Semi-automatic observing equipment provides for the manual insertion of meteorological elements which the equipment is not capable of observing.

Note.— It should be noted that human factors principles should be observed in the design of these systems as well as of other systems and equipment used in the provision of meteorological service to international air navigation. Guidance material on the matter is given in the Human Factors Training Manual (Doc 9683).

2.1.3 High-quality and timely meteorological observations and reports for international air navigation are the foundation upon which an effective aeronautical meteorological service is based and of direct consequence to aviation safety. In view of this, the provision of meteorological observations and reports must form an integral part of the quality system established by the meteorological authority.

2.1.4 To the extent practicable, aerodrome observations are made at locations considered to be suitable for representative measurements of elements affecting aircraft during take-off and landing operations. Details in respect of these locations are given in Appendix 2, and the aeronautical requirements for the operationally desirable accuracy of meteorological observations are given in Annex 3, Attachment A.

2.2 AERODROME OBSERVATIONS AND REPORTS

2.2.1 At aerodromes, routine observations are made and reported at hourly or half-hourly intervals depending on regional air navigation agreement. When required as a result of specified operationally significant changes in the meteorological conditions, special observations and reports are made whenever such changes occur between routine observations (see 2.4).

2.2.2 Observational data are combined into a report for dissemination at the local aerodrome or beyond (see Examples 2-1 and 2-2). Depending on their use, the reports are presented in two forms, i.e. as local routine reports (or MET REPORTS) and local special reports (or SPECIAL) in abbreviated plain language intended for dissemination and use at the aerodrome of origin or as an aerodrome routine meteorological report (METAR) and aerodrome special meteorological report (SPECI) intended for dissemination and use beyond the aerodrome of origin.

2.2.3 The issuance of SPECI is not necessary if METAR are issued at half-hour intervals.

2.2.4 The need to provide aeronautical users with two reports, one for local aerodrome use and one for use beyond the aerodrome, is to meet operational requirements as follows:

- a) local routine reports and local special reports for aircraft about to land or take off including requirements for automatic terminal information service (ATIS) (voice-ATIS and D-ATIS); and
- b) METAR/SPECI for flight planning and en-route flight information service purposes, including requirements for meteorological information for aircraft in flight (VOLMET) broadcasts and D-VOLMET.

The information in both reports, therefore, differs slightly to fully reflect the respective operational requirements. Technical specifications for local routine reports, local special reports, METAR and SPECI are in a set of detailed templates relating to individual portions and groups in the reports contained in Annex 3, Appendix 3, Tables A3-1 and A3-2. The appendix also contains technical specifications concerning trend forecasts, which are attached to local routine reports, local special reports, and METAR/SPECI, as required. These forecasts are dealt with in 3.5.

2.2.5 Local routine reports and local special reports, METAR and SPECI from fully automatic systems can be used without human intervention as depicted in Table 2-1. This only concerns States that are in a position to use automatic systems. Caution should be exercised in using reports from fully automatic systems in areas with rugged topography or with complex climatological regimes.

Table 2-1. Use of reports from fully automatic systems, without human intervention

<i>Hours of aerodrome</i>	<i>Type of report</i>		<i>Remarks</i>
	<i>Local routine reports and local special reports</i>	<i>METAR/SPECI</i>	
Operational hours	As determined by the meteorological authority in consultation with users		Decision to be based on the availability and efficient use of personnel
Non-operational hours	Not applicable	Acceptable	No local reports issued during non-operational hours of the aerodrome

2.2.6 Local routine reports and local special reports are supplied to ATS units which use them, together with any information obtained from their own duplicate displays (e.g. wind, height of cloud base or runway visual range (RVR) displays of automatic meteorological observing systems) or supplementary visual observations taken by ATS personnel, in order to provide the required OPMET information to aircraft taking off or landing. These reports are supplied to aircraft by ATS units by air-ground data link, by directed transmissions and/or through broadcasts. Further details on coordination between meteorological offices/stations and ATS units in this and other respects are given in the *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services* (Doc 9377).

Example 2-1. Routine reports

- a) *Local routine report (same location and weather conditions as METAR):*

MET REPORT YUDO* 221630Z WIND 240/5MPS VIS 600M RVR RWY 12 TDZ 1000M MOD DZ FG CLD SCT 300M OVC 600M T17 DP16 QNH 1018HPA

- b) *METAR for YUDO:*

METAR YUDO* 221630Z 24004MPS 0800 R12/1000U DZ FG SCT010 OVC020 17/16 Q1018

Meaning of both reports:

Local routine report or METAR for Donlon/International* issued on the 22nd of the month at 1630 UTC; surface wind direction 240 degrees; wind speed 5 or 4 metres per second (10 or 8 kt) (averaged over 2 or 10 minutes, respectively); visibility 600 metres (along the runway(s) in the local routine report); prevailing visibility 800 metres (in METAR); runway visual range representative of the touchdown zone for runway 12 is 1 000 metres (averaged over 1 or 10 minutes, respectively), and the runway visual range values have shown an upward tendency during the previous 10 minutes (RVR tendency to be included in METAR only); moderate drizzle and fog; scattered cloud at 300 metres (1 000 feet); overcast at 600 metres (2 000 feet); air temperature 17 degrees Celsius; dew point temperature 16 degrees Celsius; QNH 1 018 hectopascals.

* Fictitious location

Example 2-2. Special reports

- a) *Local special report (same location and weather conditions as SPECI):*

SPECIAL YUDO* 151115Z WIND 050/26KT MAX37 MNM10 VIS 1000M RVR RWY 12 1200M HVY TSRA CLD BKN CB 500FT T25 DP22 QNH 1008HPA

- b) *SPECI for YUDO:*

SPECI YUDO* 151115Z 05025G37KT 2000 1000S R12/1200N +TSRA BKN005CB 25/22 Q1008

Meaning of both reports:

Local special report or SPECI for Donlon/International* issued on the 15th of the month at 1115 UTC; surface wind direction 050 degrees; wind speed 26 or 25 knots (averaged over 2 or 10 minutes, respectively) gusting between 10 and 37 knots (in SPECI: "gusting to 37 knots"); visibility 1 000 metres (along the runway(s) in the local special report); prevailing visibility 2 000 metres (in SPECI) with minimum visibility 1 000 metres to south (directional variations to be included in SPECI only); runway visual range representative of the touchdown zone for runway 12 is 1 200 metres (averaged over 1 and 10 minutes, respectively), (in SPECI: "no distinct tendency detected" in runway visual range values during previous 10 minutes); thunderstorm with heavy rain; broken cumulonimbus cloud at 500 feet; air temperature 25 degrees Celsius; dew point temperature 22 degrees Celsius; QNH 1 008 hectopascals.

* Fictitious location

2.3 ROUTINE REPORTS

2.3.1 Paragraphs 2.3.4 to 2.3.17 deal with the content and format of routine reports in text format; both those in abbreviated plain language disseminated locally (local routine reports or MET REPORTs) and those disseminated beyond the aerodrome of origin (METAR). Local special reports (SPECIALs) and special reports disseminated beyond the aerodrome of their origin (SPECI) are dealt with in 2.4. Paragraphs 2.4.1.2 to 2.4.2.3 deal with the content and format of special reports in text format. Practices relating to the transmission of local reports by local ATS units to aircraft taking off and landing are given in Doc 9377.

2.3.2 The METAR and SPECI code forms were developed by the World Meteorological Organization (WMO) on the basis of aeronautical requirements established by ICAO. These code forms and local reports use the approved ICAO abbreviations contained in the *Procedures for Air Navigation Services — ICAO Abbreviations and Codes* (PANS-ABC, Doc 8400). In view of this, METAR and SPECI in text format are human-readable while their ICAO meteorological informational exchange (IWXXM) versions are machine-readable.

Note 1.— All details relating to the METAR and SPECI code forms in text format are contained in the Manual on Codes — International Codes (WMO-No. 306), Volume I.1, Part A — Alphanumeric Codes. Details related to XML coding are contained in Volume I.3, Part D — Representations derived from data models.

Note 2.— Units of measurement differ in some States depending on national practices. In this manual, all units are those prescribed by Annex 5 — Units of Measurement to be Used in Air and Ground Operations as primary or alternative units. As regards elements for which two units are permitted, numerical criteria are given for both units, and examples of reports are given in one or the other unit.

Note 3.— Details concerning requirements for the exchange of these reports between meteorological offices/stations can be found in the relevant air navigation plan (ANP), Volume II, for the various ICAO regions.

Note 4.— Selected criteria applicable to meteorological information referred to in 2.3.7 to 2.3.15 for inclusion in aerodrome reports are given in Annex 3, Attachment C.

2.3.3 Additionally, METAR and SPECI are to be disseminated in IWXXM GML form.

Note.— The technical specifications for IWXXM are contained in the Manual on Codes (WMO – No. 306), Volume I.3, Part D – Representation Derived from Data Models. Guidance on the implementation of IWXXM is provided in the Manual on the ICAO Meteorological Information Exchange Model (IWXXM) (Doc 10003).

2.3.4 Identification of the type of report

(MET REPORT) — Local routine report
(METAR) — METAR

In the event of an error being disseminated in METAR, a corrected METAR should be issued using the entry «METAR COR» in place of «METAR».

2.3.5 Location indicator

(YUDO) in both reports

ICAO four-letter location indicator for the aerodrome for which the report is made. (The full name of the aerodrome is used in the transmission to aircraft.)

Note.— The indicators are prescribed in Doc 7910 — Location Indicators.

2.3.6 Time of the observation

(221630Z) in both reports

Day and actual time of observation: day of the month and time in hours and minutes, in Coordinated Universal Time (UTC).

2.3.7 Identification of an automated or a missing report

(AUTO or NIL) — NIL in METAR only

In the case of local routine reports and METAR from automatic observing systems with no human intervention, the report is to be identified with “AUTO”. In the event of missing METAR, the abbreviation “NIL” should be used.

2.3.8 Surface wind

(WIND 240/5MPS) — Local routine report

(24004MPS) — METAR

Note.— Anemometers are to be installed at a standard height of approximately 10 m (30 ft). Guidance is given in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8), regarding the effects of variations in anemometer height on the wind measurement. This relationship depends upon the roughness length (i.e. the number and size of buildings in the vicinity of the anemometer and the general terrain of the surrounding area) of the site concerned. However, it could normally be expected that variations in measurement would be within the desirable accuracy of measurement, given in Annex 3, Attachment A, with anemometer heights between 9 m (27 ft) and 11 m (33 ft).

2.3.8.1 Wind observations in local routine reports used for arriving or departing aircraft should be representative of the touchdown zone and the conditions along the runway, respectively. Positions of wind sensors along individual runways should be indicated in local routine reports together with the reported wind data by the sections of the runway for which the wind data are to be representative. When wind observations are available from more than one runway in use, the indication of the relevant runway should also be attached to the wind data in local routine reports. Surface wind observations included in the METAR should be representative of the whole runway complex at the aerodrome, and no indication of the runway or runway sections should be included therein.

2.3.8.2 Direction (true) from which surface wind is blowing should be indicated in degrees rounded off to the nearest 10°. The unit used for wind speed should be indicated both in local routine reports and METAR. In local routine reports, the term “CALM” is used when a wind speed of less than 0.5 m/s (1 kt) is observed. Wind speed of 50 m/s (100 kt) or more is to be indicated as ABV49MPS or ABV99KT.

Note 1.— Wind direction reported to aircraft for landing or take-off purposes must be converted into degrees magnetic. This conversion is normally carried out by the ATS unit concerned.

Note 2.— For wind speed, either metres per second or knots may be used.

2.3.8.3 In local reports, surface wind should be based on an averaging period of two minutes.

2.3.8.4 In METAR, surface wind should be based on an averaging period of ten minutes, except that when the ten-minute period includes a marked discontinuity in the wind direction and/or speed, only data occurring since the discontinuity should be used for obtaining mean values, and the time interval should be correspondingly reduced. A marked discontinuity occurs when there is an abrupt and sustained change in wind direction of 30° or more, with a wind speed of 5 m/s (10 kt) before or after the change, or a change in wind speed of 5 m/s (10 kt) or more, lasting at least two minutes. The wind direction should be reported in steps of 10° using three figures, e.g. 030 or 240. The wind speed is reported in steps of one metre per second or one knot using two figures, e.g. 05 or 15, supplemented by the units used (MPS or KT) (see 2.3.8.3 a) and b)). Calm conditions are reported as 00000.

2.3.9 Significant speed and directional variations

2.3.9.1 Variations of wind direction and speed given in meteorological reports always refer to the ten-minute period preceding the observation.

2.3.9.2 In local routine reports and METAR (see Table 2-2), directional variations are indicated when the wind direction varies by 60° or more and when:

- a) the mean speed is 1.5 m/s (3 kt) or more **and** the wind direction varies by less than 180°:
 - report the two extreme directions (reported clockwise) between which the wind has varied, in degrees, after indication of the mean wind direction and speed, for example: mean surface wind direction 10°; wind speed 9 kt; wind direction variable between 350° and 050°:
 - in local routine reports: "WIND 010/9KT VRB BTN 350/ AND 050/";
 - in METAR: "01009KT 350V050";
- b) the mean speed is less than 1.5 m/s (3 kt) **and** the wind direction varies by less than 180°:
 - indicate the wind direction by the term "variable" (VRB) followed by the mean wind speed, with no indication of the mean wind direction, e.g.: mean surface wind direction 10°, wind speed 1 m/s, wind direction variable between 350° and 050°:
 - in local routine reports: "WIND VRB1MPS";
 - in METAR: "VRB01MPS";
- c) the wind direction varies by 180° or more:
 - indicate the wind direction by the term VRB followed by the mean wind speed, with no indication of the mean wind direction, e.g.: mean surface wind direction 10°, wind speed 5 m/s; wind direction variable between 350° and 190°:
 - in local routine reports: "WIND VRB5MPS";
 - in METAR: "VRB05MPS".

2.3.9.3 When the wind is gusty, with variations from the mean wind speed (gusts) exceeding 5 m/s (10 kt), speed variations are indicated (see Table 2-3). When noise abatement procedures are applied in accordance with the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), wind speed (gusts) exceeding 2.5 m/s (5 kt) are indicated in local routine reports. Speed variations are given:

- a) in local routine reports, as the maximum and minimum values of the wind speed, after indication of the mean wind direction and speed, in the form "WIND 180/10MPS MAX 18 MNM5" or "WIND 180/20KT MAX 35 MNM 10"; and
- b) in METAR, as the maximum value of the wind speed, after indication of the mean wind direction and speed and preceded by the letter indicator G (for gusts). The minimum wind speed is never included. When wind speed is 50 m/s (100 kt) or more, the wind speed is reported as P49MPS (P99KT).

Table 2-2. Reporting procedures related to directional variations of wind.
ddd = mean wind direction, **ddd₁** and **ddd₂** = extreme wind directions, **Δ** = |ddd₁ - ddd₂|,
VV = mean wind speed. Averaging period applied indicated as a subscript.
V = indicator of variability.

Type of report	Directional variations during preceding 10 minutes			
	Δ ≤ 60°	Δ > 60°		
		VV ≥ 1.5 m/s (3 kt)		VV < 1.5 m/s (3 kt) [but VV ≥ 0.5 m/s (1 kt)]*
		Δ < 180°	Δ ≥ 180°	
Local routine report	ddd/VV _{2 min}	ddd/VV _{2 min} VRB BTN ddd ₁ / AND ddd ₂ **	VRB/VV _{2 min}	VRB/VV _{2 min}
METAR	dddVV _{10 min}	dddVV _{10 min} ddd ₁ Vddd ₂ **	VRBVV _{10 min}	VRBVV _{10 min}
* If VV < 0.5 m/s (1 kt), the wind shall be reported as "CALM" and "00000" in local routine reports and METAR, respectively. ** ddd ₁ ddd ₂ in clockwise order.				

Table 2-3. Reporting procedures related to speed variations of wind.
ddd = mean wind direction, **VV_{min}** and **VV_{max}** = minimum and maximum
wind speed, **VV** = mean wind speed. Averaging period applied
indicated as a subscript. **G** = indicator for gusts.

Type of report	Speed variations during preceding ten minutes	
	Δ ≤ 5 m/s (10 kt)	Δ > 5 m/s (10 kt)*
Local routine report	ddd/VV _{2 min}	ddd/VV _{2 min} MAX VV _{max} MNM VV _{min}
METAR	dddVV _{10 min}	dddVV _{10 min} G VV _{max}
* 2.5 m/s (5 kt) in local routine reports when noise abatement procedures are applied.		

2.3.10 Visibility

(VIS 600M RVR RWY 12 TDZ 1000M) — Local routine report
(0800 R12/1000U) — METAR

2.3.10.1 Visibility may be observed by a human observer or measured by instruments. The following definition for visibility for aeronautical purposes applies.

Visibility for aeronautical purposes is the greater of:

- the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background; and
- the greatest distance at which lights in the vicinity of 1 000 candelas can be seen and identified against an unlit background.

Note 1.— The two distances have different values in air of a given extinction coefficient, and the latter (b) varies with the background illumination. The former (a) is represented by the meteorological optical range.

Note 2.— Guidance on the conversion of instrumented readings into visibility is given in Annex 3, Attachment D.

Note 3.— Transmissometers and/or forward-scatter meters should be used as sensors in instrumented systems for the measurement of visibility.

2.3.10.2 In local routine reports used for:

- a) *departing aircraft*, the visibility observations should be representative of the conditions along the runway; and
- b) *arriving aircraft*, the visibility observations should be representative of the touchdown zone.

In METAR, visibility observations should be representative of the aerodrome. In such observations, special attention should be paid to significant directional variations in visibility.

2.3.10.3 In local routine reports and METAR, visibility is reported in steps of: 50 m when visibility is less than 800 m; 100 m when visibility is 800 m or more but less than 5 km; and 1 km when visibility is 5 km or more but less than 10 km. When visibility is 10 km or more, it is given as 10 km, except when conditions for the use of CAVOK apply (see Annex 3, Appendix 3, 2.2). Any observed value that does not fit the reporting scale in use shall be rounded down to the nearest lower step in the scale.

2.3.10.4 When instrumented systems are used, the averaging period should be one minute for local routine reports.

2.3.10.5 In local routine reports, visibility along the runway(s) is reported together with the units of measurement, e.g. "VIS 600M". When the visibility is observed for more than one runway in use and at more than one location along the runway, the relevant runways and locations along the runways should be identified and attached to the reported value(s) of visibility, e.g. "VIS RWY 19 TDZ 6KM".

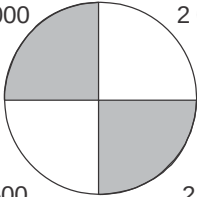
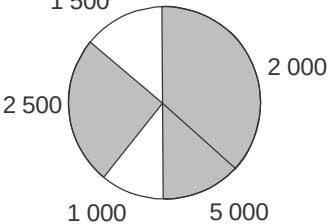
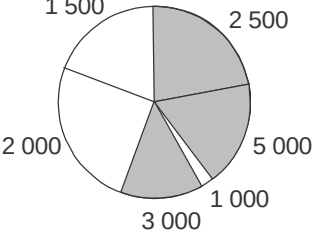
2.3.10.6 When instrumented systems are used, the averaging period should be ten minutes for METAR.

2.3.10.7 In METAR, prevailing visibility is reported. Prevailing visibility is defined as the greatest visibility value which is reached at least within half the horizon circle or within half of the aerodrome surface. This could be formed by sectors, which could be contiguous or non-contiguous. Examples of various situations are given in Figure 2-1 together with an assessment of how the prevailing visibility would be reported in each case. Where instrumented systems are used for the measurement of visibility at an aerodrome (often used for the assessment of RVR as well), the prevailing visibility can be obtained based on the visibility measured in certain sectors by these instruments. Detailed guidance is given in Appendix 3 of this manual for the reporting of prevailing visibility using fully automatic observing systems.

2.3.10.8 In METAR, visibility is reported by four figures (0200, 1500, 4000 etc.). When visibility is 10 km and above and the conditions for the use of CAVOK do not apply, visibility is indicated as 9999. When the visibility is not the same in different directions and when the lowest visibility is different from the prevailing visibility and:

- a) less than 1 500 m; or
- b) less than 50 per cent of the prevailing visibility and less than 5 000 m,

the lowest visibility observed should also be reported and, when possible, its general direction in relation to the aerodrome reference point indicated by reference to one of the eight points of the compass, e.g. "2000 1200NW". If the prevailing visibility cannot be determined due to rapid fluctuation, the lowest visibility should be reported with no indication of direction (see Figure 2-1 and Table 2-4).

Determining visibility (sectors* considered for prevailing visibility indicated by shading)			Minimum visibility	Prevailing visibility
1. Four sectors			1 500 (not reported, as per 2.3.10.8)	2 500
Visibility (metres)	Approximate degrees			
5 000	90			
2 500	90			
2 000	90			
1 500	90			
2. Five sectors			1 000 (reported, as per 2.3.10.8)	2 000
Visibility (metres)	Approximate degrees			
5 000	50			
2 500	90			
2 000	130			
1 500	50			
1 000	40			
3. Six sectors			1 000 (reported, as per 2.3.10.8)	2 500
Visibility (metres)	Approximate degrees			
5 000	60			
3 000	50			
2 500	80			
2 000	90			
1 500	70			
1 000	10			

* Sectors represent hypothetical situations with different visibility conditions.

Figure 2-1. Determination of “prevailing visibility” under three hypothetical visibility conditions

Note.— «Minimum visibility» is to be reported together with «prevailing visibility» in the second and third examples.

Table 2-4. Reporting procedures related to visibility — to be applied in METAR in the case of directional variations

<i>Condition</i>	<i>Action</i>
VIS not the same in different directions, with the lowest VIS 1 500 m or more and 50 per cent or more of the prevailing VIS	Report the prevailing VIS
The lowest VIS is less than 50 per cent of the prevailing VIS and less than 5 000 m or The lowest VIS is less than 1 500 m <i>Note.— If the lowest VIS is observed in more than one direction, include the most operationally significant direction.</i>	Report the prevailing VIS together with the lowest VIS with its general direction in relation to the aerodrome. Example: "2000 1200S"
VIS fluctuating rapidly; the prevailing VIS cannot be given <i>Note.— Direction is to be reported by reference to one of the eight points of the compass.</i>	Report lowest VIS without indication of direction

2.3.11 RVR

(RVR RWY 12 TDZ 1000M) — Local routine report

(R12/1000U) — METAR

2.3.11.1 RVR should be reported whenever visibility or RVR is less than 1 500 m, particularly at aerodromes having precision approach runways or runways used for take-off with high-intensity edge lights and/or centre line lights, including aerodromes with runways intended for Category I approach and landing operations. RVR is reported using instrumented systems at all runways intended for Category II or III instrument approach and landing operations. Steps of 25 m are used for RVR below 400 m, steps of 50 m for RVR between 400 m and 800 m and steps of 100 m for RVR above 800 m. RVR values which do not fit the reporting scale are rounded down to the next lower step in the scale.

2.3.11.2 In local routine reports, one-minute mean values are reported. RVR is reported in metres with an indication of the unit, and the runway(s) to which the values refer, e.g. RVR RWY 20: 500M RVR RWY 26: 800M (RVR runway 20: 500 metres, RVR runway 26: 800 metres). If RVR is observed for more than one position along a runway, the value representative of the touchdown zone is given first, followed by the locations representative of the mid-point and stop-end, e.g. RVR RWY 16 TDZ 600M MID 500M END 400M (RVR runway 16 at the touchdown zone 600 metres, at the mid-point 500 metres and at the stop-end 400 metres). When RVR is above the maximum value that can be determined by the system in use, it is reported in the form RVR ABV 1200M where 1 200 m is the maximum value for that system. When RVR is below the minimum value that can be determined by the system in use, it is reported in the form RVR BLW 150M, where 150 m is the minimum value for that system. For assessment of RVR, 50 m is considered the lower limit and 2 000 m the upper limit. The RVR reporting range from 1 500 to 2 000 m caters to cases in which the visibility is less than 1 500 m combined with an RVR above 1 500 m. (If both visibility and RVR were above 1 500 m, no RVR would be reported.) Outside these limits of 50 and 2 000 m, reports merely indicate that the RVR is less than 50 m or more than 2 000 m in the form RVR BLW 50M (RVR below 50 metres) or RVR ABV 2 000M (RVR above 2 000 metres), respectively.

2.3.11.3 The provisions given in 2.3.11.1 also apply to METAR. In these reports, RVR values in metres are reported by four figures preceded by the letter indicator R and the runway designator in two figures (e.g. R12/0500, R26/1200). Additional reporting procedures are given in Table 2-5.

Note 1.— RVR is the best possible assessment of “the range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line”. RVR should be assessed at a height of approximately 2.5 m (7.5 ft) above the runway for instrumented systems or assessed at a height of approximately 5 m (15 ft) above the runway by a human observer. This assessment should therefore be based on readings of transmissometers or forward-scatter meters for CAT I, CAT II and CAT III runways or, for non-precision runways, by an observer counting markers, runway lights or, in some cases, specially installed lights on the side of the runway.

Note 2.— Detailed information on RVR observing and reporting is contained in the Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328).

2.3.12 Present weather

(MOD DZ FG) — Local routine report

(DZ FG) — METAR

2.3.12.1 As a minimum, the following weather phenomena are to be identified and reported:

- a) rain, drizzle or snow (and its intensity);
- b) freezing precipitation (and its intensity);
- c) haze, mist and fog;
- d) freezing fog; and
- e) thunderstorms (also those occurring in the vicinity).

2.3.12.2 In local routine reports, present weather information should be representative of conditions at the aerodrome, i.e. within a radius of approximately 8 km of the aerodrome reference point. The word “approximately” is used to cater for aerodromes that have perimeters which are not precisely a radius of 8 km from the aerodrome reference point. In METAR, present weather information should be representative of conditions at the aerodrome and, for certain specified present weather phenomena, in its vicinity, i.e. the area that lies within a radius of approximately 8 km and 16 km of the aerodrome reference point.

2.3.12.3 In local routine reports, present weather phenomena are reported in terms of types and characteristics and are qualified with respect to intensity, as appropriate.

2.3.12.4 In METAR, present weather phenomena are reported in terms of types and characteristics and are qualified with respect to intensity or proximity to the aerodrome, as appropriate.

2.3.12.5 The *types* of present weather phenomena of significance to aviation, their respective abbreviations and relevant criteria for their reporting are given in Table 2-6.

2.3.12.6 The *characteristics* of present weather phenomena that are reported, as necessary, and their respective abbreviations are given in Table 2-7.

2.3.12.7 The relevant *intensity* or, as appropriate, the *proximity* to the aerodrome of reported present weather phenomena are indicated in Table 2-8. The proximity indicator is used only in METAR.

Table 2-5. Additional reporting procedures related to RVR data in METAR

<i>Condition</i>	<i>Reporting procedure</i>
More than one runway in use	Include all such runways up to a maximum of four. RVR values from parallel runways may be included in a report by attaching "L, C, R" (L = left, C = centre, R = right) to the runway designator D _r D _r
Section of the runway	Only the value representative of the touchdown zone is given, without indication of position.
RVR information determined using instruments	Report the mean value during the ten-minute period immediately preceding the observation
When RVR is greater than the maximum value which can be determined by the system in use	Report the highest value which can be determined by the system preceded by the letter indicator P
When RVR is below the minimum value which can be determined by the system in use	Report the lowest value which can be determined by the system preceded by the letter indicator M
When RVR is more than 2 000 m	Report 2000 preceded by the letter indicator P
When RVR is less than 50 m	Report 0050 preceded by the letter indicator M
Discontinuities in RVR values	If the ten-minute period immediately preceding the observation includes a marked discontinuity in RVR values, only those values occurring after the discontinuity should be used to obtain mean values and variations. A marked discontinuity occurs when there is an abrupt and sustained change in RVR, lasting at least two minutes, which reaches or passes through the values 800, 550, 300 and 175 m.
Tendency in RVR values	If the RVR values during the ten-minute period have shown a distinct tendency, such that the mean value during the first five minutes varies by 100 m or more from the mean value during the second five minutes of the period, this should be indicated as follows: - when the variation of the RVR values shows an upward or downward tendency, this should be indicated by "U" or "D", respectively, appended to relevant RVR values in the form "R12/1000U"; - when actual fluctuations during the ten-minute period indicate no distinct tendency, this should be reported using the indicator "N" appended to relevant RVR values in the form "R12/1000N"; and - when indications of tendency are not available, no indicator should be included.

Table 2-6. Types of present weather phenomena

Type	Phenomenon	Abbreviation*	Remarks
Precipitation	Drizzle	DZ	
	Rain	RA	
	Snow	SN	
	Snow grains	SG	
	Ice pellets	PL	
	Hail	GR	Reported when diameter of largest hailstones is 5 mm or more
	Small hail and/or snow pellets	GS	Reported when diameter of largest hailstones is less than 5 mm
	Unknown precipitation	UP	Reported for unidentified precipitation only when automatic observing systems are used
Obscurations (hydrometeors)	Fog	FG	Reported when visibility is less than 1 000 m, except when qualified by "MI", "BC", "PR" or "VC"
	Mist	BR	Reported when visibility is at least 1 000 m but not more than 5 000 m
Obscurations (lithometeors)	Sand	SA	Reported only when the obscuration consists predominantly of lithometeors and the visibility is 5 000 m or less except "SA" when qualified by "DR" and volcanic ash
	Dust (widespread)	DU	
	Haze	HZ	
	Smoke	FU	
	Volcanic ash	VA	
Other phenomena	Dust/sand whirls (dust devils)	PO	
	Squall	SQ	
	Funnel cloud (tornado or waterspout)	FC	
	Duststorm	DS	
	Sandstorm	SS	

* Used in both local routine reports and METAR.

Table 2-7. Characteristics of present weather phenomena

Characteristic	Abbreviation*	Remarks
Thunderstorm	TS	Used to report a thunderstorm with rain "TSRA", snow "TSSN", ice pellets "TSPL", hail "TSGR", small hail and/or snow pellets "TSGS", unknown precipitation "TSUP" (automatic observing systems only) or combinations thereof, for example, "TSRASN". When thunder is heard during the ten-minute period preceding the time of observation but no precipitation is observed at the aerodrome, the abbreviation "TS" is used without qualification. <i>Note.— At aerodromes with human observers, lightning detection equipment may supplement human observations. For aerodromes with automatic observing systems, guidance on the use of lightning detection equipment intended for thunderstorm reporting is given in the Manual on Automatic Meteorological Observing Systems at Aerodromes (Doc 9837).</i>
Shower	SH	Used to report showers of rain "SHRA", snow "SHSN", ice pellets "SHPL", hail "SHGR", small hail and/or snow pellets "SHGS", unknown precipitation "SHUP" (automatic observing systems only) or combinations thereof, for example, "SHRASN". In METAR, showers observed in the vicinity of the aerodrome should be reported as "VCSH" without qualification regarding type or intensity of precipitation.
Freezing	FZ	Supercooled water droplets or precipitation, used only with FG, DZ, RA and UP (automatic systems only).
Blowing	BL	Used to report DU, SA or SN raised by the wind to 2 m (7 ft) or more above ground level.
Low drifting	DR	Used to report DU, SA, or SN raised by the wind to less than 2 m (7 ft) above ground level.
Shallow	MI	Less than 2 m (7 ft) above ground level.
Patches	BC	Fog patches randomly covering the aerodrome.
Partial	PR	A substantial part of the aerodrome covered by fog while the remainder is clear.
* Used in both local routine reports and METAR.		

Table 2-8. Intensity/proximity of present weather phenomena

<i>Intensity/proximity</i>	<i>Local routine reports</i>	<i>METAR</i>
Light	FBL	–
Moderate	MOD	(no indication)
Heavy	HVY	+
used only with: DZ, FC (heavy used to indicate tornado or waterspout; moderate to indicate funnel cloud not reaching the ground), GR, GS, PL, RA, SG, SN and UP (automatic observing systems only), or in combinations involving these present weather types (in these cases, intensity refers to precipitation) DS, SS (in these cases, only moderate and heavy intensities to be indicated)		
Vicinity	not used	VC
Between approximately 8 and 16 km of the aerodrome reference point and used only in METAR with the present weather in Table 2-6 when not reported under the characteristics of the present weather phenomena (Table 2-7)		
<i>Note.— The actual range for which the qualifier vicinity is to be applied will be determined locally, in consultation with the civil aviation authority.</i>		

2.3.12.8 One or more, up to a maximum of three, of the present weather abbreviations given in Table 2-6 are to be used, as necessary, together with an indication, where appropriate, of the characteristics (Table 2-7) and intensity or proximity to the aerodrome (Table 2-8), so as to convey a complete description of the present weather at or near the aerodrome of significance to flight operations. The following general rules apply:

- an indication of intensity, or proximity (METAR only), as appropriate, is to be reported first;
- this is followed by both the characteristics and the type of weather phenomena in the form “HVY TSRA” (in local routine reports) and “+TSRA” (in METAR) or “VCFG” (in METAR only);
- where two different types of weather are observed, they are to be reported in two separate groups, in the form “HVY DZ FG” (in local routine reports) and “+DZ FG” (in METAR) or “–DZ VCFG” (in METAR only), where the intensity or proximity indicator refers to the weather phenomenon which follows the indicator; and
- different types of precipitation occurring at the time of observation are to be reported as a single group with the dominant type of precipitation reported first, preceded by only one intensity qualifier which refers to the intensity of the total precipitation, in the form “HVY” TSRASN (in local routine reports) and “+”TSRASN (in METAR) or “FBL SNRA FG” (in local routine reports) and “–SNRA FG” (in METAR).

2.3.12.9 In cases where the visibility is less than 1 000 m and the temperature is below minus 30° C it is unlikely that suspended supercooled water droplets are present (unless there are sources of open water nearby). Under these circumstances “FG” rather than “FZFG” is to be reported since airlines tend to experience operational penalties whenever FZFG is reported.

2.3.12.10 When the present weather cannot be observed by an automated observing system due to a temporary failure of a system/sensor, the present weather should be replaced by “//”.

2.3.12.11 Additional criteria for the reporting of present weather phenomena are in Table 2-9.

Table 2-9. Additional criteria for the reporting of present weather phenomena

<i>Condition</i>	<i>Local routine reports</i>	<i>METAR</i>
More than one present weather phenomena occurring	Up to a maximum of three phenomena	Up to a maximum of three phenomena
Indication of the intensity and characteristics of the present weather phenomena required	Report the present weather in the following order: 1. its intensity; 2. its characteristics; and 3. the present weather phenomenon e.g. “HVY TSRA” (in local routine reports) and “+TSRA” (in METAR)	
Indication of the proximity of the present weather phenomena required	Do not report	Report the present weather in the following order: 1. its proximity; and 2. the present weather phenomenon e.g. “VCFG” (METAR only)
Two different types of weather phenomena observed	Report in two separate groups The intensity indicator refers to the present weather phenomenon which follows the indicator e.g. “HVY DZ FG”: the qualifier “HVY” refers to drizzle	The intensity or proximity indicator refers to the present weather phenomenon which follows the indicator. e.g. “+DZ FG”: the qualifier “+” refers to drizzle “DZ VCFG”: the qualifier “VC” refers to fog
Different types of precipitation occurring	Report as one single group in the following order: 1. intensity qualifier referring to the intensity of the total precipitation 2. dominant type of precipitation 3. secondary type of precipitation e.g. “HVY TSRASN” or “FBL SNRA FG” (in local routine reports) “+TSRASN” or “-SNRA FG” (in METAR)	

2.3.13 Cloud

(CLD SCT 300M OVC 600M) — Local routine report
(SCT010 OVC020) — METAR

2.3.13.1 Cloud observations included in local routine reports should be representative of the runway threshold(s) in use. Cloud observations in METAR should be representative of the aerodrome and its vicinity, this combined area being the area within a radius of approximately 16 km of the aerodrome reference point.

2.3.13.2 The height of cloud base is reported in steps of 30 m (100 ft) up to 3 000 m (10 000 ft), together with the units used, in the form “CLD 300M” or “CLD 1000FT” in local routine reports and in the form “010” in METAR. In local routine reports from aerodromes where low-visibility procedures are established for approach and landing, as agreed between the meteorological authority and the appropriate ATS authority, the height of cloud base may be reported in steps of 15 m (50 ft) up to 90 m (300 ft) and in steps of 30 m (100 ft) between 90 m (300 ft) and 3 000 m (10 000 ft), together with the units used, in the form “CLD 45M” or “CLD 150FT”. Any observed value which does not fit the reporting scale in use must be rounded down to the nearest lower step in the scale.

Note 1.— The reporting increments to be used above 3 000 m (10 000 ft) are not specified in Annex 3 since only clouds of operational significance are to be reported, and clouds of operational significance with bases exceeding 3 000 m (10 000 ft) (i.e. cumulonimbus (CB) and/or towering cumulus (TCU) clouds) only occur under exceptional conditions.

Note 2.— Clouds of operational significance are clouds with a height of cloud base below 1 500 m (5 000 ft) or below the highest minimum sector altitude, whichever is greater or a CB cloud or TCU cloud at any height. TCU is used to indicate cumulus congestus clouds of great vertical extent. Guidance on the reporting of CB and TCU is provided in Doc 9837, 7.4.4.

2.3.13.3 In local routine reports and METAR, only clouds of operational significance are to be reported. Cloud amount is given using the abbreviations FEW (1-2 oktas)*, SCT (3-4 oktas), BKN (5-7 oktas) or OVC (8 oktas). The type of cloud is identified only for CB and TCU clouds when observed at or near the aerodrome. When several layers or masses of cloud of operational significance are observed, their amount, type (CB and TCU only) and height of cloud base should be reported in increasing order of the height of cloud base and in accordance with the following criteria:

- a) the lowest layer or mass, regardless of amount, reported as FEW, SCT, BKN or OVC, as appropriate;
- b) the next layer or mass, covering more than 2 oktas, reported as SCT, BKN or OVC, as appropriate;
- c) the next higher layer or mass, covering more than 4 oktas, reported as BKN or OVC, as appropriate; and
- d) CB and/or TCU clouds independently of their height(s) of cloud base, whenever observed and not reported in previous parts of the report.

2.3.13.4 When an individual layer or mass of cloud is composed of CB and TCU clouds with a common cloud base, the type of cloud is reported as CB only.

* Eighths of the sky.

2.3.13.5 If no clouds of operational significance are present and no restriction on vertical visibility exists and the abbreviation “CAVOK” is not appropriate, the abbreviation “NSC” (i.e. nil significant cloud) should be used.

Note 1.— The term CAVOK is used when the following visibility/cloud/weather conditions occur simultaneously:

- *Visibility:* 10 km or more, and the lowest visibility is not reported.
- *Cloud:* No cloud of operational significance.
- *Weather:* No weather of significance to aviation as given in Tables 2-6 and 2-7.

Note 2.— In local routine reports used for arriving aircraft, where a precision approach runway has a touchdown elevation of 15 m (50 ft) or more below the aerodrome elevation, arrangements are made for height of cloud base to be given with reference to the touchdown elevation.

Note 3.— In reports from offshore structures, the height of cloud base is given above mean sea level.

2.3.13.6 When the cloud base is diffused or ragged or fluctuating rapidly, the minimum height of the cloud, or cloud fragments, is given.

2.3.13.7 Where local routine reports include cloud base data from more than one runway in use, the runway indication should be attached to the reported cloud base data, e.g. “CLD RWY 08 BKN 200FT”.

2.3.13.8 When the sky is obscured, the observations of vertical visibility should be reported in lieu of cloud amount, cloud type and height of cloud base. The reporting steps for vertical visibility are 30 m (100 ft) up to 600 m (2 000 ft). In local routine reports from aerodromes where low-visibility procedures are established for approach and landing, as agreed between the meteorological authority and the appropriate ATS authority, the vertical visibility may be reported in steps of 15 m (50 ft) up to and including 90 m (300 ft) and in steps of 30 m (100 ft) between 90 m (300 ft) and 600 m (2 000 ft). In local routine reports, the abbreviations VER VIS (vertical visibility) are used, followed by the value of the vertical visibility and the units used, e.g. “CLD OBSC VER VIS 150M”. In METAR, the vertical visibility value is reported in the same manner as the height of cloud base preceded by the letter indicator VV. The absence of vertical visibility data in METAR is indicated by VV///. When the sky is obscured and the vertical visibility cannot be determined by an automatic observing system due to a temporary failure of a system/sensor, the vertical visibility should be replaced by “///”.

2.3.13.9 The reporting of vertical visibility, either by a human observer or an automated observing system, is known to pose certain observing challenges, such as the lack of a vertical visual reference. Comprehensive comparison studies on vertical visibility with respect to height of cloud base and present weather (such as fog) have identified that further improvements are necessary in respect of the quality of manual observations of vertical visibility through observer training and the quality of automated observations of vertical visibility through enhancement of the systems/sensors and the algorithms used. Certain States elect to use an equivalent height of cloud base as an alternative to the vertical visibility (e.g. reporting OVCnnn instead of VVnnn in a METAR), whereas other States prefer to retain the use of VVnnn (or VV///).

2.3.13.10 In automated local routine reports and METAR, when the cloud amount or cloud type cannot be identified by the automatic observing system, the cloud amount or cloud type in each cloud group should be replaced by “///”; when no clouds are detected by the automatic observing system, this should be indicated by using the abbreviation “NCD”. When CB or TCU are detected by the automatic observing system but the cloud amount and/or the height of cloud base cannot be observed, the cloud amount and/or the height of cloud base should be replaced by “///”.

2.3.14 Air temperature/dew point temperature

(T17 DP16) — Local routine report

(17/16) — METAR

2.3.14.1 Observations of air temperature and dew point temperature should be representative of the whole runway complex.

2.3.14.2 In local routine reports and METAR, the temperatures are reported in steps of whole degrees Celsius, with observed values involving 0.5° rounded up to the next higher whole degree Celsius, for example, +2.5°C is rounded up to +3°C and –2.5°C is rounded up to –2°C.

2.3.14.3 In local routine reports, the air temperature is identified by T and the dew point temperature by DP in the form T17 DP16 (temperature 17, dew point 16). For a temperature below 0°C, the value is preceded by MS (minus), e.g. TMS8.

2.3.14.4 Air temperature and dew point temperature values are reported in METAR in two figures separated by “/”, e.g. air temperature of +20.4 and dew point temperature of +8.7 are reported as “20/09”. Temperatures below 0°C are preceded by M (meaning minus). Temperatures in the range of –0.5°C to –0.1°C are reported as “M00”, while temperatures in the range of 0.0° to 0.4°C are reported as “00”.

2.3.15 Atmospheric pressure

(QNH 1018 HPA) — Local routine reports

(Q1018) — METAR

2.3.15.1 QNH is the altimeter showing aerodrome elevation when the aircraft is on the ground and QNH is set on the altimeter sub-scale. QFE is the altimeter showing zero elevation when the aircraft is on the ground and QFE is set on the altimeter sub-scale. QFE is normally used only at the aerodrome where it is provided on request or, by local agreement, on a regular basis, in addition to QNH. Only QNH is included in METAR. QFE is used only in local routine reports.

Note.— When a QFE altimeter setting is provided, it corresponds to the aerodrome elevation except for:

- a) non-precision approach runways if the threshold is 2 m (7 ft) or more below the aerodrome elevation; and*
- b) precision approach runways;*

in which cases, the QFE corresponds to the relevant runway threshold elevation.

2.3.15.2 In local routine reports and METAR, atmospheric pressure is given in hectopascals, rounded down to the nearest lower whole hectopascal and reported in four figures, e.g. QNH 1011.4 is reported as “QNH 1011HPA” in local routine reports and “Q1011” in METAR, and QFE 995.6 is reported as “QFE 0995HPA” or “QFE RWY 18 0995HPA” (where the number of the runway is indicated).

2.3.16 Supplementary information

2.3.16.1 In local routine reports and METAR, supplementary information includes information on recent weather as given in Table 2-10, observed at the aerodrome during the period since the last issued routine report or last hour, whichever is the shorter, but not at the time of observation. Up to three groups of recent weather information selected from Table 2-10 may be included in these reports.

Note.— The meteorological authority, in consultation with users, may agree not to provide recent weather information where SPECI are issued.

2.3.16.2 Local routine reports may also include available supplementary information on significant meteorological conditions, particularly those in the approach or climb-out area. The abbreviations in Table 2-11 should be used in reporting this supplementary information.

Note.— Observations of supplementary information, in particular the conditions relating to the occurrence of icing and turbulence, are often derived from aircraft observations during the approach and climb-out phases of flights. (For details concerning aircraft observations and reports, see Chapter 7.)

Table 2-10. Abbreviations to be used in reporting recent weather phenomena in local routine reports and METAR

<i>Abbreviation</i>	<i>Phenomenon/Decode</i>
REFZDZ	Recent freezing drizzle
REFZRA	Recent freezing rain
REDZ	Recent drizzle (moderate or heavy)
RERA	Recent rain (moderate or heavy)
RESN	Recent snow (moderate or heavy)
RERASN	Recent rain and snow (moderate or heavy)
RESG	Recent snow grains (moderate or heavy)
REPL	Recent ice pellets (moderate or heavy)
RESHRA	Recent rain showers (moderate or heavy)
RESHSN	Recent snow showers (moderate or heavy)
RESHGR	Recent showers of hail (moderate or heavy)
RESHGS	Recent showers of small hail and/or snow pellets (moderate or heavy)
REBLSN	Recent blowing snow
RESS	Recent sandstorm
REDS	Recent duststorm
RETSRA	Recent thunderstorm with rain
RETSSN	Recent thunderstorm with snow
RETSGR	Recent thunderstorm with hail
RETSGS	Recent thunderstorm with small hail
RETS	Recent thunderstorm without precipitation
REFC	Recent funnel cloud (tornado or waterspout)
REVA	Recent volcanic ash



<i>Abbreviation</i>	<i>Phenomenon/Decode</i>
REUP	Recent unidentified precipitation (only when automatic observing systems are used)
REFZUP	Recent freezing rain with unidentified precipitation (only when automatic observing systems are used)
RETSUP	Recent thunderstorm with unidentified precipitation (only when automatic observing systems are used)
RESHUP	Recent showers of unidentified precipitation (only when automatic observing systems are used)

Table 2-11. Supplementary information for inclusion in local routine reports

	<i>Abbreviation</i>	<i>Condition/Decode</i>
a)	<i>Significant weather conditions</i>	
	CB	Cumulonimbus
	TS	Thunderstorm
	MOD TURB	Moderate turbulence
	SEV TURB	Severe turbulence
	WS	Wind shear
	GR	Hail
	SEV SQL	Severe squall line
	MOD ICE	Moderate icing
	SEV ICE	Severe icing
	FZDZ	Freezing drizzle
	FZRA	Freezing rain
	SEV MTW	Severe mountain wave
	SS	Sandstorm
	DS	Duststorm
	BLSN	Blowing snow
	FC	Funnel cloud (tornado or waterspout)
b)	<i>Location</i>	
	IN APCH	In the approach
	IN CLIMB-OUT	In the climb-out
	RWY	Runway

Note.— Additional information may be included using abbreviated plain language.

2.3.16.3 In METAR, where local circumstances so warrant, wind shear should be included as necessary. Information on wind shear is added in the form “WS RWY 12” or “WS ALL RWY”.

Note 1.— The “local circumstances” referred to above include, but are not necessarily limited to, wind shear of a non-transitory nature such as might be associated with low-level temperature inversions or local topography.

Note 2.— Warnings of wind shear in the climb-out and approach areas are detailed in Chapter 4.

2.3.16.4 In METAR, in accordance with regional air navigation agreement, two additional groups may be included as supplementary information:

- a) information on sea-surface temperature and the state of the sea or the significant wave height at aeronautical meteorological stations established on offshore structures in support of helicopter operations; and
- b) information on the state of the runway(s).

Note 1.— The state of the sea is specified in WMO-No. 306, Volume I.1, Part C — Code Tables, Code Table 3700.

Note 2.— The significant wave height is to be reported in decimetres.

Note 3.— The state of the runway is specified in WMO-No. 306, Volume I.1, Part C, Code Tables 0366, 0519, 0919 and 1079.

2.3.17 Landing forecasts

A landing forecast, in the form of a trend forecast, when provided by an aerodrome meteorological office, is attached to a local routine report as well as a METAR; details of the trend forecast are given in Annex 3, Appendix 3, Tables A3-1 and A3-2.

2.4 SPECIAL REPORTS

2.4.1 Local special reports

2.4.1.1 Local special reports are issued in addition to local routine reports to provide information on significant deterioration or improvement in aerodrome meteorological conditions at the aerodrome concerned. They are issued whenever one or more elements of a local routine report change in accordance with criteria established by the meteorological authority in consultation with the appropriate ATS authority, the operators and others concerned. These criteria include:

- a) values which correspond to the operating minima of the operators using the aerodrome;
- b) values which satisfy other local requirements of ATS units and the operators;
- c) an increase in air temperature of 2°C or more from that given in the latest report, or an alternative threshold value as agreed between the meteorological authority, the appropriate ATS authority and the operators concerned;

- d) the available supplementary information concerning the occurrence of significant meteorological conditions in the approach and climb-out areas;
- e) when noise abatement procedures are applied in accordance with Doc 4444 and the variation from the mean surface wind speed (gusts) has changed by 2.5 m/s (5 kt) or more from that given in the latest report, the means speed before and/or after the change being 7.5 m/s (15 kt) or more; and
- f) the criteria given for the issuance of SPECI (see 2.4.2.1).

Local special reports in respect of RVR, surface wind or other elements need not be issued if the local ATS unit(s) has (have) displays for these elements corresponding to the displays in the aeronautical meteorological station, or if changes in RVR are continuously reported to the ATS unit by an observer at the aerodrome.

2.4.1.2 Local special reports carry the identifier SPECIAL and, as Example 2-2 shows, have the same content and sequence of elements as local routine reports (see 2.3.4 to 2.3.16). As with local routine reports, a trend forecast is appended, as required, to the local special report.

2.4.2 Aerodrome special meteorological report (SPECI)

2.4.2.1 SPECI are issued in accordance with the following criteria:

- a) when the mean surface wind direction has changed by 60° or more from that given in the latest report, the mean speed before and/or after the change being 5 m/s (or 10 kt) or more;
- b) when the mean surface wind speed has changed by 5 m/s (or 10 kt) or more from that given in the latest report;
- c) when the variation from the mean surface wind speed (gusts) has changed by 5 m/s (10 kt) or more from that given in the latest report, the mean speed before and/or after the change being 7.5 m/s (15 kt) or more;
- d) when the wind changes through values of operational significance. The threshold values should be established by the meteorological authority in consultation with the appropriate ATS authority and operators concerned, taking into account changes in the wind which would:
 - 1) require a change in runway(s) in use; or
 - 2) indicate that the runway tailwind and crosswind components have changed through values representing the main operating limits for typical aircraft operating at the aerodrome;
- e) when the visibility is improving and changes to, or passes through, one or more of the following values; or when the visibility is deteriorating and passes through one or more of the following values:
 - 1) 800, 1 500 or 3 000 m; and
 - 2) 5 000 m, in cases where significant numbers of flights are operated in accordance with visual flight rules;

Note.— In local special reports, visibility refers to the value(s) to be reported in accordance with 2.3.10.5. In SPECI, visibility refers to the value(s) to be reported in accordance with 2.3.10.7 and 2.3.10.8.

- f) when RVR is improving and changes to, or passes through, one or more of the following values; or when RVR is deteriorating and passes through one or more of the following values:
- 50, 175, 300, 550 or 800 m;
- g) when the onset, cessation or change in intensity of any of the following weather phenomena or combinations thereof occurs:
- freezing precipitation
 - moderate or heavy precipitation (including showers thereof)
 - thunderstorm (with precipitation)
 - duststorm
 - sandstorm
 - funnel cloud (tornado or waterspout);
- h) when the onset or cessation of any of the following weather phenomena or combinations thereof occurs:
- freezing fog
 - low drifting dust, sand or snow
 - blowing dust, sand or snow
 - thunderstorm (without precipitation)
 - squall;
- i) when the height of the base of the lowest cloud layer of BKN or OVC extent is lifting and changes to, or passes through, one or more of the following values; or when the height of the base of the lowest cloud layer of BKN or OVC extent is descending and passes through one or more of the following values:
- 1) 30, 60, 150 or 300 m (100, 200, 500 or 1 000 ft);
 - 2) 450 m (1 500 ft), in cases where significant numbers of flights are operated in accordance with visual flight rules;
- j) when the amount of a cloud layer below 450 m (1 500 ft) changes:
- 1) from SCT or less to BKN or OVC; or
 - 2) from BKN or OVC to SCT or less;
- k) when the sky is obscured and the vertical visibility is improving and changes to, or passes through, one or more of the following values; or when the sky is obscured and the vertical visibility is deteriorating and passes through one or more of the following values:
- 30, 60, 150 or 300 m (100, 200, 500 or 1 000 ft); and
- l) any other criteria based on local aerodrome operating minima, as agreed between the meteorological authority, the appropriate ATS authority and the operators concerned.

Note.— Other criteria based on local operating minima are to be considered in parallel with similar criteria for the inclusion of change groups and for the amendment of aerodrome forecasts (TAF).

2.4.2.2 When a deterioration of a weather element is accompanied by an improvement in another element, a single SPECI shall be issued; it shall then be treated as a deterioration report.

2.4.2.3 SPECI carry the identifier SPECI and, as Example 2-2 shows, have the same content and sequence of elements as METAR (see 2.3.4 to 2.3.16). As with METAR, a trend forecast is appended, as required, to SPECI.

2.4.2.4 SPECI are disseminated beyond the aerodrome of origin to other aerodromes in accordance with regional air navigation agreement, which ensures, *inter alia*, that SPECI are available for VOLMET broadcasts, for D-VOLMET and for individual transmissions to aircraft in flight through ATS units or operators.

Note.— Details on requirements for the exchange of SPECI between meteorological offices/stations can be found in the relevant ANP, Volume II.

2.5 REPORTS OF VOLCANIC ACTIVITY

2.5.1 As mentioned in 1.4.2, meteorological stations located in the vicinity of active or potentially active volcanoes are required to make observations of volcanic activity. The volcanic activity reports resulting from these observations should contain:

- a) message type VOLCANIC ACTIVITY REPORT;
- b) station identifier, location indicator or name of the station;
- c) date/time of the message;
- d) location of volcano, and name, if known; and
- e) concise description of the event including, as appropriate, the level of intensity of the volcanic activity, including significant pre-eruption volcanic activity, occurrence of the eruption and its date and time, and the existence of a volcanic ash cloud in the area together with the direction of the ash cloud movement and height.

Note.— Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity which could presage a volcanic eruption.

2.5.2 The reports should be issued in abbreviated plain language and disseminated, as a matter of urgency, to the associated meteorological watch offices, ATS units and aeronautical information services units. These reports are important for the operation of the IAVW.

2.6 BASIC METEOROLOGICAL DATA

2.6.1 Weather radar observations

2.6.1.1 Weather radar observations permit the locating and tracking of thunderstorms and tropical cyclones, and the evaluation of precipitation and cloud height. This information is used for early warning of certain meteorological phenomena hazardous to aviation, particularly in the vicinity of aerodromes, and in the preparation of trend forecasts. Radar data are usually available only locally, but in many parts of the world, data from large radar networks are

distributed in coded or pictorial forms and, in particular, in digital form, to meteorological offices/stations and other aeronautical users by means of various data processing systems and high-speed communication channels. The processed and integrated weather radar information is often displayed for ATS personnel through ATS systems.

2.6.1.2 Increasing use is being made of Doppler weather radar both for storm warning purposes and, specifically, to detect low-level wind shear. In the latter case, fully automated terminal Doppler weather radar is available, which can provide wind shear warnings to air traffic control and directly to aircraft equipped with an air-ground data link.

2.6.2 Automated aircraft observations and air-reports

Automated meteorological reports from aircraft constitute an important source of upper-air data. They are especially useful in areas where ground-based observations are sparse or not available. Air-reporting is also useful in the observation of volcanic ash, wind shear and turbulence. A substantial proportion of upper-air wind and temperature information is obtained through the WMO aircraft meteorological data relay (AMDAR) programme based on the use of standard equipment carried on board most aircraft. All these data are disseminated in code forms established by WMO and are used for the preparation of upper-air forecasts. In view of its importance, air-reporting is discussed further in Chapter 7.

2.6.3 Basic surface and upper-air observations

2.6.3.1 Meteorological observations containing elements similar to those in aerodrome reports, but with additional details of cloud, weather, pressure, etc., are made at many aerodromes and other locations (including ships) for basic meteorological purposes. They are made at three-hour or six-hour intervals (0000 UTC, 0300 UTC, 0600 UTC, etc.), disseminated in a code form (SYNOP) established by WMO, and used, *inter alia*, for the calculations involved in numerical weather prediction.

2.6.3.2 Upper-air information is obtained principally from instruments carried aloft by balloons released from fixed ground observation sites or from ships. These balloon-borne instruments reach altitudes approaching 30 km (100 000 ft) and provide data on wind speed and direction, temperature, pressure and relative humidity to approximately 15 km (50 000 ft). Upper-air observations of this type are made at standard hours, 0000 UTC and 1200 UTC and additionally in some areas at 0600 UTC and 1800 UTC.

2.6.4 Meteorological satellite data

In addition to information on cloud type, cloud amount and height of cloud tops, meteorological satellite data also provide information on vertical temperature and humidity distribution and on upper winds derived from cloud movement and, increasingly, are used to detect volcanic ash. The information provided by satellites is of particular importance in areas where ground-based observations are sparse or not available. It is received directly from geostationary or polar-orbiting satellites by ground-receiving equipment. The processed satellite data can be used to supplement the integrated weather radar data. Data from geostationary and polar-orbiting meteorological satellites are also used by volcanic ash advisory centres for the detection and tracking of volcanic ash clouds.

Chapter 3

FORECASTS

3.1 GENERAL

A forecast is a concise statement of expected meteorological conditions at an aerodrome or over an area or along a route. Owing to the variability of meteorological elements in space and time, the limitation of forecasting techniques, and the limitations imposed by the definitions of some of the individual meteorological elements (e.g. surface wind, weather phenomena), the specific value of any forecast element is to be understood as being the most probable value which the element is likely to assume during the period of the forecast. Similarly, when the time of occurrence or change of an element is given in a forecast, this is to be understood to be the most probable time.

3.2 ACCURACY OF AERONAUTICAL METEOROLOGICAL FORECASTS

The accuracy of aeronautical forecasts depends upon the accuracy, spacing and frequency of observations, the period of the forecast and various factors associated with analysis and forecasting techniques. In general, the forecast elements are the best estimate of the conditions expected to occur within a range of values. Guidance on the operationally desirable accuracy of aeronautical forecasts is contained in Annex 3, Attachment B.

3.3 TYPES OF AERONAUTICAL METEOROLOGICAL FORECASTS

3.3.1 There are different types of aeronautical forecasts designed to meet requirements for the various stages of flight planning. They differ in respect of area or airspace covered and in respect of the offices preparing and issuing them, as shown in Table 3-1.

Note.— While forecasts generally refer to the meteorological conditions expected to occur (i.e. in the future), SIGMET and AIRMET information, aerodrome warnings and wind shear warnings may refer to existing as well as expected conditions. (For further details on SIGMET and AIRMET information, aerodrome warnings and wind shear warnings, see Chapter 4.) Similarly, volcanic ash advisories containing information concerning location, extent and trajectories of volcanic ash clouds; tropical cyclone advisories containing information concerning tropical cyclones and the movement of their centres and space weather advisories containing information concerning space weather effects can also be considered forecasts. Details concerning the advisories are given in Chapter 4.

3.3.2 The various formats in which forecasts are normally issued (abbreviated plain language, code or graphical) are listed in Table 3-2.

3.3.3 Forecasts also differ in regard to the period of validity or fixed time of validity for which they are normally prepared, as shown in Table 3-3.

Table 3-1. Types of aeronautical meteorological forecasts, including SIGMET and AIRMET information, warnings, volcanic ash advisories, tropical cyclone advisories and space weather advisories

<i>Type of forecast</i>	<i>Area/airspace covered</i>	<i>Stage of flight planning</i>	<i>Responsibility for preparing/issuing the forecast</i>
TAF	Aerodrome	Pre-flight and in-flight	Aerodrome meteorological office
Landing forecast (trend)	Aerodrome	In-flight	Aerodrome meteorological office
Take-off forecast	Runway complex	Pre-flight	Aerodrome meteorological office
Forecasts of en-route conditions	Route(s), an area or flight levels applicable to the operation	Pre-flight and in-flight	World area forecast centre (WAFC) (Aerodrome meteorological office for low-level flights)
SIGMET information	Flight information region (FIR) or control area (CTA)/ encompassing all flight levels used for flight operations	Pre-flight and in-flight	Meteorological watch office (MWO)
AIRMET information	FIR or CTA or a sub-area thereof/encompassing all flight levels up to FL 100 (FL 150 or higher in mountainous areas)	Pre-flight and in-flight	MWO
Aerodrome warnings	Aerodrome surface conditions	Not applicable (intended for parked aircraft, aerodrome installations)	Aerodrome meteorological office
Wind shear warnings	Aerodrome and approach/take-off paths between runway level and 500 m (1 600 ft), or higher, if necessary	In-flight	Aerodrome meteorological office
Volcanic ash advisories	Area affected by volcanic ash cloud	Pre-flight and in-flight	Volcanic ash advisory centre (VAAC)
Tropical cyclone advisories	Area affected by tropical cyclone	Pre-flight and in-flight	Tropical cyclone advisory centre (TCAC)
Space weather advisories	Area affected by space weather phenomena	Pre-flight and in-flight	Space weather centre (SWXC)

Table 3-2. Formats of forecasts, including SIGMET and AIRMET information, warnings, volcanic ash advisories, tropical cyclone advisories and space weather advisories

Type of forecast	Abbreviated plain language	Alpha-numeric code form	Binary code form ¹	IWXXM GML form ²	Graphical format
TAF		X		X	
Trend forecasts	X	X ³		X	
Take-off forecasts	X				
Forecasts of en-route conditions	X		X		X ⁴
SIGMET information	X ⁵			X	X ⁷
AIRMET information	X ⁵			X	
Aerodrome warnings	X ⁵				
Wind shear warnings	X ⁵				
Volcanic ash advisories	X ⁵			X	X ⁶
Tropical cyclone advisories	X ⁵			X	X ⁶
Space weather advisories	X ⁵			X	

1. BUFR and GRIB code forms for WAFS forecasts.
2. IWXXM form.
3. Part of the METAR code form.
4. Chart form for area forecasts for low-level flights.
5. See Chapter 4.
6. Portable network graphic (PNG) format.
7. Format not specified in Annex 3.

3.4 AERODROME FORECASTS (TAF)

3.4.1 TAF follow the general form of an aerodrome routine meteorological report (METAR), consisting of a concise statement of the expected meteorological conditions at an aerodrome for a specified period. Paragraphs 3.4.4 to 3.4.7 deal with the content and format of TAF in text format. They include surface wind, visibility, weather phenomena and cloud, and relevant significant changes thereto (see Example 3-1). Forecasts of weather phenomena are for the area at the aerodrome, i.e. the area within a radius of approximately 8 km of the aerodrome reference point. The word “approximately” is used to cater for aerodromes that have perimeters which are not precisely a radius of 8 km from the aerodrome reference point. Forecasts of cloud are for the aerodrome and its vicinity, i.e. the area within a radius of approximately 16 km of the aerodrome reference point. Forecasts of maximum and minimum temperatures are included in accordance with regional air navigation agreement. Detailed technical specifications for TAF can be found in Annex 3, Appendix 5, Table A5-1, which also includes an extensive set of examples of TAF in text format relating to individual portions of the forecast. TAF valid for less than 12 hours are issued every 3 hours and those valid for 12 hours or more are issued at 6-hour intervals. The validity period of TAF is determined for each region in accordance with regional air navigation agreement but must be between 6 and 30 hours inclusive. When issuing TAF, aerodrome meteorological offices must ensure that only one TAF is valid at an aerodrome at any given time. TAF must be issued at a specified time not earlier than one hour prior to the beginning of its validity period.

3.4.2 TAF should be kept under continuous review by the aerodrome meteorological office concerned to enable the issuance of amendments as necessary. Annex 3 does not explicitly require that complete METAR be available to maintain such a review (although many States do stipulate in their national regulations that METAR be required for this purpose). It is recommended that other sources of meteorological information be used in the absence of full METAR (weather radar data, observations from automatic weather stations, satellite images, etc.). TAF that cannot be kept under continuous review must be cancelled. The issuance of a new TAF by an aerodrome meteorological office is understood to automatically supersede any TAF previously issued for the same place and for the same period of validity or part thereof.

Example 3-1. TAF in text format

TAF:

TAF YUDO 152300Z 13001706 13005MPS 9000 BKN020 BECMG 16061608 SCT015CB BKN020 TEMPO 16081612 17007G12MPS 1000 TSRA SCT010CB BKN020 FM161230 15004MPS 9999 BKN020 TX25/1612Z TNM02/1623Z

Meaning of forecast:

TAF for Donlon/International* issued on the 15th of the month at 2300 UTC valid from 0000 UTC on the 16th of the month to 0600 UTC on the 17th of the month; surface wind direction 130 degrees; wind speed 5 metres per second; visibility 9 kilometres; broken cloud at 600 metres (2 000 feet); becoming between 0600 UTC and 0800 UTC on the 16th of the month, scattered cumulonimbus cloud at 450 metres (1 500 feet) and broken cloud at 600 metres (2 000 feet); temporarily between 0800 UTC and 1200 UTC on the 16th of the month; surface wind direction 170 degrees, wind speed 7 metres per second (14 kt) gusting to 12 metres per second (24 kt); visibility 1 000 metres in a thunderstorm with moderate rain, scattered cumulonimbus cloud at 300 metres (1 000 feet) and broken cloud at 600 metres; from 1230 UTC on the 16th of the month; surface wind direction 150 degrees, wind speed 4 metres per second; visibility 10 kilometres or more; broken cloud at 600 metres (2 000 feet); maximum air temperature 25 degrees Celsius at 1200 UTC on the 16th of the month;** minimum air temperature minus 2 degrees Celsius at 2300 UTC on the 16th of the month.**

* Fictitious location.

** Inclusion of temperature forecasts (maximum and minimum expected to occur during the TAF validity period and their corresponding times of occurrence) is in accordance with regional air navigation agreement.

3.4.3 The specific values of elements and the time of expected changes indicated in TAF are understood as being approximate and as representing the most probable mean of a range of values or times. Criteria for giving expected changes, or for amending TAF, are based on values given in Table 3-4.

3.4.4 The expected changes referred to in 3.4.3 are given using the following indicators and associated time groups:

- a) *BECMG* (abbreviation for “becoming”) — this change indicator describes changes where the conditions are expected to reach or pass specified values at a regular or irregular rate;
- b) *TEMPO* (abbreviation for “temporary”) — this indicator is used to describe temporary fluctuations in the meteorological conditions, lasting less than one hour in each instance and, in the aggregate, covering less than half of the forecast period. For forecast changes in excess of these criteria, the change group “BECMG” should be used;

- c) *PROB* (abbreviation for “probability”) — followed by a percentage (rounded to the nearest ten) indicates the probability that a certain change or value will occur. Only PROB30 or PROB40 are used, as less than 30 per cent probability is considered in aviation to have little operational significance and 50 per cent or more should be indicated as BECMG or TEMPO, as appropriate; and
- d) *FM* (abbreviation for “from”) — is used to indicate self-contained time periods within the overall validity period during which certain conditions prevail.

A full description of the usage of the above indicators is given in Annex 3, Appendix 5, 1.3. It should be noted that the number of change indicators used should be kept to a minimum and should not exceed five groups.

3.4.5 TAF (and amendments thereto) for intended destinations and alternates will normally be supplied by aerodrome meteorological offices upon appropriate notification by operators. All TAF issued are to be disseminated to international OPMET databanks and centres designated by regional air navigation agreement for the operation of the aeronautical fixed service (AFS) Internet-based services for onward dissemination to States.

Note.— Information on regional differences in period of validity of TAF, and on requirements for their exchange between aerodrome meteorological offices, can be found in the relevant air navigation plan (ANP), Volume II, Part V, Table MET II-2.

3.4.6 An amended TAF is identified as “TAF AMD” in place of “TAF”; it covers the whole of the remaining period of the original forecast. (For amendment criteria, see 3.4.3 and Table 3-4; an example is provided in Example 3-2). A TAF is amended as a result of changes to the forecast or current meteorological conditions leading to the original TAF no longer accurately reflecting the expected meteorological situation. A TAF can also be issued as a corrected TAF using TAF COR which indicates that the original TAF contained errors in terms of syntax and that the correction is merely to correct this rather than any change in the meteorological conditions.

3.4.7 A TAF is cancelled using CNL if the TAF cannot be kept under continuous review or is no longer valid owing to the closure of the aerodrome. If a TAF is not available for a particular aerodrome, it is identified with the abbreviation NIL within a bulletin that may contain TAF for several aerodromes.

3.4.8 The TAF code form was developed by the World Meteorological Organization (WMO) on the basis of aeronautical requirements established by ICAO. This code uses the approved ICAO abbreviations contained in the *Procedures for Air Navigation Services — ICAO Abbreviations and Codes* (PANS-ABC, Doc 8400). In view of this, TAF in text format are human-readable while their IWXXM versions are machine readable.

Note.— All details relating to the TAF code forms in text format are contained in the Manual on Codes — International Codes (WMO-No. 306), Volume I.1, Part A — Alphanumeric Codes. Details related to XML coding are contained in Volume I.3, Part D — Representations derived from data models.

3.4.9 Additionally, TAF are to be disseminated in IWXXM GML form.

Note.— The technical specifications for IWXXM are contained in the Manual on Codes (WMO – No. 306), Volume I.3, Part D – Representation Derived from Data Models. Guidance on the implementation of IWXXM is provided in the Manual on the ICAO Meteorological Information Exchange Model (IWXXM) (Doc 10003).

Example 3-2. Cancellation of TAF in text format

Cancellation of TAF:

TAF AMD YUDO 161500Z 16001706 CNL

Meaning of the message:

Amended TAF for Donlon/International* issued on the 16th of the month at 1500 UTC cancelling the previously issued TAF valid from 0000 on the 16th of the month to 0600 UTC on the 17th of the month.

* Fictitious location

Table 3-3. Validity of forecasts, including SIGMET and AIRMET information, warnings, volcanic ash advisories, tropical cyclone advisories and space weather advisories

<i>Forecast</i>	<i>Usual validity period or fixed time of validity</i>
TAF	Between 6 and 30 hours inclusive
Trend forecasts	2 hours
Take-off forecasts	For specified period (usually short)
Forecasts of en-route conditions	<i>In chart and binary code forms:</i> up to 36 hours for fixed validity times, usually 0000, 0300, 0600, 0900, 1200, 1500, 1800 and 2100 UTC*
SIGMET information	Not more than 4 hours
SIGMET information for volcanic ash and tropical cyclones	6 hours
AIRMET information	Not more than 4 hours
Aerodrome warnings	Usually not more than 24 hours
Wind shear warnings	For as long as wind shear is expected to last
Volcanic ash advisories	18 hours
Tropical cyclone advisories	24 hours
Space weather advisories	24 hours

* All the forecasts issued within WAFCs are issued for fixed validity times of 0000, 0300, 0600, 0900, 1200, 1500, 1800 and 2100 UTC. These forecasts should be used as follows:

<i>Validity time (UTC)</i>	<i>Period for use (UTC)</i>
0000	2230–0130
0300	0130–0430
0600	0430–0730
0900	0730–1030
1200	1030–1330
1500	1330–1630
1800	1630–1930
2100	1930–2230