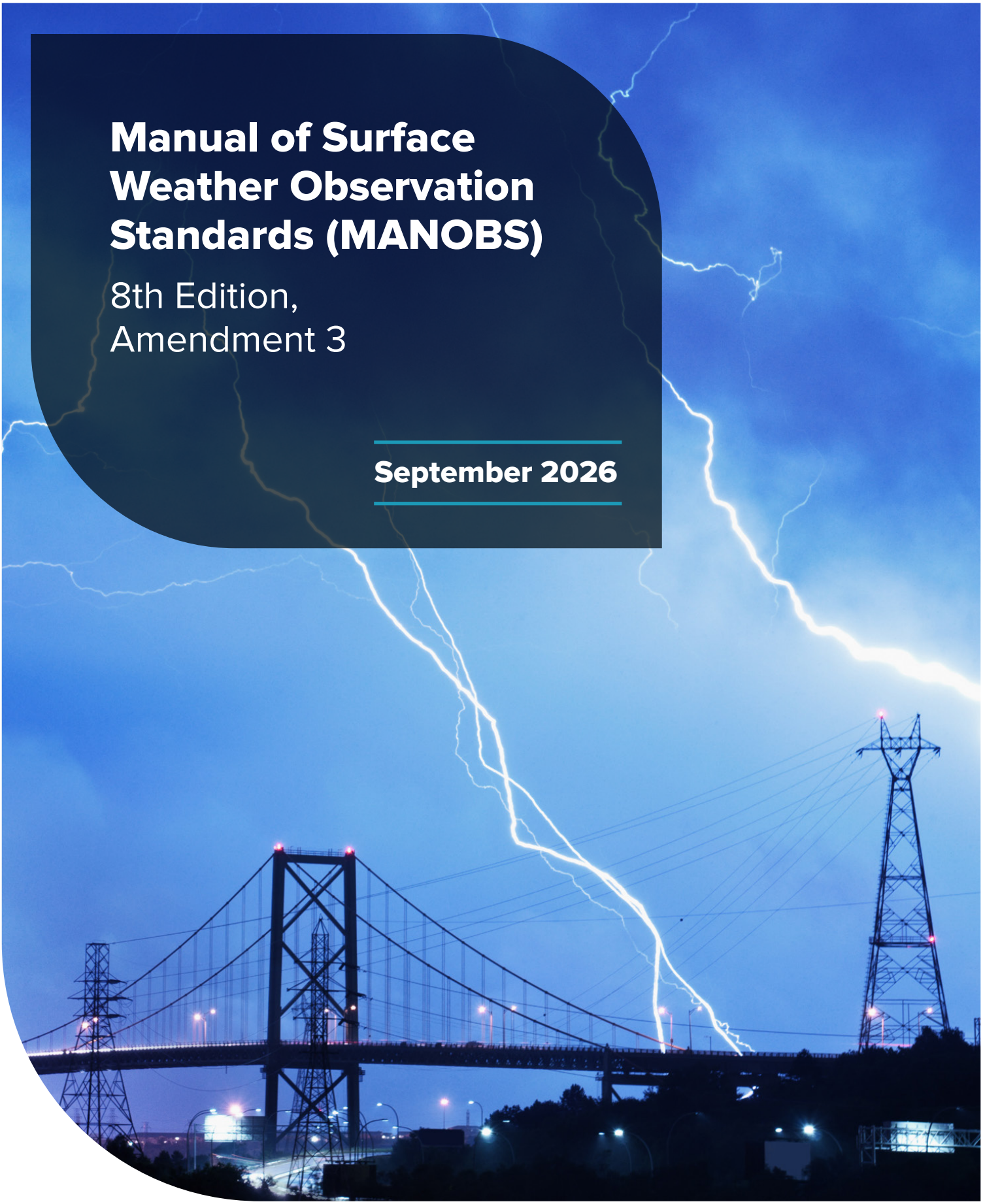
Manual of Surface Weather Observation Standards (MANOBS)

8th Edition,
Amendment 3

September 2026



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Foreword

The *Manual of Surface Weather Observations Standards* (MANOBS), Eighth Edition, has been prepared with due consideration to the standards and recommendations set down by the World Meteorological Organization (WMO) and, for the aeronautical portions, by the International Civil Aviation Organization (ICAO) and *Canadian Aviation Regulations* (CARs). The standards set out in MANOBS do not inhibit agencies from doing more than is specified.

Manual conventions

Throughout this manual:

- The term "**shall**" or "**shall not**" indicates that compliance with a standard is mandatory
- All references to miles (mi.) are references to the international statute mile (precisely equal to 1.609344 km)
- All reference for clouds based height are in feet (precisely equal to 0.3048 meters)
- All reference for wind speed are in knots (precisely equal to 1.852 km/h)

The following typographical and stylistic conventions are used throughout this manual:

- Code forms, symbolic letters and code figures have been printed in 14 point dark blue Courier New font
- Notes have been printed in medium grey-shaded boxes, preceded by the word "Note" in bold
- Blank table cells have been marked with an en-dash "–" to indicate to assistive technology users that these cells may be ignored

Amendments

Amendments will be issued when warranted, and a review will take place in conjunction with amendments to relevant WMO and ICAO standards. All holders of paper copies of the manual are responsible for keeping their copies current. When amendments are entered in the manual, they should be recorded on the page headed "Record of amendments."

The version of the Manual found published on the Meteorological Service of Canada website, in either official language, **shall** be considered to be the official version.

Changes, additions, deletions, and corrections will be issued as necessary solely by the Meteorological Service of Canada after consultation and coordination with the working group (Transport Canada, NAV CANADA and the Department of National Defence) responsible for MANOBS.

Note: Following consultation between Environment and Climate Change Canada, NAV CANADA, and the Department of National Defence in October 2019, it was agreed that modifications to MANOBS 8 were required to increase the harmonization of the Standards with the corresponding standards established elsewhere under the *Canadian Aviation Regulations* (CAR) regulatory framework and related international standards. This also expands the scope of the MANOBS 8 standards to provide a nearly comprehensive set of standards for most aviation weather services beyond those otherwise established in ICAO Annex 3 and, by extension, the Procedures for Air Navigation Services – Meteorology (PANS-MET) and MANAIR. These changes are based primarily upon removing gaps between the previous version of the MANOBS 8 standards and the evolving international standards as well as the provisions of long standing exemptions to the CAR that previously served as the basis of a significant portion of aviation weather services. Editorial and formatting changes are also made. MANOBS 8 Edition, Amendment 3, is effective as of September 2026. Affected sections are listed within the Record of Revisions. Affected pages are labelled in their respective page headers as Eighth Edition, Amendment 3, September 2026.

Inquiries

Inquiries about the content of this manual should be directed to the Assistant Deputy Minister (ADM), Meteorological Service of Canada, through appropriate channels.

Application

MANOBS is applicable to stations taking the following types of observations:

- **Staffed**: Stations where surface weather observers are responsible for the meteorological observations
- **Automated**: Stations where surface weather observing systems are implemented to prepare the requisite meteorological reports for transmission, without a weather observer being present

Observing procedures

With the publication of the Eighth Edition, procedures and practices specific to weather observing have been removed from MANOBS. Individual service providers **shall** issue their own manuals setting out their weather observing procedures and practices which implement the MANOBS standards. Such manuals **shall** complement, not supersede, the standards contained in MANOBS, Eighth Edition.

Pilot reports (PIREP)

Pilot reports are no longer part of MANOBS. The responsibility for publishing procedures for PIREP now resides with individual service providers (NAV CANADA and Department of National Defence). Weather observation staff who receive special air reports **shall** refer them to the appropriate ATS unit.

Editor's remarks

This manual has been edited to be consistent with the Government of Canada's brand guidelines, and best practices for accessibility (Web Content Accessibility Guidelines 2.0), as well as the design and structural requirements of the *Canada.ca Content Style Guide*.

Record of amendments

Number	Effective date	Entered by	Date of entry
1	December 2021	Sylvain Pelletier	December 2021
2	February 2023	Sylvain Pelletier	February 2023
3	September 2026	Sylvain Pelletier	September 2026

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Record of revisions

Significant and substantial revisions to MANOBS Eighth Edition are listed below with a description of the changes. The Record of revisions is updated whenever amendments are issued.

Note: Vertical change bars are used to identify new and revised content in affected sections.

Section	Revision description	Effective date
Forward	Addition of "PANS-MET" in the **Note**	September 2026
Forward	Under **Pilot report (PIREP)**, add a sentence as per ICAO Audit findings	September 2026
1.3	Addition of "PANS-MET" as per ICAO amendment 82	September 2026
1.3.1	Addition of "PANS-MET" as per ICAO amendment 82	September 2026
2.2	Reworded sixth bullet	September 2026
2.2	Under **Siting**, reworded Third bullet	September 2026
2.2	Under **Validation of Instrument**, second bullet correction "Istruments" - "Instruments". Third & Fourth bullets, move to Sub-para	September 2026
2.2	Under **Observing**, after second bullet, addition of four new bullets. Addition of a para on ISO 9001:2015 and a **Note** before the last para	September 2026
2.3	Under **Sensor siting**, reworded the first para	September 2026
2.4	Under **Automated weather observing systems**, addition of two paragraphs and a **Note**	September 2026
2.5.3	Under **Accident observation**, reworded para 3)	September 2026
2.7	Replaced "an" - "a"	September 2026

Section	Revision description	Effective date
2.8	Under **Time of observations**, reworded para 4)	September 2026
2.9	Under **Scheduled observations**, reworded first para which include move the last sentence from 2.9.1 to 2.9	September 2026
2.9.2	Under **Late observation**, change +18 to +13 in the example	September 2026
3.2.4	Under **Calm wind**, reworded second para	September 2026
3.2.5	Under **Wind speed**, second bullet, replaced "00 and 01 kt" - "01 kt"	September 2026
3.3.1	Under **Gusts**, reworded para 2)to remove any ambiguity	September 2026
3.3.2	Under **Squalls**, reworded para 1)to remove any ambiguity	September 2026
4.4	Under **Visibility charts**, second line, replaced "continuous basis" - "regular cycle"	September 2026
4.5.1	The **Note** changed to a sentence since it has the word "**shall**"	September 2026
4.5.2	Under **Variable Visibility**, added a line to the first para to remove any ambiguity when using variable visibility	September 2026
5.3	Under **RVR remarks**, added a Note to refer CAR 804/824	September 2026
6.3.2	Under **Standards for reporting**, added "FUNNEL CLOUD" to para 6) to be consistent. Added para seven to describe no intensity for tornadoes, waterspouts or funnel clouds	September 2026
6.4.2.4	Remove the third example, it was redundant	September 2026
6.5.2	Added "and LTNG (Undetermined)" to para 2)	September 2026

Section	Revision description	Effective date
6.5.2.1 6.5.2.2	Reworded Chapter to **Frequency of lightning** Added "OCNL" to the first example and added a new example for undetermined lightning	September 2026
6.6.2.4	Added a new paragraph for automated ice accretion	September 2026
6.6.2.5.1	The **Note** changed to a para since it has the word "**shall**"	September 2026
6.6.2.5.3	Added "**criteria**" to the title	September 2026
6.6.2.6	Reworded the para and added a **Note** to remove any ambiguity for the use of the /Rrr/ group	September 2026
6.6.2.7	New chapter for **Rainfall remark for part-time stations**	September 2026
6.6.2.8.1	Reworded the title to "Small hail" and the following para as per WMO	September 2026
6.6.2.10	Reworded para and the **Note** to remove any ambiguity	September 2026
6.6.2.11	New chapter for **Snowfall remark for part-time stations**	September 2026
6.7	Reworded title to be consistent with **Appendix 2.** Also change the paragraph hierarchy to fall underneath as 6.7.1.1-6.7.1.8	September 2026
6.8 6.8.1	Reworded title to be consistent with **Appendix 2**. For chapter 6.8.1, 6.8.1.1-4 use same format as 6.7.1 Added new para for additional phenomena	September 2026
6.8.1.1.1 6.8.1.2.1	Reworded the examples to remove any ambiguity	September 2026
6.8.1.5	New para to add volcanic ash	September 2026

Section	Revision description	Effective date
7.2.3.1	New para for smoke	September 2026
7.3	Added para 8 and reworded para 9-12. **Note (2)** added	September 2026
7.3.3	Added the word "RMK" to the example. Added a sentence to avoid variable ceiling remarks of little value.	September 2026
7.3.4	Replaced the word "OVC" with "CLD" in second example. The **Note,** changed to a para since it has the word "**shall**"	September 2026
9.1.2	Removed last para	September 2026
9.1.3	Added a sentence for the unit of measurement for the Altimeter setting	September 2026
10.1	Added a para for the service provider	September 2026
10.2	Added the word 'estimated' to the hail size bullet. Added icing bullet to the list	September 2026
11.1	Added additional content to the third para on IWXXM and reworded the last sentence of the last para	September 2026
11.2.2.14	Added a **Note** for cloud layers	September 2026
11.2.3.7	Replaced "small hailstones" – "small hail"	September 2026
11.2.3.11	Replaced "define" – "defined" in last bullet	September 2026
12.2.2.3	Replaced "wind" – "visibility"	September 2026
12.2.3.1	Reworded para 3)	September 2026

Section	Revision description	Effective date
12.2.3.2	Added an example of icing remark	September 2026
12.2.4.1	Reworded para 2), 4) and added a **Note** for cloud layers	September 2026
12.2.6.4	New chapter on weather cameras	September 2026
12.2.7	Replaced "Canadian Flight Supplement" - "Canada Air Pilot" in par 5) sub-para c)	September 2026
13.2.9	Reworded first bullet to remove any ambiguity and Replaced "Sand strom" – "Sandstorm"	September 2026
13.2.14	Replaced "small hailstones" – "small hail". Reworded the definition to match WMO	September 2026
15.3.3.3	Reworded table 15-4 code figure 9 and /. Replaced "**shall**" – "must" in **Note (2)** an added **Note (4)** with an example for sky completely obscured	September 2026
15.3.3.4	Replaced "**shall not**" – "cannot" in **Note (1)** and replaced " **shall**" – "must" in **Note (2) & (3)**	September 2026
15.3.4.2	Replaced "**shall not**" – "cannot" in the **Note** of table 15-8	September 2026
15.3.6.3	Removed the "C" in table15-10 and added it to the title	September 2026
15.3.7.3	Removed the "C" in table15-11 and added it to the title	September 2026
15.3.10.3	Removed the "hPa" in table15-16 and added it to the title	September 2026
15.3.11.2	Replaced "**shall**" – "have to" in **Note (2)** of table 15-17	September 2026
15.3.11.3	Replaced "**shall**" – "must" in **Note (1) & (3)**	September 2026

Section	Revision description	Date
15.3.12.2	Replaced "**shall**" – "must" in the **Note.** In the last sentence of the **Note**, replaced "**shall**" – "applies". Reworded Code 18 in Figure 15-1 to match content of code figure 18	September 2026
15.3.12.2.1	Added "mi." last line in the fourth para	September 2026
15.3.12.2.2	Replaced "**shall**" – "must" in the **Note**. Replaced "**shall**" – "must" in **Note (1), (2)**, **(4)**, **(6)**	September 2026
15.3.12.3.5	Merged examples 2 & 3 for 7wwW1W2. Replaced "totally" - "completely" to the **Note** of example 4. Replaced "6" - "7" in **Note** of example 5. Replaced "2" - "3" in **Note** of example 16. Replaced "totally" - "completely" to the **Note** of example 17	September 2026
15.3.13	Replaced "totally" - "completely" in para one	September 2026
15.3.13.2.1	Added an example for partial obscuration aloft to remove any ambiguity in the **Note**	September 2026
15.3.13.3	Removed all references to the International Cloud Atlas plate numbers has they are no longer available	September 2026
15.3.13.3.1	Replaced "strong vertical extent" - "Towering Cumulus" in para 2) c. Replaced all "ragged Cumuls" - "Cumulus Fractus". Replaced all "in ragged shreds" - "Stratus Fractus". Replaced all "ragged Stratus" - "Stratus Fractus". Replaced all "pannus (ragged shreds of Stratus)" - "Stratus Fractus". Added extra words in **Note (3)** to help clarify its purpose	September 2026
Figure 15-2	Replaced image to improve quality and clarity	September 2026
15.3.13.4	Removed all references to the International Cloud Atlas plate numbers has they are no longer available	September 2026

Section	Revision description	Date
15.3.13.4.1	Replaced "with sprouting in the form of turrets or battlements" - "Castellanus" in para 1) b)	September 2026
Figure 15-3	Replaced image to improve quality and clarity	September 2026
15.3.13.5	Removed all references to the International Cloud Atlas plate numbers has they are no longer available	September 2026
Figure 15-4	Replaced image to improve quality and clarity	September 2026
15.5.2	The **Note** changed to a para since it has the word "**shall**"	September 2026
15.5.4.3	Removed the "C" in table15-23 and added it to the title	September 2026
15.5.7.2	Replaced "**shall**" – "must" in the **Note**	September 2026
15.5.8.2	Removed the "mm" in table15-27 and added it to the title	September 2026
15.5.9.3.1	Reworded para 1) to help when coding code 29	September 2026
15.5.9.4.1	Removed the "mm" in table15-31 and added it to the title added a column for cm	September 2026
15.7.4.2	Removed the "cm" in table15-32 and added it to the title	September 2026
15.7.5.2	Removed the "mm" in table15-33 and added it to the title	September 2026
Appendix 1	Reworded first para as per ICAO amendment 82 and redo the stations list by province	September 2026
Appendix 2	Under **Obstruction to Vision** (Visibility 6 mi. or less), adding vis. Criteria as per chapter 6.7.6	September 2026

Section	Revision description	Effective date
Appendix 3	Reworded fourth para as per TC recommendation	September 2026
Appendix 4	Addition of a new para and a **Note** after the second para as per TC recommendation	September 2026
Appendix 4	Addition of a para (d) in chapter A.3 **Quality Control for specified automated weather observations** after the **Note** as per TC recommendation	September 2026

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Part A Standards for weather observing programs

Chapter 1 Introduction

1.1 General information

This chapter contains information on the legal authority for meteorological and aeronautical matters, as well as the application of that authority as set out in MANOBS and related publications. Information on the World Meteorological Organization and synoptic reports is also provided.

1.2 Meteorological authority

In accordance with the *Department of Environment Act*, the Minister of Environment and Climate Change Canada has delegated to the Assistant Deputy Minister for the Meteorological Service of Canada the meteorological authority for Canada for all matters related to the WMO. Throughout this manual, the initialism "ADM" is used to refer to the Assistant Deputy Minister for the Meteorological Service of Canada.

All statements made in this manual **shall** be regarded as authoritative and **shall** be considered by the weather service provider and weather observers to be requirements and standards for surface weather observing programs.

1.3 Aeronautical authority

The Minister of Environment and Climate Change Canada is assigned all powers, duties and functions for all meteorological matters over which Parliament has jurisdiction that are not assigned by law to another department. Under the *Aeronautics Act* and *Canadian Aviation Regulations*, responsibility for the safety, regularity and efficiency of Canada's civil air transportation systems, including aviation weather services, rests with the Minister of Transport.

In accordance with the *Aeronautics Act*, the Minister of Transport has delegated the meteorological authority for matters related to civil aeronautical meteorology to the Director of Standards, Civil Aviation Directorate. Matters related to Canadian Forces meteorology and oceanography are the responsibility of the Minister of Defence.

The aeronautical standards set out in this manual **shall** be considered in conjunction with the standards contained in International Civil Aviation Organization (ICAO) Annex 3, *Meteorological Service for International Air Navigation*, PANS-MET, and in the *Manual of Standards and Procedures for Aviation Weather Forecasts* (MANAIR) as referenced by *Canadian Aviation Regulations* 804.01 (1) subparagraphs (a) and (b), respectively. Any reference from ICAO Annex 3 to any standards in the PANS-MET **shall** be treated as if they are in Annex 3. Any reference to the standards contained in Annex 3 or PANS-MET also includes the differences notified to ICAO in respect of those standards by the Government of Canada in accordance with *Canadian Aviation Regulations* 800.01 (2).

1.3.1 Joint standards documents

Environment and Climate Change Canada and Transport Canada, each having an interest in the standards applicable to aviation weather observing and forecasting, agree that the *Manual of Standards for Aviation Weather Forecasts* (MANAIR) and the *Manual of Surface Weather Observations* (MANOBS) are joint documents.

Standards within MANOBS, except for those found in Part B, are regulatory standards which are referenced in aviation safety regulations. As such, changes to these sections of MANOBS are subject to the consultation process established by the Minister of Transport for regulatory standards. Where necessary due to urgent or safety related matters, an amendment may precede the consultation process, subject to the concurrence of the meteorological authority.

In accordance with Article 37 of the *International Convention on Civil Aviation*, Canada has agreed to collaborate on achieving the highest practicable degree of uniformity in the regulations, standards, and procedures related to the collection and exchange of meteorological information.

When provisions set out in MANOBS are rendered obsolete or superseded by revisions to ICAO Annex 3, the required amendments to MANOBS can be made without further consultation, subject to the concurrence of the meteorological authority.

The details of Canadian state differences to Annex 3 and PANS-MET are published in the state aeronautical information publication (AIP), *AIP Canada (ICAO)*, which is available on the NAV CANADA website. Canadian state differences to the *WMO Manual on Codes* are published in WMO No. 306, Volume II.

In the event of real or apparent conflict between MANOBS and ICAO Annex 3 or standards in PANS-MET, the provisions of either are permissible, and an amendment to MANOBS and/or a Canadian state difference will be expedited.

MANOBS includes a separate synoptic section, Part B, "Standards for synoptic observations and reports," referencing *WMO Manual on Codes* No. 306, Volume I.1, FM 12-XI SYNOP. Part B is not used as a regulatory document referenced in aviation safety regulations. As such, amendments to Part B in MANOBS are not subject to the consultation process established by the Minister of Transport for regulatory standards.

1.3.2 Application

For aeronautical purposes, the observation standards in this manual are applicable to all meteorological reports to aviation other than those used exclusively for local visual flight rules or as otherwise permitted by the *Canadian Aviation Regulations* or exemptions thereto. Otherwise, all meteorological reports for aeronautical purposes **shall** comply with the requirements of MANOBS in accordance with *Canadian Aviation Regulations* 804.01 (1) (c). It is the responsibility of a service provider to furnish the necessary resources and to be accountable for compliance with regulatory standards.

1.4 World Meteorological Organization

Weather recognizes no international boundaries. A precise synoptic picture of weather conditions over a vast area of the earth's surface is required in order to provide national and international forecasts and climatological data to satisfy the needs of aviation, agriculture, industry and the public. As a first step in meeting these requirements, surface weather reports are prepared and exchanged throughout the world in an international code developed and agreed upon by member states of the World Meteorological Organization. Such reports are generally made at least four times daily, and a complete report may contain over 20 pieces of information including measurements of atmospheric pressure, which are calculated from barometer readings taken at precisely the same time throughout the world (i.e., 0000 UTC, 0600 UTC, 1200 UTC and 1800 UTC). These observations are referred to as synoptic observations.

The international meteorological code FM 12-IX SYNOP is used for reporting synoptic surface observations from a land station, either staffed or automatic. The common synoptic code comprises six sections numbered 0 to 5, each of which is primarily composed of five-figure code groups. Most groups in sections 0 to 5 begin with a numerical indicator and these indicators are numbered consecutively within each section. The numerical indicators identify a specific group which always contains the same weather elements. Thus the omission, whether accidental or deliberate, of any one group will not affect the identification of other groups. Indeed, provision is made within the code for omission of groups when their weather elements are either not present or cannot be observed. This also ensures that the code is flexible enough for both staffed and automatic stations.

Note (1): All of the codes, international, regional and national, are listed in WMO publication number 306, *Manual on Codes*, Volumes I and II.

Note (2): As stated in WMO Technical Note No. 91, Canada has adopted the pressure reduction method to SLP based on the recommended form of the hypsometric equation described in WMO Technical Note 7, formula (14) (see reference 3) and WMO Technical Note No. 61 paragraph 8 (see reference 4).

Note (3): Most WMO publications are accessible, without charge, on the internet.

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Chapter 2 Surface weather observing program standards

2.1 General information

The purpose of routine aeronautical weather observations is to provide detailed information on current weather for aviation and aviation forecasting. Records of weather observations have both immediate and long-term value. Information obtained from aeronautical weather observations is also used for public forecasts, building codes, climatological data and other weather related purposes.

A surface weather observation is a quantitative or qualitative evaluation by instrumental or visual means of one or more meteorological elements at a place at a given time.

A surface weather report is a statement, presented in plain language or in code, either orally, in written form or by telecommunication, of past or present meteorological conditions at a place at a given time.

This chapter is meant to introduce aviation weather observing program staff to the general standards and requirements of weather observing programs. This chapter contains information on sensor siting, types of staffed and automated observations, reference points for observations, standard parameters to be observed, and times and schedules of observations.

2.2 Quality Assurance Management System (QAMS)

Notification

Each aviation weather service provider **shall** provide notification to the Minister of Transport (who, hereinafter, may be referred to as 'TC' for Transport Canada) pertaining to their services and inform the Minister of any changes to this information. This **shall** include:

- The name, address and telephone number (and e-mail address, as applicable) of the service provider (The person named is responsible for all aspects of the service being provided and is liable for meeting all requirements);
- The aerodrome or meteorological station, its elevation and the elevation of any pressure sensor with reference to a survey result or benchmark and its geographical coordinates, where the meteorological reports originate;
- A summary description of the service to be provided including specification of the meteorological elements to be reported;
- Method(s) by which meteorological reports will be disseminated;
- The schedule (including specification of an 'on request' basis, as applicable), at which meteorological reports will be provided

- Subject to section 803.01 of the *Canadian Aviation Regulations*, a service provider **shall** notify TC and NAV CANADA in advance of commencing to provide these services or making changes to services already being provided. It is essential that each service provider establish and maintain formal arrangements with the AIS provider (NAV CANADA), including immediate notification in the event of an interruption or change in services

- The service provider **shall** immediately notify NAV CANADA and the appropriate air traffic services units of any change to the service being provided, including if they are discontinued, if that service is used to permit the execution of an instrument procedure that is published in the Canada Air Pilot.

- It is the responsibility of the service provider to develop and maintain all documentation necessary in support of QAMS.

Note: Further information / contact with TC can be obtained at:

Email: TC.ANSWeatherInfo-InfoMeteoSNA.TC@tc.gc.ca

The service provider **shall** establish, document, implement and maintain a quality management system comprising the procedures, processes and resources necessary to provide for quality management of the meteorological information to be supplied.

The service provider **shall** ensure that the following criteria are part of their QAMS:

Siting

- Proper siting and exposure of instruments
- Establishment and maintenance of station inspection frequency requirements and methods
- The service provider **shall** coordinate the construction and siting of meteorological instruments with the aerodrome operator

Validation of Instruments

- Instruments **shall** be tested over a range that is representative of the expected environmental conditions (regardless of whether in a controlled environment or in the field)
- Instruments **shall** be verified to meet performance requirements, in accordance with requirements set out in the *Guide to Meteorological Instruments and Methods of Observation*, WMO-No. 8, as amended from time to time, or equivalent developed by the service provider by a person who is either:
    - Independent from the manufacturer of the meteorological instruments and from the service provider and has a degree in meteorology or the natural or applied sciences or mathematics from a recognized university and experience in: instrumental references, standards and traceability; methods of statistical analysis and an understanding of the operating principles and use of meteorological instruments; or

- A licensed professional engineer (P. Eng) in Canada.

Note: Compliance by equivalent means is intended to provide flexibility for national service providers and may not be within the capabilities of most smaller operators.

Reporting

- Meteorological observations and reports comply with prescribed standards, including format and content, as specified in this document
- Meteorological reports reflect conditions existing at the actual time of meteorological observations
- Observations are monitored and audited
- Non-conforming observations are identified and corrective measures are taken
- Consistency in the time and frequency of issuance of reports using approved software and procedures
- Retention requirement of weather observing data is for a minimum of 30 days except accident report **shall** be retained until the inquiry or investigation is completed

Observing

- Manuals and directives, to provide more detailed instructions and training to the service provider's personnel and users of the QAMS
- The service provider must establish practices and procedures that ensure that all personnel performing work in support of the meteorological service and system are competent to support aviation weather observations that are accurate and that meet standards
- Service providers **shall** require that observers are trained and demonstrate their competencies in the key areas of maintaining a weather watch, observe and record weather elements, perform MET data quality assurance, monitor MET equipment, and communicate meteorological data to users
- The service provider **shall** establish performance requirements for each of the competencies mentioned above
- The service provider **shall** develop a recurrent competency assessment program for observers that will highlight any gross deficiencies so corrective measures can be immediately taken. All personnel training and recurrency documentation **shall** be recorded and retained by the service provider and made available to the Minister upon request
- Agreements **shall** be in place between the relevant ATS and MET service providers for the provision of integrated MET data on ATS display systems. These agreements **shall** also include the mutual sharing of supplemental weather observations from aircraft when obtained by either ATS or MET staff. Where applicable, internal arrangements within a single service provider shall also be established for this purpose

- Development and maintenance of operational procedural manuals and documentation
- The service provider **shall** document the training and competency procedures and make a copy available to, and upon reasonable notice by, TC.

Note (1): This is inclusive of all personnel involved in installation, commissioning, inspection and maintenance and, where human observers are used, to those who conduct observations and provide reports.

Note (2): Guidance from the WMO related to competency can be found at:

WMO No. 49 Volume I Technical Regulations Part V Competency requirements

The service provider **shall** monitor and measure the ongoing performance of their QAMS by conducting routine program validation by an independent external conformity body equivalent to ISO 9001:2015 QAMS standards.

Note: Supporting guidance is in WMO No. 1100 - Guide to the Implementation of QMS for National MET Providers.

The quality management system **shall** be audited in accordance with the requirements of the quality management system, and all audit findings **shall** be evidenced and properly documented.

2.3 Sensor siting

The following are standards for sensor siting:

1) The service provider **shall** establish and follow practices, procedures and specifications for the siting, installation, commissioning, operation and maintenance of meteorological systems. The siting process **shall** define the aeronautical requirements for aviation MET data for each aerodrome. Site surveys of potential installation locations **shall** be assessed for local weather conditions and airport infrastructures and obstacles that may influence MET sensors. Where the siting of sensor(s) is determined to not be continuously representative of conditions for the touchdown zone of each runway this **shall** be documented, and appropriate mitigation **shall** be implemented
2) The service provider **shall** document the practices, procedures and specifications established and **shall** provide all of the relevant information to Transport Canada , upon reasonable notice given by Transport Canada
3) Except as otherwise required by the regulations set out in MANOBS, meteorological instruments **shall** be exposed in accordance with the practices, procedures and specifications established by the World Meteorological Organization in the *Guide to Meteorological Instruments and Methods of Observation*, WMO-No.8 Part III

Where the above requirements cannot be met, the service provider **shall** document any irregularity in the exposure of the meteorological instruments and **shall** make all of the relevant information available to Transport Canada, upon a request made by the same, within a reasonable timeframe

4) The service provider **shall** ensure the installation follows a commissioning protocol and establish proof of performance of newly installed sensors or meteorological systems that are in accordance with methods established by the manufacturer, or equivalent documentation developed by or for the service provider

Note: The service provider retains responsibility for work done on their behalf by others.

2.4 Automated weather observing systems

The observation requirements for wind direction, speed and character, temperature, dew-point temperature, or atmospheric pressure as altimeter setting, are instrumental. However, where human observers utilize these weather elements, they **shall** provide quality monitoring and backup as required.

The standards for Automated Weather Observing Systems (AWOS) and Limited Weather Instrument Systems (LWIS) set out in MANOBS are based on the results of testing and consultation. Thus, many routines of the signal processing algorithms employed by AWOS/LWIS are outlined here as the minimum required processing for METAR AUTO. METAR AUTO is intended specifically for the METAR, SPECI and TAF as a stand-alone automatic dependent system used for aerodrome observations and forecasting. Standards for automated weather observing systems are given in Chapter 12.

No new or significantly modified meteorological instruments or meteorological systems for the automated reporting of visibility, present weather, or sky conditions **shall** be introduced into service or continue in operation unless their performance characteristics, limitations and sources of potential failure and a detailed comparison against human observations have been quantified and documented.

The service provider **shall**, upon request, provide a summary of the documentation required by subsection 3.4 to users of the meteorological reports based on these instruments or systems or to the Minister.

Note: A significant modification to a meteorological instrument is one that would change its performance in a manner which could reasonably affect the decision making of a pilot.

2.5 Types of staffed observations

2.5.1 Aerodrome routine meteorological report (METAR)

METAR is the primary observation code reported on the hour (UTC) for surface meteorological data. METAR contains a report of wind, visibility, runway visual range, present weather, sky condition, temperature, dew-point, and altimeter. In addition, coded and/or plain language information elaborating on weather elements can be found in the "Remarks" section.

2.5.2 Aerodrome special meteorological report (SPECI)

SPECI is an unscheduled report taken when any of the selected changes in weather conditions significant to aviation occur off the hour. SPECI **shall** contain all data elements found in a METAR. In addition, coded and/or plain language information elaborating on weather elements can be found in the "Remarks" section.

2.5.3 Accident observation

The following are standards for accident observations:

1) Immediately upon learning of an aircraft accident at or near the weather observing station, the observer **shall** make an accident observation
2) The accident observation (METAR/SPECI) **shall** be recorded and transmitted
3) It **shall** be as complete and accurate as possible, with particular care being taken to include all meteorological facts
4) The service provider **shall** preserve the integrity of accident observations
5) All accident observations **shall** be retained until the inquiry or investigation is completed

2.6 Point of observation

All METAR and SPECI **shall** be representative of conditions at or near the aerodrome reference point, as if observed from an out-of-doors location at ground or water level where a minimum of obstacles to the view of the full circle of the horizon and the full celestial dome exist.

Documentation **shall** be maintained by the aviation weather service provider to show how compliance with the above paragraph is achieved.

2.7 Parameters to be observed during a METAR/SPECI/Accident Observation

The data listed below **shall** be included in the reported METAR, SPECI and Accident Observation:

- sky condition
- visibility
- weather and obstruction to vision
- sea level pressure
- temperature
- dew-point
- wind
- altimeter setting
- clouds
- remarks
- RVR (if available and reportable)
- tendency[1]

Note (1): Not required for SPECI or Accident Observation

2.8 Times of observations

The standard time of observation is determined by international agreement; it is referenced to Coordinated Universal Time (UTC) and is published in the *WMO Technical Regulations*. In the aviation community Zulu time "Z" is often used in lieu of UTC; MANOBS reflects the use of both abbreviations.

The following are standards for times of observations:

1) All dates and times entered in observations **shall** be with reference to the 24-hour clock, UTC
2) The time of a METAR observation **shall** be on the hour
3) The time assigned to a SPECI observation **shall** be the time at which the element necessitating the SPECI was observed refer to chapter 2.9.1
4) The time assigned to an Accident Observation **shall** be the time an accident is observed or when advised of the accident
5) For automated systems where SPECI observations are required, a full observation **shall** be performed each minute
6) The SPECI observation **shall** be the minutely observation containing the weather element that has changed according to the standards for issuing SPECI

2.9 Scheduled observations

The barometer **shall** be read exactly on the hour. Other elements **shall** be observed in the few minutes preceding the hour and as close as possible to the hour. The computations, coding and recording of METAR observations **shall** be done immediately after the hour. NAV CANADA employees **shall** prioritize duties as outlined in the Manual of Air Traffic Services. All other weather observing staff **shall** prioritize non-related duties in accordance with procedures established by the service provider.

The schedule of observations found in Table 2—1 applies when only the hourly observation is required.

Table 2—1: Schedule of hourly observations

From	To	Duty
Hour minus six minutes	Hour	Observe all weather elements except pressure
Hour	Hour plus one minute	Read the barometer and the pressure trace
Hour plus one minute	Hour plus seven minutes	Input the hourly observation for transmission and complete necessary entries

The schedule of observations found in Table 2—2 applies when both hourly and synoptic observations are required:

Table 2—2: Schedule of both hourly and synoptic observations

From	To	Duty
Hour minus 10 minutes	Hour minus three minutes	Observe all weather elements except pressure
Hour minus three minutes	Hour	Make necessary entries
Hour	Hour plus one minute	Read the barometer and the pressure trace
Hour plus one minute	Hour plus seven minutes	Input hourly observation for transmission. Complete necessary entries
Hour plus seven minutes	Hour plus 12 minutes	Input the synoptic data/observation for transmission

2.9.1 Time assigned to SPECI observations

A SPECI observation **shall** be taken and reported whenever one or more of the elements listed in section 11.2.3 have changed in the amount specified (except in the case of end of thunderstorm or precipitation). The amount of change is with reference to the preceding METAR or SPECI observation. If more than one element has changed sufficiently to trigger a SPECI, the time **shall** be the time of observation of the element considered to be the most important to aviation.

A SPECI should be reported within "Time of SPECI +5 minutes." This is the time allowed to issue a SPECI without it being considered reported late. This allowed time period is for sites that have more than weather observing as their main responsibility.

2.9.2 Late observation

To ensure that users of weather observations have confidence in the observations and use them safely, hourly observations must be accurate and adhere to the schedules specified in section 2.8. Every effort must be made to ensure that weather observations are taken on time. However, should an occasion arise that is beyond the control of the observer and that necessitates taking the observation late, the following **shall** apply:

1) the number of minutes after the hour that the observation has been taken **shall** be entered as the first of the general weather remarks
2) the format of the remark **shall** be, "`OBS TAKEN +tt`", where "`+tt`" indicates the number of minutes the observation was taken after the hour

Example: The observation was taken 13 minutes after the hour (barometric values and other direct-ingest weather data are from the hour):

```
METAR CYAM 101300Z 00000KT 15SM FEW012 FEW220 M20/M22
A3039 RMK SC1CI1 OBS TAKEN +13 SLP308
```

2.9.3 Observation program remarks

To enable users of weather observations to determine if a station is staffed or when the next observation will be, remarks indicating the status of operation are required.

At sites with a 24-hour program and a staff/machine mix for observations, enter the status of operation in the Remarks section for the last staffed observation of the day.

Example: The last daily staffed weather observation is issued at 03Z; the next staffed weather observation will be issued at 13Z:

```
METAR CYXH 100300Z 28015G21KT 15SM FEW270 03/M02
A3001 RMK CI2 LAST STFD OBS/NEXT 101300Z SLP187
```

At sites with less than a 24-hour observation program and observations not supplemented by those of an automatic station, entered in the Remarks section for the last observation of the day.

Example: The last daily weather observation is issued at 03Z; the next weather observation will be issued at 13Z:

```
METAR CYGK 100300Z 20005KT 15SM SCT090 BKN110 21/17
A2994 RMK AC3AC2 LAST OBS/NEXT 101300UTC SLP138
```

2.10 Duties

The meteorological elements entered in a meteorological report **shall**, as closely as possible, reflect the conditions existing at the actual time of the meteorological observation. While on duty, weather observers are required to keep a close and continuous watch on the weather. Their records and reports **shall** be as complete and accurate as possible. If communication or other difficulties delay or prevent the distribution of reports; the observers **shall** continue to observe the weather and record their observations on schedule. It is essential that climatological records be complete. Whenever an error is detected in a disseminated report, a correction **shall** be issued as soon as is practical.

Any attempt by any individual to have the observer alter any portion of an observation in such a manner as to decrease its accuracy to suit the purpose of an individual or organization **shall** be reported by letter immediately, giving full details to:

Director, Standards
Transport Canada
330 Sparks Street
Ottawa, Ontario K1A 0N8

2.10.1 Priority of duties

Personnel who take weather observations as only one component of their duties **shall** give such duties the priority specified by their employing agency. Any other personnel whose primary duty is to observe the weather **shall** maintain a continuous weather watch and **shall** give the highest priority to weather observing duties.

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Chapter 3 Wind standards

3.1 General information

This chapter describes the wind information that is required to be contained in a METAR/SPECI and the standards for the instrument that measured the winds. Standards for wind characteristics such as calm wind, gusts, squalls, wind shift, variable wind direction, variations in wind direction and estimation of wind are given. Tables for estimating wind and examples of surface weather reports are also given.

3.2 General wind standards

3.2.1 Reporting

The following are standards for reporting wind:

1) Wind information is included in all surface weather reports and **shall** contain both velocity (direction and speed) and character
2) Wind direction **shall** be reported with respect to true North and the speed **shall** be expressed in nautical miles per hour (knot, abbreviated as "kt")
3) The wind direction and speed reported in the METAR/SPECI/Accident Observation **shall** be a two-minute mean
4) The direction **shall** be determined to the nearest ten degrees and the speed to the nearest knot.
5) The occurrence of gusts, squalls, variable wind direction, variations in wind direction and wind shifts **shall** be reported

3.2.2 Wind instruments

The following are standards for wind instruments:

1) The wind measurements **shall** be representative of winds that are 10 m above the ground over level terrain at a distance equal to at least 10 times the height of any object from that object or, if this is not possible, at such a height and location that the indications are reasonably unaffected by local obstructions
2) The wind velocity is averaged over a two-minute period and the wind speed is reported in knots
3) The instruments **shall** function for winds of up to and including at least 100 kt speed

3.2.3 Wind direction

The wind direction is the direction from which the air is moving. It represents the average direction during the two-minute period ending at the time of observation.

The following are standards for wind direction:

1) Wind direction **shall** always be reported using three digits, in degrees true, and rounded off to the nearest 10 degrees
2) Values of wind direction less than 100 degrees **shall** be preceded by a zero
3) Wind from true north **shall** be encoded as `360`
4) Wind direction for calm winds **shall** be encoded as `000`

3.2.4 Calm wind

The following are standards for calm wind:

1) Calm wind may be reported for mean wind speeds less than 2 kt
2) Mean wind of 1 kt or less **shall** be reported as calm wind
3) Calm wind **shall** be coded as `00000` followed immediately, without a space, by `KT` to specify the units

3.2.5 Wind speed

The wind speed is the rate of airflow past a fixed point. It represents the average speed during the two-minute period ending at the time of observation.

The following are standards for wind speed:

1) Wind speed **shall** be reported using two digits if under 100 kt, or by using three digits if 100 kt and over
2) Wind speed of less than 01 kt **shall** be encoded as `00KT`

3.3 Reporting standards for wind characteristics

3.3.1 Gusts

Gusts are sudden, rapid and brief changes in the wind speed. They are characterized by more or less continual fluctuations between high (peak) and low (lull) speed.

The following are standards for gusts:

1) The speed of a gust **shall** be the maximum wind speed, in kt, averaged over a maximum of a five-second period
2) Gusts **shall** be reported when both of the following criteria are met during the 10-minute period preceding the observation:
   a) the highest peak speed is at least 5 kt higher than the current two-minute average
   b) the highest peak is at least 15 kt

3.3.2 Squalls (SQ)

The following are standards for squalls:

1) Squall **shall** be reported when all of the following occur during the 10-minute period preceding the observation:
   a) the wind speed increases by 15 kt or more over the two-minute average speed that preceded the increase
   b) the duration of the peak speed period is at least 2 minutes
   c) the wind speed attains a one-minute mean of at least 20 kt, during the peak speed period
   d) the wind speed diminishes by at least 5 kt
2) The speed to be reported **shall** be the highest one-minute mean speed during the squall period
3) When squalls are observed, the peak wind speed **shall** be reported as a gust and SQ **shall** be reported in present weather

3.3.3 Wind shift

Wind shift is a definite change in the general direction from which the wind is blowing.

The following are standards for wind shift:

1) A wind shift **shall** be recorded when all of the following occur:
   a) the direction from which the wind is blowing changes by 45° or more
   b) the change in direction takes place in less than 15 minutes
   c) the direction at the completion of the shift **shall not** be variable
   d) the average wind speed at the completion of the shift is 10 kt or more
2) The time of the wind shift **shall** be the time at which the wind begins to shift
3) The time of a wind shift **shall** be recorded in Remarks

Note: A change in wind speed from less than 2 kt (calm) to 10 kt or more is not considered a wind shift.

3.3.4 Variable wind direction

In the case of variable wind direction, the wind direction **shall** be coded as `VRB` when the wind speed is less than 3 kt. A variable wind at higher speeds **shall** be reported only when the variation of wind direction is 180° or more, or when it is impossible to determine a single wind direction.

3.3.5 Variations in wind direction

If, during the 10-minute period preceding the observation, the total variation in wind direction is 60° or more and less than 180°, and the mean wind speed is 3 kt or greater, the observed two extreme directions between which the wind has varied **shall** be reported in clockwise order.

Example: `240V350`

3.3.6 Estimation of wind

The following are standards for the estimation of wind:

1) When suitable instruments are lacking or when the instruments are not in operating condition, the wind direction (to eight points of the compass), the wind speed and character **shall** be estimated
2) The observer **shall not** estimate the peak speed of a gust or squall
3) If winds are estimated, the following remark **shall** be included in the report: `WIND EST`

3.3.6.1 Estimates of wind speed by Beaufort scale of winds

When the observer lacks any other method to determine wind speed, the wind speed **shall** be estimated using the Beaufort scale of winds. This scale relates the equivalent speeds in knots of common effects of wind. Report the Beaufort scale knots average for the speed.

Table 3—1: Beaufort scale of winds

Force	Wind speed				
	KT average	KT	Descriptive term	Effects observed at sea	Effects observed on land
0	0	Less than 1	Calm	Sea surface like a mirror, but not necessarily flat.	Smoke rises vertically.
1	2	1–3	Light air	Ripples with the appearance of scales are formed, but without foam crests.	Direction of wind shown by smoke drift, but not wind vanes.
2	5	4–6	Light breeze	Small wavelets, still short but more pronounced. Crests do not break. When visibility good, horizon line always very clear.	Wind felt on face. Leaves rustle. Ordinary vane moved by wind.
3	9	7–10	Gentle breeze	Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered whitecaps.	Leaves and small twigs in constant motion. Wind extends light flag.

Force	Wind speed KT average	Wind speed KT	Descriptive term	Effects observed at sea	Effects observed on land
4	14	11–16	Moderate breeze	Small waves, becoming longer. Fairly frequent whitecaps.	Raises dust and loose paper. Small branches are moved.
5	19	17–21	Fresh breeze	Moderate waves, taking a more pronounced long form. Many whitecaps are formed. Chance of some spray.	Small trees with leaves begin to sway. Crested wavelets form on inland waters.
6	25	22–27	Strong breeze	Large waves begin to form. The white foam crests are more extensive everywhere. Probably some spray.	Large branches in motion. Whistling heard in telephone wires. Umbrellas used with difficulty.
7	31	28–33	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.	Whole trees in motion. Inconvenience felt in walking against wind.
8	37	34–40	Gale	Moderately high waves of greater length. Edges of crests begin to break into the spindrift. The foam is blown in well-marked streaks along the direction of the wind.	Breaks twigs off trees. Generally impedes progress. Walking into wind almost impossible.
9	44	41–47	Strong gale	High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility.	Slight structural damage occurs, e.g. roofing shingles may become loose or blow off.
10	52	48–55	Storm	Very high waves with long overhanging crests. Dense white streaks of foam. Surface of the sea takes a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected.	Trees uprooted. Considerable structural damage occurs.
11	60	56–63	Violent storm	Exceptionally high waves. Sea completely covered with long white patches of foam. Visibility affected.	Widespread damage.
12	-	64+	Hurricane	Air filled with foam and spray. Sea entirely white with foam. Visibility seriously impaired.	Rare. Severe widespread damage to vegetation and significant structural damage possible.

Table 3—2: Northern Beaufort scale and wind effects on land

Beaufort number	Speed range	KT average	Effects
1	1–3	2	No noticeable wind. Smoke rises nearly vertically.
2	4–6	5	Wind felt on face, leaves rustle.
3	7–10	9	Hair is disturbed, clothing flaps.
4	11–16	14	Dust and loose paper raised, hair is disarranged.
5	17–21	19	Force of wind felt on body. Limit of agreeable wind on land.
6	22–27	25	Some inconvenience in walking.
7	28–33	31	Difficulty when walking against wind.
8	34–40	37	Difficulty with balance in walking.
9	41–47	44	Danger in being blown over.
10	48–55	52	Trees uprooted; considerable structural damage.

3.4 Examples of wind remarks

Example: The wind direction and speed at 1645Z was 20025KT, then the wind direction started to shift at 1650Z and at 17Z the wind direction and speed was 27040G55KT:

`METAR…27040G55KT …RMK… WSHFT 1650`

If winds are estimated, the remark `WIND EST` **shall** be included in the report:

`METAR…14014KT …RMK… WIND EST`

Chapter 4 Visibility standards

4.1 General information

This chapter defines visibility and describes the standards for reporting visibility, including the standards related to the unit of measure, variable visibility and identification of the elevated position. Descriptions of prevailing visibility, point of observation and visibility charts are given. Examples of visibility remarks are also provided.

4.1.1 Definition of visibility

Visibility, for aeronautical purposes, is defined as the greater of:

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

Note: These two distances have different values in air of a given extinction coefficient: the former 1) is represented by the Meteorological Optical Range (MOR), and the latter 2) varies with the background illumination.

4.2 Prevailing visibility

It is the maximum visibility value common to sectors comprising one-half or more of the horizon circle. Prevailing visibility is reported in international statute miles and fractions up to 3 mi., then in whole miles up to 15 mi., and in units of 5 mi. thereafter, where suitable visibility markers are available.

The visibility to be reported is the prevailing visibility observed at eye level (internationally defined as 1.5 meters above the ground).

4.3 Point of observation

Prevailing visibility is determined at the surface. A roof is convenient for enabling the observer to obtain a complete view of the horizon circle. However, if the observer has any reason to believe that the visibility near the ground is different, the observer **shall** make an observation from the ground and record it as the prevailing visibility.

Optical devices used to enhance visibility, such as binoculars, **shall not** be used by the observer when determining visibility.

Recorded visibility **shall not** be reduced on account of darkness alone.

4.4 Visibility charts

Visibility charts **shall** be available for each observing station and **shall** include day and night markers that are valid for use in all four seasons.

Visibility charts **shall** be reviewed on a regular cycle and updated as required.

4.5 Visibility observing standards

4.5.1 Units of measure

Visibility **shall** be reported at land stations in international statute miles (SM).

Table 4—1: Reportable visibility standards

Available increment	Reportable visibility						
Increments of ⅛ mi.	0	⅛	¼	⅜	½	⅝	¾
Increments of ¼ mi.	1	1 ¼	1 ½	1 ¾	2	2 ¼	2 ½
Increments of 1 mi.	3	4	5	6	7	8	up to 15
Increments of 5 mi.	20	25	30	35	40	45	etc.

Increments of 5 mi. beyond 15 mi. **shall** be used only if suitable markers are available.

4.5.1.1 Visibility between two reportable values

If the observed value of visibility is between two reportable values, then the lower value **shall** be reported.

4.5.1.2 Maximum reportable value

If suitable markers beyond 15 mi. are lacking, then 15 mi. is the maximum reportable value.

4.5.1.3 Sector visibility

If the visibility in one or more directions is half or less, or double or more, of the prevailing visibility, details of the visibility in such directions **shall** be reported in Remarks.

4.5.2 Variable visibility

If the prevailing visibility is observed to be fluctuating rapidly and increasing and decreasing from a mean value by ¼ or more of the mean value, the range of variation **shall** be entered in Remarks beginning with the lowest visibility value. The mean value **shall** be entered as the prevailing visibility. Variable visibility remarks **shall not** be used when the prevailing visibility is greater than 6 mi.

4.5.3 Elevated positions

When observing visibility from elevated positions, such as a control tower or roof, if the visibility differs by a reportable value from the prevailing visibility observed on the ground (at eye level), the visibility from the elevated position and the identification of that position **shall** be reported in Remarks. The observer **shall** provide an estimate of the depth of the fog as well as the roof-top visibility.

4.6 Examples of visibility remarks

```
METAR...1/2SM FG ...RMK... VIS VRB 1/4-3/4
METAR...10SM PRFG ...RMK... FG BANK VIS W 2
METAR...3/4SM BR ...RMK... VIS IMPR RPDLY
METAR...1/2SM BLSN ...RMK... TOWER VIS 2
METAR... 0SM FG ...RMK... VIS 100 FT
METAR...3/4SM BR ...RMK... FG DSIPTG RPDLY
METAR...1/4SM FG ...RMK... FG 45 FT THK ROOF VIS 2
METAR...10SM ...RMK... FU DRFT OVR FLD VIS N 1
METAR...6SM -RA BR ...RMK... BCFG VIS SE 1/4
METAR...1/2SM FG ...RMK... PRFG SE-N
METAR...10SM BCFG ...RMK... VIS SE QUAD 1/2
```

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Chapter 5 Runway visual range (RVR)

5.1 General information

This chapter details standards for reporting RVR and provides examples of RVR remarks used in surface weather reports.

5.1.1 Definition of runway visual range

Runway visual range (RVR) is the range over which the pilot of an aircraft, located on the centre line of a runway, can see the runway surface marking or the lights delineating the runway or identifying its centre line. RVR is used for determining the landing and take-off conditions for aircraft pilots. RVR observations should be representative of the touchdown zone. RVR is used as one of the main criteria for minima on instrument approaches, as in most cases a pilot must obtain visual reference of the runway in order to land an aircraft.

5.2 Standards for reporting

The assessment of runway visual range output **shall** be updated at least every 60 seconds to permit the provision of current representative values. The averaging period for runway visual range values **shall** be 10 minutes for METAR and SPECI, except when the 10-minute period immediately preceding the observation includes a marked discontinuity in runway visual range values. If this is the case, only those values occurring after the discontinuity **shall** be used to obtain mean values.

Runway visual range inclusion in the METAR or SPECI is generally automated and is only included when at least one RVR reports 6 000 ft or less, or reported prevailing visibility is 1 mi. or less.

The maximum RVR reportable range is "6 000 ft plus," encoded as `P6000`. The minimum RVR reportable range is 300 ft, encoded as `M300`.

The following **shall** apply to reports of runway visual range:

1) Runway visual range **shall** be reported in:
   a) increments of 100 ft from the minimum reportable value of the RVR detection equipment up to 1 200 ft
   b) increments of 200 ft from 1 200 ft to 3 000 ft
   c) increments of 500 ft from 3 000 ft to 6 000 ft or the maximum reportable value for the RVR detection equipment whichever is less
2) If the assessed value is between the reportable values in accordance with paragraph 1), then the reported value of runway visual range **shall** be lowered downward to the next lower reportable value
3) In reports of runway visual range intended for take-off or landing, the most recent one-minute-mean value **shall** be used

5.2.1 Requirements for the assessment of runway visual range based on instrumented systems

1) The installation, siting, exposure, operation and maintenance of the system **shall** be such that:
   a) instruments used for the assessment of runway visual range **shall** be located within 120 m of the centerline of the runway
   b) the height of the optical path is between 2.5 m and 5 m above the level surface of the runway
   c) a background luminance detection sensor **shall** be used that is accurate to within 10% with at least a 90% confidence
   d) the extinction coefficient assessment is within:
      i) 20% of the root mean square value of a reference transmissometer, with at least a 90% confidence, for measured values from 0.001/m to 0.01/m
      ii) 15% of the root mean square value of a reference transmissometer from 0.01/m to 0.105/m
2) Sensors used to assess the extinction coefficient or scatter coefficient as part of the calculation of the runway visual range:
   a) are traceable to a transmissometer standard
   b) have documented performance characteristics with respect to the full range of hydrometeors that can be expected at the aerodrome
   c) provide either no report, or a report of a very low runway visual range, in the event of instrumental failure or blockage of the sampling volume
3) There are displays relating to each runway visual range sensor that are:
   a) clearly marked to identify the runway and the section of the runway to which they correspond
   b) reporting values of runway visual range that are updated at least every 60 seconds and are available within 15 seconds of the end of the averaging period
4) The runway light intensity to be used for calculation of runway visual range, for use in METAR/SPECI, **shall** be the maximum light intensity
5) The runway light intensity to be used for calculation of runway visual range for operational flight information **shall** be:
   a) if the runway lights are switched on, the actual runway light intensity in use on that runway
   b) if the runway lights are switched off, the minimum intensity runway light intensity
   c) degraded to account for aging and contamination of the lamps

5.2.2 Significant Variation

When the RVR at a runway varies significantly and when, during the ten-minute period preceding the normal observation time, the one-minute-mean extreme values assessed vary by more than 150 feet, or more than 20% of the mean value, whichever is greater, the one-minute-mean minimum and the one- minute-mean maximum values **shall** be recorded instead of the ten-minute mean. Tendency **shall** also be indicated.

5.2.3 Tendency

If the runway visual range values during the ten minute period preceding the observation show a distinct upward or downward tendency such that the mean during the first five minutes varies by 300 feet or more from the mean during the second five-minute period, a tendency **shall** be indicated as either upward or downward. When no distinct change in runway visual range is observed, the tendency **shall** indicate that no distinct change has been observed. When it is not possible to determine the tendency, tendency **shall** be omitted.

5.3 RVR Remarks

Runway visual range remarks are automatically generated by an RVR system. Use `RVR MISG` when RVR data is not available.

The only time RVR remarks are included in the METAR or SPECI by the observer is when the RVR system has lost communication with the weather system. For manual reports of RVR, the most recent one-minute-mean value may be used in the remarks of the METAR or SPECI for the RVR intended for take-off or landing. The following is an example of manually entered RVR remarks:

`RVR RWY 15 3500FT`

Note: Standards for the provision of runway visibility assessment are contained in CAR 804/824 division III.

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Chapter 6 Atmospheric phenomena standards

6.1 General information

This chapter defines present weather and describes the standards for reporting atmospheric phenomena, determining intensity and character, and for observing miscellaneous phenomena and unusual weather conditions. This chapter is structured to provide a definition, standards for reporting, and examples of remarks for each of the following present weather phenomena: tornadoes, waterspouts, funnel clouds, thunderstorms, lightning, precipitation, and obstructions to vision.

6.2 Present weather

6.2.1 Definition

Present weather is defined as weather that is occurring at the time of observation, which includes all atmospheric phenomena observed, with the exception of clouds. This includes forms of precipitation as well as weather phenomena that obstruct vision.

6.2.2 Standards for reporting

The observation and reporting of present weather by human observers **shall** be inclusive of the weather phenomena (as detailed in sections 6.3 through 6.8) that are occurring at and/or are visible from the aerodrome.

Observed present weather phenomena **shall** be reported in terms of type and characteristics, and qualified with respect to intensity or proximity to the aerodrome, as appropriate.

6.3 Tornadoes (+FC), Waterspouts (+FC), and Funnel Clouds (FC)

6.3.1 Definition

Tornadoes: A rotating column of air, extending from the base of a cumuliform cloud (usually Cumulonimbus), and often visible as a condensation funnel in contact with the ground, and/or attendant circulating dust or debris cloud at the ground.

Waterspouts: A tornado occurring over water. It is normally a relatively small, weak rotating column of air over open water below a Cumulonimbus or Cumulus congestus (towering Cumulus) cloud.

Funnel clouds or cold-air funnels: A funnel cloud, or (rarely) a small relatively weak tornado, that can develop from a small shower or thunderstorm when the air aloft is unusually cold. Cold-air funnels typically do not reach the ground (funnel cloud), but when they do reach the ground as tornadoes, they are much less violent than the other types.

6.3.2 Standards for reporting

1) Tornadoes, funnel clouds and waterspouts **shall** be reported as occurring "at the station" when within sight (at any distance)
2) The code `+FC` **shall** be used to report any tornado (when it occurs over land) or waterspout (when it occurs over water) that is within sight
3) The code `FC` **shall** be used to report any funnel cloud when within sight
4) A tornado or waterspout **shall not** be reported when the vortex does not reach the ground, or when the observer is not sure that the vortex of the funnel reaches the ground (or water), that is, a "bush" is not observed
    a) in this case, "funnel cloud" (`FC`) and its direction from the station **shall** be reported
5) The observer **shall** note the direction of the storm from the station and the direction in which it is moving
6) The plain language words `TORNADO`, `FUNNEL CLOUD` or `WATERSPOUT` **shall** be inserted in the Remarks whenever these phenomena are observed
7) No intensity is ascribed to tornadoes, waterspouts or funnel clouds.

6.4 Thunderstorm (TS)

6.4.1 Definition

A thunderstorm is a local storm that is produced by a Cumulonimbus cloud, and is always accompanied by lightning and thunder, usually with strong gusts of wind, heavy rain, and sometimes with hail. Lightning may not be always visible to the naked eye.

6.4.2 Standards for reporting

Thunderstorm activity at the station **shall** be reported when:

1) thunder is first heard
2) overhead lightning is observed and the local noise level might prevent the observer from hearing thunder (in this case, hail may also be an indicator of a thunderstorm in progress)

6.4.2.1 Time of beginning of thunderstorm

The time of beginning of a thunderstorm **shall** be recorded as the time of the earliest occurrence that indicates thunderstorm activity at the station.

6.4.2.2 Time of ending of thunderstorm

When thunderstorm activity at the station has not occurred in the last 15 minutes, the observer **shall** record the thunderstorm as having ended 15 minutes before.

6.4.2.3 Intensity

No intensity is ascribed to thunderstorms.

6.4.2.4 Examples of thunderstorm remarks

```
METAR...BKN045CB 10SM TS ...RMK... CB W MOV N
SPECI...BKN025CB 7SM -TSRA ...RMK... CB OHD MOV SE
```

6.5 Lightning

6.5.1 Definition

A luminous manifestation accompanying a sudden electrical discharge that takes place from or inside a cloud or, less often, from high structures on the ground or from mountains. Three main types of lightning can be distinguished: cloud-to-ground, intra-cloud, and cloud-to-cloud. In addition, there are other forms of luminous electrical manifestations.

Note: Lightning may sometimes be observed in association with volcanic ash plumes during eruptions.

6.5.2 Standards for reporting

When lightning is observed, the following **shall** be reported:

1) frequency, reported as `OCNL` (occasional), `FRQ` (frequent), `CONS` (continuous)
2) type, reported as `LTGCG` (Lightning Cloud-to-Ground), `LTGIC` (Lightning Intra-Cloud), `LTGCC` (Lightning Cloud-to-Cloud) and `LTNG` (Undetermined)
3) direction from station

6.5.2.1 Frequency of lightning

The following may be used as a guide:

1) `OCNL` less than one flash per minute
2) `FRQ` one to six flashes per minute
3) `CONS` more than six flashes per minute

6.5.2.2 Examples of lightning remarks

When only one lightning type is visible, the remark is of the form:

```
METAR...SCT035CB 10SM ...RMK... OCNL LTGIC SW
```

When multiple lightning types are visible, the remark is of the form:

```
SPECI...BKN020CB 7SM TS ...RMK... FRQ LTGCGICCC NW
```

When an undetermined type of lightning is visible from a distance, the remark is of the form:

```
METAR...SKC 10SM ...RMK... OCNL LTNG DIST N
```

6.6 Precipitation

6.6.1 Definition

Any product of the condensation of atmospheric water vapour that is deposited on the earth's surface is a type of precipitation. The types of precipitation that originate aloft are classified in the following sections under liquid precipitation, freezing precipitation, and frozen precipitation.

6.6.1.1 Character of precipitation

Under the term "character," precipitation is classified as showery, continuous or intermittent.

6.6.1.1.1 Showery precipitation

Showery precipitation falls from cumuliform cloud. Showers often (but not always) begin and end abruptly. Showers usually occur in periods of short duration, perhaps 15 minutes or so, but they may last much longer. Usually there are rapid fluctuations in the intensity of the precipitation. Certain types of precipitation, such as snow pellets and hail, are always showery. The terms "rain showers," "snow showers" are used to indicate showery character.

6.6.1.1.2 Continuous precipitation

Precipitation that is not showery is considered to be continuous when either of the following criteria apply:

- it continues without a break for at least one hour preceding the time of observation
- it continues without a break since beginning in the hour preceding the time of observation

6.6.1.1.3 Intermittent precipitation

Precipitation that is not showery is considered to be intermittent, when it has stopped and recommenced at least once during the hour preceding the actual time of observation.

6.6.2 Standards for reporting

6.6.2.1 Intermittent and showery precipitation

Precipitation of an intermittent or showery character, which has been active at the station within the preceding 15 minutes, is not occurring at the time of observation, but is expected to begin again soon, **shall** be reported in Remarks.

6.6.2.1.1 Examples of intermittent precipitation remarks

Example remark for when intermittent precipitation is occurring at the time of observation:

```
METAR...SCT045 10SM -RA...RMK... -RA INTMT
```

Example remark for when intermittent precipitation has been active within the preceding 15 minutes, is not occurring at the time of observation, but is expected to recommence:

```
METAR...OVC040 8SM ...RMK... INTMT -RA
```

Example remark for when showery precipitation has been active within the preceding 15 minutes, is not occurring at the time of observation, but is expected to recommence:

```
METAR...BKN025 10SM ...RMK... OCNL -SHRA
```

6.6.2.2 Liquid precipitation

Liquid precipitation and freezing precipitation **shall not** be reported in the same observation (by definition one excludes the other).

6.6.2.3 Freezing precipitation

Freezing precipitation **shall** always appear alone as a separate group.

6.6.2.3.1 Freezing drizzle (FZDZ)

Freezing drizzle **shall** be reported when the temperature is below zero degrees Celsius or when drizzle is freezing on the ice accretion indicator or on other objects at or near the earth's surface.

6.6.2.3.2 Freezing rain (FZRA)

Freezing rain **shall** be reported when the temperature is below zero degrees Celsius or when rain is freezing on the ice accretion indicator or on other objects at or near the earth's surface.

6.6.2.4 Ice accretion indicator

The horizontal surface of the ice accretion indicator **shall** be examined, and if ice has formed on it, freezing precipitation **shall** be reported. If frost has formed on the indicator, or if ice is detected during fog conditions, appropriate remarks for "frost on indicator," "rime icing on indicator," etc., **shall** be recorded and reported.

An automated ice accretion sensor that meets the applicable requirements of 12.2.3.1 may be used as an observer's aid, in accordance with procedures developed by the service provider. In such case, the observer **shall** be responsible for validating the presence and the cause of the icing.

6.6.2.5 Intensity of precipitation

The precipitations classified as liquid, freezing and frozen (with the exception of ice crystals) are always qualified as to intensity: light, moderate or heavy. The term "light" also includes scattered drops, flakes, grains, pellets or stones accruing at a rate that would not wet or cover a surface, regardless of the duration. The intensities "light," "moderate," and "heavy" are determined by considering either the effect on visibility or the rate of fall.

6.6.2.5.1 Intensity of precipitation with an obstruction to vision

The following are standards for reporting the intensity of precipitation with an obstruction to vision:

1) Drizzle occurring with fog **shall not** be reported as moderate or heavy when the visibility is ⅝ mi. or more
2) Snow with blowing snow **shall not** be reported as heavy when the visibility is ⅜ mi. or more
3) If multiple precipitation types are observed, the intensity assigned to the group will be that of the predominant precipitation type as determined by the greater intensity
    a) the predominant precipitation **shall** be reported first in the combined report
4) Freezing precipitation **shall** be reported as a separate group
5) Intensity **shall not** be applied to precipitation associated with the proximity qualifier "VC"

Precipitation of sufficient intensity may account for a considerable reduction in visibility without the presence of any obstruction to vision. However, when heavy rain is occurring with visibilities less than 2 mi., "obstruction to vision" **shall** be reported with the rain, unless there is evidence that only the rain is restricting visibility. Light or moderate rainfall (e.g., -RA or SHRA), without an obstruction to vision, will not be sufficient to reduce visibility to less than 2 mi.

6.6.2.5.2 Intensity by rate of fall criteria

Intensity for the following conditions: rain, rain showers, and freezing rain **shall** be defined using the following criteria:

- **Light**: if rate of fall is 2.5 mm/h or less
- **Moderate**: if rate of fall is 2.6 to 7.5 mm/h
- **Heavy**: if rate of fall is 7.6 mm/h or more

6.6.2.5.3 Intensity by visibility criteria

Visibility for snow, snow showers, snow grains, snow pellets, drizzle, and freezing drizzle **shall** be defined using the following criteria:

- **Light**: if visibility is ⅝ mi. or more
- **Moderate**: if alone[1] and visibility is reduced to ½ or ⅜ mi.
- **Heavy**: if alone[1] and visibility is reduced to ¼, ⅛, or 0 mi.

Note: "Alone" means no other precipitation and/or obstruction to vision is present.

6.6.2.6 Rainfall remark

The `/Rrr/` group **shall** be recorded within Remarks and reported only on the hourly report, when the rainfall accumulated since the time of the last main synoptic report equals or exceeds 10 mm (rounded). Additionally, the `/Rrr/` group **shall** be reported on the hourly report if, up to the following synoptic report, rainfall accumulations exceed the previous `/Rrr/` group by 10 mm (rounded) or more.

The letter "`R`" identifies the precipitation as rain and the letters "`rr`" the units in whole millimetres.

Table 6—1: Examples of coding of accumulated rainfall for code group `/Rrr/`

Time (UTC)	Accumulated rainfall (mm)	Recorded rainfall
0700	3.2	–
0800	9.8	/R10/
0900	20.7	/R21/
1000	30.1	–
1100	43.4	/R43/
1200	52.4	–
1300	12.1	/R12/

Note: For the purpose of this group, precipitation accumulations are tracked from immediately after a synoptic report (1201, 1801, 0001, and 0601 UTC) up to the next synoptic report (1200, 1800, 0000, and 0600 UTC) after which they are reset to 0 mm.

6.6.2.7 Rainfall remark for part-time stations

Part-time stations are defined as operating daily but fewer than 24 hours. When the station reopens, the first observation will indicate the reportable rainfall amount, using the format /Rrr AFT HH/, where HH is the hour (UTC) of the main synoptic at or prior to the time of closing.

If the closed period includes a main synoptic hour, and if the reopening time is at a nonsynoptic hour, the second and subsequent rain reports will take the form /Rr_1r_1 AFT H_1H_1 UTC/, where the flag indicates that H_1H_1 UTC is the time the station reopened and r_1r_1 is the rainfall amount since the station reopened.

6.6.2.8 Hail (GR)

Precipitation composed of small balls or pieces of ice (hailstones) with a diameter ranging from 5 mm to 50 mm (sometimes even larger) and which fall either separately or fused into irregular lumps **shall** be reported using the abbreviation GR.

6.6.2.8.1 Small hail (SHGS)

Small hail meet the criteria for hail, except that the diameter of the largest stones is smaller than 5 mm. Small hail **shall** be abbreviated as SHGS. Unlike ice pellets, small hail may be irregular in shape; it is composed of alternating or concentric layers of transparent and translucent ice.

Note: Snow pellets are also abbreviated SHGS.

6.6.2.8.2 Examples of hail remarks

```
METAR...BKN025CB 4SM TSRAGR ...RMK... HAIL DIAM 12 MM
METAR...BKN025CB 4SM TSRAGS ...RMK... HAIL DIAM 04 MM
```

6.6.2.9 Ice Crystals (IC)

When ice crystals (IC) are observed, this observation **shall** be reported in the METAR or SPECI with any reportable visibility.

6.6.2.10 Snowfall remark

The /Sss/ group **shall** be recorded within Remarks and reported only on the hourly report, when the snowfall accumulated since the time of the last main synoptic report equals or exceeds 1 cm (rounded). Additionally, the /Sss/group **shall** be reported on the hourly report if, up to the following synoptic report, snowfall accumulations exceed the previous /Sss/group by 1 cm (rounded) or more. The letter "S" identifies the precipitation as snow and the letters "ss" the units in whole centimetres. If all the snow melts as it hits the ground, /Sss/ **shall not** be reported.

Table 6—2: Examples of coding of accumulated snowfall for code group /Sss/

Time (UTC)	Accumulated snowfall (cm)	Recorded snowfall
0700	0.2	–
0800	1.4	/S01/
0900	3.2	/S03/
1000	3.8	/S04/
1100	4.4	–
1200	5.8	/S06/
1300	1.4	/S01/

Note: For the purpose of this group, precipitation accumulations are tracked from immediately after a synoptic report (1201, 1801, 0001, and 0601 UTC) up to the next synoptic report (1200, 1800, 0000, and 0600 UTC) after which they are reset to 0 cm.

6.6.2.11 Snowfall remark for part-time stations

Part-time stations are defined as operating daily but fewer than 24 hours. When the station reopens, the first observation will indicate the reportable snowfall amount, using the format /Sss AFT HH/, where HH is the hour (UTC) of the main synoptic at or prior to the time of closing.

If the closed period includes a main synoptic hour, and if the reopening time is at a nonsynoptic hour, the second and subsequent snow reports will take the form /Ss_1s_1 AFT H_1H_1 UTC/, where the flag indicates that H_1H_1 UTC is the time the station reopened and s_1s_1 is the snowfall amount since the station reopened.

6.7 Obstructions to vision (Visibility 6 mi. or less)

6.7.1 Standards for reporting obstructions to vision

Obstructions to vision **shall** be recorded only when the prevailing visibility is 6 mi. or less.

6.7.1.1 Fog (FG)

Fog **shall** only be reported when the prevailing visibility is reduced to ½ mi. or less at the earth's surface.

6.7.1.2 Freezing Fog (FZFG)

Freezing fog **shall** be reported when the temperature is in the range of -0.1 to -30.0 °C and the visibility is ½ mi. or less. When temperatures are colder than -30.0 °C and visibility is ½ mi. or less, freezing fog **shall** be reported if there is clear physical evidence of ice accretion from fog.

6.7.1.3 Mist (BR)

Mist **shall** be reported when the prevailing visibility is reduced to a range of ⅝ to 6 mi., inclusive.

6.7.1.4 Blowing snow (BLSN), blowing dust (BLDU), blowing sand (BLSA)

Blowing snow, blowing dust, blowing sand **shall** be reported when prevailing visibility is 6 mi. or less and it is the only factor reducing visibility.

6.7.1.5 Dust storm (DS), and sandstorm (SS)

Dust storms, and sandstorms **shall** be reported when the prevailing visibility is 6 mi. or less and it is the only factor reducing visibility, and **shall** be reported as heavy when the prevailing visibility is reduced to ¼ mi. or less.

6.7.1.6 Haze (HZ), dust haze (DU), smoke (FU)

Haze, dust haze, and smoke **shall** be reported when the prevailing visibility is reduced to 6 mi. or less.

6.7.1.7 Volcanic Ash (VA)

Volcanic ash **shall** be reported regardless of the prevailing visibility.

6.7.1.8 Vicinity (VC)

The vicinity qualifier VC **shall** be used when specific weather phenomena are observed within 5 mi. or less, but are not occurring at the point of observation.

The vicinity qualifier VC **shall** be used with the following weather phenomena: VCSH (showers), VCFG (fog), VCBLSN (blowing snow), VCBLDU (blowing dust), VCBLSA (blowing sand), VCPO (dust/sand whirls), VCDS (dust storm), VCSS (sandstorm), VCVA (volcanic ash).

6.8 Additional phenomena (visibility greater than 6 mi.)

Visibility is reduced below eye level whenever a meteor, other than precipitation, has veiled or hidden very low objects, but the visibility at eye level is not appreciably restricted.

6.8.1 Standards for reporting additional phenomena

Additional phenomena, when alone, **shall** be recorded when the prevailing visibility is greater than 6 mi.

6.8.1.1 Fog Patches (BCFG)

Fog patches consists of fog extending to at least 1.5 m above ground level with a coverage of less than 50% of the ground normally visible from the observing point. The letter abbreviation BCFG **shall** be used to report fog patches covering part of the aerodrome. The apparent visibility in the fog patch **shall** be ½ mi. or less. BCFG should be used only when the visibility in parts of the aerodrome is more than ½ mi. However, when the fog is close to the point of observation, the minimum visibility will be ½ mi. or less (see Appendix 2).

6.8.1.1.1 Example of BCFG Remarks

```
METAR...8SM -RA ...RMK... BCFG SE VIS 1/4
```

6.8.1.2 Fog covering part of aerodrome (PRFG)

Fog covering part of aerodrome describes a fog bank or area of fog (or freezing fog) which may have small breaks; however, within the area of fog at least 50% of the ground must be covered (see Appendix 2). Non-patchy fog (more or less continuous fog) extends to at least 1.5 metres above ground level, covering part of the aerodrome. The apparent visibility within the area of fog **shall** be ½ mi. or less (see Appendix 2).

6.8.1.2.1 Example of PRFG remarks

```
METAR...7SM ...RMK... PRFG SE-N VIS 1/2
```

6.8.1.3 Shallow Fog (MIFG)

Low-lying fog that does not obstruct the visibility at eye level (1.5 metres above the surface), even if the visibility within the fog is ½ mi. or less (see Appendix 2). Low-lying fog usually occurs with a clear sky or high thin cloud conditions.

6.8.1.3.1 Example of MIFG Remark

```
METAR...10SM MIFG ...RMK... MIFG OVR APCH RWY 27
```

6.8.1.4 Drifting dust (DRDU), drifting sand (DRSA) and drifting snow (DRSN)

Drifting snow, sand or dust **shall not** be reported in the same observation as blowing conditions of the same phenomenon; by definition, one excludes the other. For example drifting snow **shall not** be reported with blowing snow.

6.8.1.5 Volcanic Ash (VA)

Volcanic ash **shall** be reported regardless of the prevailing visibility.

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Chapter 7 Sky condition standards

7.1 General information

This chapter describes the standards for reporting sky conditions and the definition of cloud types. Terms and definitions are given for celestial dome, sky condition, obscuring layers, total amount, and reference level. Sky condition standards are given for cloud amount, vertical visibility, and variable ceiling, followed by examples of remarks. Abbreviations of cloud types and obscuring phenomena for use in reporting sky conditions are also provided.

7.2 Terms and definitions

7.2.1 Celestial dome

In this chapter, "celestial dome" refers to that portion of the sky that would be visible if there was an unobstructed view of the horizon in all directions from the point of observation.

7.2.2 Sky condition

An observation of the sky requires an examination and identification of the clouds and obscuring phenomena (fog, smoke, precipitation, etc.) which prevent an uninterrupted view of the sun, moon, stars or the clear blue of the celestial dome. Such obstructions occur as layers aloft with comparatively level bases or as surface-based layers. Each layer is analyzed for its type, amount, and height of base, or vertical visibility.

7.2.3 Obscuring layers

An "obscuring layer" is a non-cloud layer which either wholly or partly prevents an observer from seeing the sky or clouds at higher levels.

7.2.3.1 Smoke

Smoke can be reported as a surface-based layer and as a layer aloft together.

7.2.4 Transparent layers

A layer aloft that does not conceal a layer or portion of a layer above.

7.2.5 Total amount

Total amount is the amount in oktas, of the whole sky that is covered by all layers observed.

7.2.6 Summation amount

The sum of individual layer amounts in oktas. However, traces of layers, aloft or surface-based, **shall** be disregarded when determining summation amount.

7.2.7 Ceiling

Ceiling is the lowest layer aloft reported as broken (BKN) or overcast (OVC) or the vertical visibility (VV).

7.3 Observing and reporting sky condition standards

1) Cloud amount and height of base **shall** be reported for each cloud layer or, if the sky is obscured, the observed vertical visibility **shall** be reported
2) The reference point for the observation of sky condition **shall** be a point from which a minimum of obstructions[1] exist to the view of the full celestial dome
3) The reported amount for each observed layer **shall** be the summation amount covered by all layers at and below that level, excluding ground-based layers
4) Portions of upper layers seen through transparencies in lower layers do not increase the amount of sky cover and **shall not** be counted when determining the summation amount
5) When observed, CB and TCU of any amount **shall** always be reported in the remark of the METAR/SPECI
6) When either CB or TCU are the predominant cloud type in a layer reported in the cloud group of the METAR / SPECI then the applicable cloud type (CB or TCU) **shall** be included within the cloud group
7) When an individual layer of cloud is composed of CB and TCU with a common cloud base, the type **shall** be reported as CB only
8) If the observed layers aloft or vertical visibility height is between two reportable values, the lower value **shall** be reported
9) If the observed cloud amount is between two reportable values, the greater value **shall** be reported
10) If there are no cloud bases visible, sky clear (SKC) **shall** be reported alone
11) When the sky is completely obscured, vertical visibility **shall** be observed and reported, where measured, in lieu of cloud amount, cloud type and height of cloud base
12) The height values of layers aloft or vertical visibilities into an obscuring layer **shall** be reported in increments of 100 ft up to and including 10 000 ft, and in increments of 1 000 ft above 10 000 ft

Note (1): Objects that block less than 45° of the horizon or natural objects such as trees and hills are not considered to be obstructions.

Note (2): ICAO/WMO recommend a maximum of 4 cloud layers.

7.3.1 Reference level

At airport locations, height **shall** be determined with reference to the official aerodrome level. At non-airport locations, it **shall** be determined with reference to ground level at the observing station. Table 7—1 **shall** be used as a guide to determine the approximate height of the base of a cloud type.

Table 7—1: Guide to determine the approximate height of the base of a cloud type

Definitions of clouds	Approximate height of base	Remarks
Cirrocumulus: thin, white patch, sheet or layer of cloud without shading, composed of very small elements in the form of grains, ripples etc., merged or separated, and more or less regularly arranged; most of the elements have an apparent width of less than one finger held at arm's length.	20 000 to 39 000 ft	Average height of base 29 000 ft in summer; in winter 26 000 ft. If very thin, average height of base 32 000 ft.
Cirrus: detached clouds in the form of white, delicate filaments of white or mostly white patches or narrow bands. These clouds have a fibrous (hair-like) appearance, or a silky sheen, or both.	20 000 to 39 000 ft	Average height of base 29 000 ft in summer; in winter 26 000 ft. If very thin, average height of base 32 000 ft.
Cirrostratus: transparent, whitish cloud veil or fibrous (hair-like) or smooth appearance, totally or partly covering the sky, and generally producing halo phenomena.	20 000 to 39 000 ft	Bases more often near the lower 20 000–39 000 ft limit of this range, averaging about 20 000 ft in winter and 26 000 ft in summer.
Altocumulus: white or grey, or both white and grey, patch, sheet or layer of cloud, generally with shading, composed of laminae, rounded masses, rolls, etc., which are sometimes partly fibrous or diffuse and which may or may not be merged; most of the regularly arranged small elements usually have an apparent width of between one and three fingers held at arm's length.	Above 6 500 to 20 000 ft	Small elements with little shading, usually based at approximately 16 000 ft, larger and darker elements based lower.

Definitions of clouds	Approximate height of base	Remarks
Altocumulus Castellanus: Altocumulus with cumuliform protuberances, at least in some portion of the upper part. The turrets, some of which are taller than they are wide, are connected by a common base and seen to be arranged in lines.	Above 6 500 to 20 000 ft	Small elements with little shading usually based at approximately 16 000 ft, larger and darker elements based lower.
Altostratus: greyish or bluish cloud sheet or layer of striated, fibrous or uniform appearance, totally or partly covering the sky, and having parts thin enough to reveal the sun at least vaguely, as if seen through ground glass. Altostratus does not show halo phenomena.	Above 6 500 to 20 000 ft	When no sun or moon is visible the average height of the base is 8 000 ft, thin layers are higher.
Nimbostratus: grey cloud layer, often dark, the appearance of which is rendered diffuse by more or less continuously falling rain or snow, which in most cases reaches the ground. It is thick enough throughout to blot out the sun.	Near surface to 6 500 ft	Usually the darker the cloud the lower the base. Stratus Fractus usually forms in precipitation below Nimbostratus and may or may not merge with the higher layer.
Stratocumulus: grey or whitish, or both grey and whitish, patch, sheet or layer of cloud which almost always has dark parts, composed of tessellations, rounded masses, rolls, etc., which are non-fibrous (except for virga) and which may or may not be merged; most of the regularly arranged small elements have apparent width of more than three fingers at arm's length.	500 to 1 000 ft	Few rolls, large cloud elements.
	1 000 to 6 500 ft	More rolls and smaller cloud elements as the height of the base increases.

Definitions of clouds	Approximate height of base	Remarks
Stratus: generally grey cloud layer with a fairly uniform base, which may give drizzle, freezing drizzle, snow grains. When the sun is visible through the cloud, its outline is clearly discernible. **Stratus Fractus**: ragged Stratus.	Near surface to 1 500 ft	Usually based below 1 000 ft.
Cumulus: detached clouds, generally dense and with sharp outlines, developing vertically in the form of rising mounds, domes or towers, whose bulging upper part often resembles a cauliflower. The sunlit part of these clouds shows dazzling white colour; their bases are relatively dark and almost flat. **Cumulus Fractus**: ragged Cumulus.	Usually 1 500 to 6 500 ft, but up to 10 000 ft or higher	Highest bases occur in summer in very dry air.
Towering Cumulus: strongly sprouting cloud with generally sharp outlines and often great vertical extent. The bulging upper part resembles a cauliflower. This cloud sometimes looks narrow with very high towers. Sides are white in the sun; when overhead, its base is dark, flat and almost horizontal.	Usually 1 500 to 6 500 ft but up to 10 000 ft or higher	Highest bases occur in summer in very dry air.
Cumulonimbus: heavy and dense cloud with considerable vertical extent, in the form of a mountain or a huge tower. At least part of its upper portion is usually smooth, fibrous or striated, and nearly always flattened; this part often spreads out in the shape of an anvil or vast plume. Under the base of this cloud which is often very dark, there are frequently low ragged clouds either merged with it or not, and precipitation, sometimes in the form of virga.	Usually 1 500 to 6 500 ft but up to 10 000 ft or higher.	Highest bases occur in summer in very dry air.

Note: Cirriform clouds in the high Arctic may be observed at very low levels.

7.3.2 Cloud amount

Table 7—2: Information on cloud amounts

Three-letter symbol abbreviation	Terminology	Layer as defined by summation amount
SKC	Sky clear	No cloud or layer present
FEW	Few	Less than 1/8 to 2/8 summation amount
SCT	Scattered	3/8 to 4/8 summation amount
BKN	Broken	5/8 to less than 8/8 summation amount
OVC	Overcast	8/8 summation amount

7.3.3 Variable ceiling

When the mean value of the ceiling is 1 500 ft or less and is observed to be "variable" (i.e., rising and falling from the mean value by ¼ or more of the mean value), the range of variation **shall** be indicated in Remarks as:

```
METAR...OVC003 ...RMK... CIG VRB 002-004
```

Variable ceiling remarks **shall** only be used when the mean value of the ceiling is 1500 ft or below.

7.3.4 Examples of sky condition remarks

```
METAR...BKN070 ...RMK... AC EXTD RPDLY FM SW
METAR...OVC007 ...RMK... CLD TPG HILLS NE
METAR...FEW250 ...RMK... CONTRAILS[1]
```

The remark `CONTRAILS` **shall** be used when middle (C_M) or high (C_H) cloud consists in whole or in part of persistent (15 minutes or more) condensation trails. Rapidly dissipating condensation trails **shall not** be reported.

7.4 Abbreviations of cloud types and obscuring phenomena

Table 7—3: Abbreviations of cloud types

Abbreviations	Cloud type
AC	Altocumulus
ACC	Altocumulus Castellanus
AS	Altostratus
CC	Cirrocumulus
CS	Cirrostratus
CI	Cirrus
CB	Cumulonimbus
CU	Cumulus
CF	Cumulus Fractus
TCU	Towering Cumulus
NS	Nimbostratus
SC	Stratocumulus
ST	Stratus
SF	Stratus Fractus

Table 7—4: Abbreviations of obscuring phenomena

Abbreviations	Obscuring Phenomena
RA	Rain (any form including SHRA and FZRA)
GR	Hail (any diameter)
PL	Ice Pellets
DZ	Drizzle (including Freezing Drizzle)
IC	Ice Crystals
SN	Snow (Snow Showers, Snow Pellets, Snow Grains)
BLSN	Blowing Snow
FG	Fog (any form)
BLDU	Blowing Dust
DS	Dust Storm
HZ	Haze
BLSA	Blowing Sand
SS	Sandstorm
FU	Smoke
VA	Volcanic Ash

Chapter 8 Air and dew-point temperature

8.1 General information

This chapter provides definitions of terms and describes the standards for air and dew-point temperature.

The temperature of a body is the condition which determines its ability to communicate heat to other bodies or to receive heat from them. In a system of two bodies, the one that loses heat to the other is said to be at the higher temperature. With the latest technologies, the temperature is now derived from automated instruments which already have corrections and tolerances built into them.

8.2 Terms and definitions

8.2.1 Temperature

Temperature is a measure of the warmth or coldness of an object or substance with reference to a standard value. It is measured in degrees Celsius (C).

8.2.2 Humidity

Humidity is a measure of the water vapour content of the air. It is calculated with respect to water, both at temperatures above and below freezing. Humidity is commonly expressed in terms of dew-point temperature and relative humidity.

8.2.3 Dew-point

The dew-point is the temperature at which the air would become saturated (with respect to water) if cooled at constant pressure and without the addition or removal of water vapour. The dew-point is expressed in degrees Celsius.

8.2.4 Relative humidity

Relative humidity is the ratio, expressed as a percentage, of the amount of water vapour actually present in the air to the amount of water vapour which would be present if the air were saturated with respect to water at the same temperature and pressure.

8.3 Temperature standards

The following are standards for reporting air temperature and dew-point:

1) The air temperature and dew-point temperature **shall** be rounded to the nearest whole degree Celsius
2) Observed values involving 0.5 °C **shall** be rounded up to the next highest (warmer) degree Celsius
3) Rounded whole-degree single-digit values (-9 °C to +9 °C) of air temperature and dew-point temperature **shall** be preceded by 0 (e.g., `M09` or `09`)
4) Temperatures below 0 °C **shall** be immediately preceded by `M` to indicate the temperature is minus

8.3.1 Examples of reports of temperature in METAR

`METAR...06/M00...`

Chapter 9 Atmospheric pressure standards

9.1 General information

This chapter first defines station elevation and the units of measurements used for atmospheric pressure, and then the standards for observing and reporting atmospheric pressure are described.

9.1.1 Atmospheric pressure

Atmospheric pressure, also called barometric pressure, is the force per unit area exerted by the atmosphere as a consequence of its weight, and thus is equal to the weight of a vertical column of air of unit area, extending from the level in question to the outer limit of the atmosphere.

A barometer for aviation purposes **shall** contain two or more independently operating sensors each of which is traceable to a WMO primary standard barometer.

9.1.2 Station elevation

The station elevation is the vertical distance in metres above Mean Sea Level (MSL) of the datum level to which barometer readings are corrected to give station pressure.

At surface weather observing sites located at airports, the station elevation is equal to the aerodrome elevation as reported in the *Canada Flight Supplement*.

9.1.3 Units of measurement

The unit of measurement of atmospheric pressure is hectopascals; the corresponding symbol is hPa. The unit of measurement of the altimeter setting is in hundredths of inches of mercury.

9.2 Pressure standards

Meteorological observations of atmospheric pressure intended to be provided as meteorological reports of altimeter setting **shall** meet the following requirements:

1) The atmospheric pressure for aviation purposes **shall** be measured using a digital barometer containing two or more independently operating sensors meeting the requirements of section 12.2.6
2) The sensors **shall** be installed and operated in accordance with the manufacturer's specifications, or equivalent specifications developed by the service provider
3) The sensors **shall** be accurate to within 0.02 inches of mercury
4) The altimeter setting (QNH) value **shall** be rounded down to the nearest whole hundredths of inches of mercury using four digits preceded, without a space, by the letter indicator "A"
5) The computed sea level pressure **shall** be reported in observations so that the barometric pressures at stations of different elevations can be compared at a common level for synoptic purposes
6) Altimeters **shall** have quality control that in the event of sensor failure prevent the report from being issued

Note: Aircraft altimeters do not meet the above standards. Please refer to Appendix 4.

9.2.1 Mandatory remarks

The remark PRESRR is used when the pressure trace indicates that the station pressure is rising at the rate of 2.0 hPa per hour or more at the time of observation.

The remark PRESFR is used when the pressure trace indicates that the station pressure is falling at the rate of 2.0 hPa per hour or more at the time of observation.

Note: If the pressure trace shows an increase or decrease of 0.5 hPa during the last 15 minutes, the rate of increase or decrease would be 2.0 hPa per hour and the remark PRESRR or PRESFR would be appropriate.

9.2.2 Sea level pressure (SLP_{ppp})

SLP: Group indicator that precedes the sea level pressure.

ppp: Sea level pressure in hectopascals. The recorded values are the last three digits including the tenths of the measured pressure.

Chapter 10 General aviation remarks

10.1 General information

This chapter explains what general aviation remarks are and outlines the standards for their usage. Criteria for inclusion of remarks and supplementary meteorological information are also provided.

The service provider **shall** establish operational procedures regarding the inclusion of remarks and, where associated reports are disseminated by broadcast, criteria regarding which content is to be included in such broadcasts.

Note: Observers are encouraged to use the Remarks section and are not restricted to the remarks listed in section 10.2.

10.2 Standards for the inclusion of remarks

The following are standards for the inclusion of remarks in meteorological reports:

1) The indicator `RMK` denotes the beginning of a section containing information included by national decision
2) General aviation remarks, defined as meteorological information of importance to aviation and other users not captured elsewhere in the METAR/SPECI, **shall** be recorded under Remarks
3) The observer **shall** use discretion in the understanding that the METARS are disseminated globally
4) Standard abbreviations from the *Manual of Word Abbreviations* (MANAB) **shall** be used (plain language may also be used, provided all terms are spelled out fully and well understood by users)
5) All reports from human sites **shall** contain remarks and supplementary meteorological information, which at a minimum **shall** include each of the following, when present:
   - cloud layer type, amount, and obscuring phenomena
   - `TORNADO`, `FUNNEL CLOUD` or `WATERSPOUT` **shall** be spelled out in the Remarks section
   - lightning as per 6.5.2.2
   - volcanic eruption or volcanic ash as per 6.7.1.7
   - wind as per 3.4
   - visibility as per 4.6
   - sky condition as per 7.3.4
   - significant pressure changes as per 9.2.1
   - character of precipitation as per 6.6.2.1.1

- snowfall amount as per 6.6.2.10
- rainfall amount as per 6.6.2.6
- estimated hail size as per 6.6.2.8.2
- RVR as per 5.3
- late weather observations as per 2.9.2
- observation program status as per 2.9.3
- Icing as per 6.6.2.4
- SLPppp

Chapter 11 METAR—Aerodrome routine meteorological report

11.1 General information

METAR (Aerodrome routine meteorological report) is the primary observation code reported on the hour (UTC) when reporting surface meteorological data. SPECI (Aerodrome special meteorological report) is an unscheduled report taken when any of the selected changes in weather conditions significant to aviation occur off the hour (UTC). LWIS (Limited Weather Information System) is a system that generates additional weather reports outside the hours of human observations.

This chapter describes standards for coding and reporting METAR, SPECI, and LWIS reports. It provides the symbolic code forms of each type of report, followed by detailed descriptions of the code groups and elements that make up a particular code form. Guidance and notes to ensure standard encoding of observed meteorological data are also included.

Aerodrome routine and special reports are also to be disseminated in ICAO meteorological information exchange Model (IWXXM) Geography Markup Language (GML) form in addition to the dissemination of the METAR and SPECI in accordance with the code form otherwise specified in this chapter. The IWXXM version of the METAR / SPECI **shall** contain all the content and meet all the requirements for a standard METAR / SPECI but may also, as documented by the service provider, include additional information in accordance with ICAO Annex 3 and PANS-MET or to meet local requirements.

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 Digital Exchange of Aeronautical Meteorological Information (Doc 10003).

It is emphasized that no meteorological reports **shall** be issued in the ICAO code form for aerodrome routine and special reports (in METAR / SPECI form as detailed as follows in this Chapter) or be distributed on the Global Telecommunication System (GTS) unless they comply with all requirements for these reports, as establish in *Canadian Aviation Regulations* standards. This includes including all related meteorological elements, a continuous weather watch resulting in the issuance of special reports when SPECI thresholds are crossed and quality control and management. Further guidance on these requirements can be requested by email from:
TC.ANSWeatherInfo-InfoMeteoSNA.TC@tc.gc.ca

11.2 The METAR and SPECI code

Detailed coding instructions for each element of each group of the METAR and SPECI codes are given below. The type of report is usually determined after all data have been observed. The order in which elements are observed or that entries are made by the observer may differ from the order of the code form below; however, the order in which elements are reported must match the symbolic form. Although the observer may find that some weather elements are automatically encoded, it is still necessary for the observer to have a basic understanding of how these weather elements are encoded.

11.2.1 Symbolic form of the Canadian METAR or SPECI code

(**METAR** or **SPECI**) CCCC YYGGgg**Z** AUTO BBB dddffG$f_m f_m$**KT** $d_n d_n d_n$**V**$d_x d_x d_x$ VVVV**SM** (**R**$D_R D_R$/$V_R V_R V_R V_R$**FT**/i or **R**$D_R D_R$/$V_R V_R V_R V_R$**V**$V_R V_R V_R V_R$**FT**/i) w′w′ ($N_s N_s N_s h_s h_s h_s$ and/or **VV**$h_s h_s h_s$) T′T′/T′$_d$T′$_d$ **A**$P_H P_H P_H P_H$ (**WS RWY**$D_R D_R$ or **WS ALL RWY**) **RMK** (layer type and amount, as well as general remarks) **SLP**ppp

Note: Symbols shown in bold in the symbolic form above are included verbatim as part of the message whenever the relevant group is included in the message. All other symbols are replaced by appropriate data as applicable.

11.2.2 Detailed description

11.2.2.1 Type of reports (METAR or SPECI)

The code name METAR or SPECI **shall** be included at the beginning of an individual report.

METAR (Aerodrome routine meteorological report) is the code name of the international meteorological code for reporting surface weather observations that are taken and reported on the hour (UTC). METAR contains a report of wind, visibility, runway visual range, present weather, sky condition, temperature, dew-point, and altimeter. In addition, coded and/or plain language information elaborating on weather elements can be found in the "Remarks" section.

SPECI (Aerodrome special meteorological report) is the code name for an unscheduled report transmitted when any of the selected changes in weather conditions significant to aviation occur off the hour (UTC). SPECI **shall** contain all data elements found in a METAR. In addition, coded and/or plain language information elaborating on weather elements can be found in the "Remarks" section.

11.2.2.2 ICAO station identifier (CCCC)

Four-letter identifier beginning with the letter "C" which identifies it as a Canadian station.

11.2.2.3 Date and time of observation (YYGGggZ)

The date and time of observation (YYGGggZ) **shall** be included in all reports.

YY: Day of month.

GG: Hour of the day.

gg: Minute of the hour.

Z: Indicates UTC.

11.2.2.4 Automatic station indicator (AUTO)

AUTO: Indicates the report is from an automatic observation station.

11.2.2.5 Correction indicator (BBB)

BBB: Formed by the letters CC preceding an incremented letter to indicate the corrected observation. Use CCA for first correction, CCB for second correction, and so on.

11.2.2.6 Wind velocity ($dddffGf_mf_mKT$)

ddd: The two-minute mean wind direction from which the surface wind is blowing. This data is always encoded with three digits.

ff: The two-minute mean wind speed. This data is encoded with two digits if under 100 kt, and with three digits if equal to or over 100 kt.

Gf_mf_m: Gust information will be included if gust speed criteria are met. If gust criteria are not met, this group **shall not** be reported. G indicates gust and f_mf_m is the peak gust speed reported.

KT: Indicates that the units are knots.

11.2.2.7 Variation in wind direction ($d_nd_nd_nVd_xd_xd_x$)

$d_nd_nd_n$: First counter-clockwise wind direction from the mean wind direction.

V: Variable indicator that is mandatory when this group is reported.

$d_xd_xd_x$: Last clockwise wind direction from the mean wind direction.

11.2.2.8 Variable wind direction (VRB)

Report variable wind direction as VRB when the criteria for variable wind are met.

11.2.2.9 Prevailing visibility (VVVVSM)

The prevailing visibility is reported in international statute miles and fractions of miles followed by the letters "SM" to indicate units.

VVVV: Prevailing visibility.

SM: Indicates the units are international statute miles.

11.2.2.10 Runway Visual Range (RVR) ($RD_RD_R/V_RV_RV_RV_RFT/i$)

R: Group indicator that precedes the runway visual range information.

D_RD_R: Designator of each runway for which runway visual range is reported.

$V_RV_RV_RV_RFT$: The 10-minutes average runway visual range immediately preceding the observation. FT **shall** be appended to the measurement to indicate that the measurement is in feet.

i: Indicates the RVR trend.

11.2.2.10.1 Variations in runway visual range ($RD_RD_R/V_RV_RV_RV_RVV_RV_RV_RV_RFT/i$)

Variation in the runway visual range **shall** be given in the form $RD_RD_R/V_RV_RV_RV_RVV_RV_RV_RV_RFT/i$ instead of the 10-minute mean.

11.2.2.11 Present weather (w′w′)

One or more w′w′ groups **shall** be used to report all present weather phenomena observed at or near the aerodrome and of significance to aeronautical operations, in accordance with WMO Code table 4678 (see Table 11—1).

11.2.2.12 Intensity

If the intensity of the phenomena being reported in a group is either light "−" or heavy "+", this is indicated by the appropriate sign. No sign is included if the intensity is moderate, or when intensity is not relevant.

11.2.2.12.1 Intensity of multiple precipitation types

If multiple precipitation types are observed, the intensity assigned to the group will be that of the predominant precipitation type as determined by the greater intensity. The predominant precipitation **shall** be reported first within the combined report, except when freezing precipitation occurs. Freezing precipitation **shall** be reported as a separate group.

11.2.2.13 Priority of present weather groups

Present weather (w′w′) groups **shall** be reported in the following order:

1) the qualifier for intensity or for proximity (if appropriate), followed without a space by 2)
2) the abbreviation for the descriptor (if appropriate), followed without a space by 3)
3) the abbreviation for the observed weather phenomenon or combinations thereof

Table 11—1 **shall** be used to specify the code figure for w′w′.

Table 11—1: WMO code table 4678—Specification of code figures for w′w′

Qualifier				Weather phenomena					
1 Intensity or proximity		2 Descriptor		3 Precipitation		4 Obscuration		5 Other	
-	Light	MI	Shallow	DZ	Drizzle	BR	Mist	PO	Dust/Sand Whirls (dust devils)
	Moderate (no qualifier)	BC	Patches	RA	Rain	FG	Fog	SQ	Squalls
+	Heavy (well-developed in the case of dust/sand whirls, dust devils and funnel clouds)	PR	Partial (covering part of the aerodrome)	SN	Snow	FU	Smoke	FC	Funnel Cloud(s) (tornado or water-spout)
VC	In the Vicinity	DR	Low Drifting	SG	Snow Grains	VA	Volcanic Ash	SS	Sandstorm
		BL	Blowing	IC	Ice Crystals (diamond dust)	DU	Widespread Dust	DS	Dust storm
		SH	Shower(s)	PL	Ice Pellets	SA	Sand		
		TS	Thunderstorm	GR	Hail	HZ	Haze		
		FZ	Freezing (supercooled)	GS	Small Hail and/or Snow Pellets				
				UP	Unknown Precipitation (AWOS only)				

11.2.2.14 Layers aloft ($N_sN_sN_sh_sh_sh_s$)

$N_sN_sN_s$: The amount of each layer.

$h_sh_sh_s$: The height of layers aloft.

Note: ICAO/WMO recommend a maximum of 4 cloud layers

11.2.2.15 Vertical visibility ($VVh_sh_sh_s$)

VV: Group indicator that precedes the vertical visibility information.

$h_sh_sh_s$: Vertical visibility.

11.2.2.16 Temperature/dew-point temperature ($T'T'/T'_dT'_d$)

$T'T'$: Dry-bulb temperature.

$T'_dT'_d$: Dew-point temperature.

11.2.2.17 Altimeter setting ($AP_HP_HP_HP_H$)

A: Group indicator that precedes the altimeter settings information.

$P_HP_HP_HP_H$: The altimeter setting in hundredths of inches of mercury using four digits.

11.2.2.18 Wind shear in the lower layers (WS $RWYD_RD_R$ or WS ALL RWY)

WS: Group indicator that precedes the wind shear information

$RWYD_RD_R$: RWY is the standard indicator, followed by D_RD_R which represents the runway designators. As in the case of RVR, the letters "L", "C", or "R" may be appended (indicating the left, central or right parallel runway, respectively).

ALL RWY: Is used if the existence of wind shear applies to all runways.

11.2.2.19 Remarks (RMK)

The Remarks portion of the METAR or SPECI observation is used to describe meteorological information of importance. General aviation remarks are referenced in Chapter 10. Directions in Remarks **shall** be recorded in a clockwise order.

11.2.3 Criteria for reporting SPECI

11.2.3.1 Ceiling

A SPECI report **shall** be reported whenever ceiling decreases to less than, or increases to equal or exceed (if below), the following coded values of height (in hundreds of feet):

- 15
- 10
- 5
- 4[1]
- 3
- 2[1]
- 1[1]
- any additional limits as specified by the service provider

11.2.3.2 Obstruction to vision

A SPECI report **shall** be reported whenever freezing fog begins or ends.

11.2.3.3 Sky condition

A SPECI report **shall** be reported whenever a layer aloft is observed below 1 000 ft and no layer aloft was reported below this height in the immediately preceding report.

11.2.3.4 Visibility

A SPECI report **shall** be reported whenever prevailing visibility decreases to less than, or increases to equal or exceed (if below), the following values:

- 3 mi.
- 1 ½ mi.
- 1 mi.
- ¾ mi.[1]
- ½ mi.
- ¼ mi.[1]
- any additional limits as specified by the service provider

Note: These referenced criteria are applicable only at aerodromes with approved precision approaches and only down to and including the lowest published minima for these aerodromes.

11.2.3.5 Tornado, waterspout or funnel cloud

A SPECI report **shall** be reported whenever a tornado, waterspout or funnel cloud:

- is observed
- is reported from a reliable source
- disappears from sight

11.2.3.6 Thunderstorm

A SPECI report **shall** be reported whenever a thunderstorm:

- begins
- ends (15 minutes have elapsed without the occurrence of thunderstorm activity)

11.2.3.7 Precipitation

A SPECI report **shall** be reported whenever any of the following begin, end or change in intensity:

- freezing rain
- freezing drizzle
- ice pellets
- rain
- rain showers
- drizzle
- snow
- snow showers
- snow grains
- hail
- small hail
- snow pellets
- ice crystals (begin or end)

A SPECI report **shall** be reported, as required, to report the beginning and end of each individual type of precipitation, regardless of simultaneous occurrences of other types. A leeway of up to 15 minutes is allowed after the precipitation ends before a SPECI is mandatory.

Changes in the character of precipitation do not require a SPECI if the break in precipitation does not exceed 15 minutes and there is no change to the intensity in the precipitation.

11.2.3.8 Temperature changes

Designated sites[1] are required to issue special (SPECI) reports when temperature changes occur that are of concern to aviation operations. Temperature changes meeting the following criteria **shall** be reported by all designated sites[1] whenever:

1) the rounded temperature increases by 5 °C or more from the previous reported value and the previous reported value was 20 °C or higher
2) the temperature decreases to a reported value of 2 °C or lower from the previous report

Note: The term "designated sites" refers to sites designated by NAV CANADA as listed in Appendix 1 of MANOBS, "Stations where SPECI reports are required for temperature changes."

11.2.3.9 Wind changes

A SPECI report **shall** be reported whenever wind direction or speed changes occur and equal or exceed the following criteria:

1) speed (two-minute mean) increases suddenly to at least double the previously reported value and exceeds 30 kt
2) direction changes sufficiently to fulfill criteria required for a "wind shift" as per section 3.3.3
3) the existence of low-level wind shear along the runway takeoff or approach path 1 500 ft AGL and below, which is considered significant to aircraft operations, **shall** be reported

11.2.3.10 Volcanic eruption

A SPECI report **shall** be reported whenever a volcanic eruption is observed. The following data **shall** be included in Remarks, when known:

1) name of the volcano
2) direction (16 points, true, of the compass) and approximate distance (international statute miles) of the volcano
3) date/Time (UTC) of eruption
4) height and direction of movement of ash cloud
5) other pertinent data

Post-eruption volcanic ash clouds **shall** be included in the Remarks section of METAR and observations, if significant.

11.2.3.11 Additional observations

The criteria specified in the preceding paragraphs **shall** be regarded as the minimum requirements for taking SPECI observations. Observers are encouraged to exercise initiative by taking additional observations when any weather condition exists that may impact the safety and efficiency of aircraft operations or is considered to be otherwise significant. This is to ensure that significant changes in weather are reported. Additional observations **shall** be reported as a SPECI:

- on request of a forecast centre
- on request of Air Traffic Services (ATS)
- based upon an observer's initiative
- upon notification of an aircraft accident
- based on local criteria as defined by service providers

11.3 The LWIS code

11.3.1 General information

The Limited Weather Information System (LWIS) generates additional weather reports outside the hours of human observations. These reports provide wind, temperature, dew-point and altimeter setting information. The LWIS information is updated on an hourly basis.

11.3.2 Symbolic form of the LWIS code

LWIS CCCC YYGGgg**Z** AUTO dddffG$f_m f_m$**KT** T'T'/T'$_d$T'$_d$

A$P_H P_H P_H P_H$

Note: Symbols shown in bold in the symbolic form above are included verbatim as part of the message whenever the relevant group is included in the message. All other symbols are replaced by appropriate data as applicable.

11.3.3 Detailed description

11.3.3.1 Type of report

The code name `LWIS` **shall** be included at the beginning of an individual report.

11.3.3.2 ICAO station identifier (CCCC)

See section 11.2.2.2.

11.3.3.3 Date and time of observation (YYGGggZ)

See section 11.2.2.3.

11.3.3.4 Automatic station indicator (AUTO)

See section 11.2.2.4.

11.3.3.5 Wind velocity ($dddffGf_mf_mKT$)

See section 11.2.2.6.

11.3.3.6 Temperature/dew-point temperature ($T'T'/T'_dT'_d$)

See section 11.2.2.16.

11.3.3.7 Altimeter setting ($AP_HP_HP_HP_H$)

See section 11.2.2.17.

Chapter 12 Automatic system standards

12.1 General information

This chapter explains what an automated observing and reporting system is and outlines the standards for observations, reports, and instruments when using an automated system. Examples of remarks to be used for weather elements are provided. This chapter applies to service providers who provide aviation weather services consisting of automated observation and reporting of any or all of the following: wind direction, speed and character; visibility, RVR, present weather, sky condition, temperature, dew-point temperature, atmospheric pressure and remarks.

12.2 Standards for observations, reports, and instruments

12.2.1 Wind standards

Meteorological observations of surface wind **shall** meet the following standards:

1) The wind measurements **shall** be representative of winds that are 10 m above the ground over level terrain at a distance equal to at least 10 times the height of any object from that object or, if this is not possible, at such a height and location that the indications are reasonably unaffected by local obstructions
2) The instruments **shall** function for winds of up to and including at least 100 kt speed
3) The accuracy of wind sensors and wind reports **shall** be such that:
    a) the direction is correctly reported within ± 10°
    b) the mean speed is correctly reported within ± 2 kt up to 20 kt, and within 10% of the mean speed above 20 kt
4) The wind measurement **shall** include:
    a) direction
    b) speed
    c) character (if applicable)
5) The wind direction from which the wind is blowing and the wind speed **shall** be averaged over a two-minute period
6) The wind direction from which the wind is blowing **shall** be reported in tens of degrees with reference to true North
7) For voice communication purposes in support of take-off or landing operations in the Southern Domestic Airspace wind direction **shall** be reported in tens of degrees with reference to magnetic North
8) The wind speed **shall** be reported in knots

9) Calm wind may be reported for mean wind speeds less than 2 kt and 1 kt or less **shall** be reported as calm wind

10) The wind character **shall** be reported as a "gust" if wind speed data for the most recent ten minutes indicate rapid fluctuations in wind speed and:

    a) a peak wind speed that exceeds the current two-minute mean wind speed by 5 kt or more

    b) the highest peak wind speed is at least 15 kt

11) The speed of a gust **shall** be the maximum wind speed, in kt, averaged over a maximum of a five-second period

12) The wind character **shall** be reported as a "squall" if wind speed increases by 15 kt or more over the two-minute average speed that preceded the increase and:

    a) the duration of the peak speed period is at least two minutes

    b) the wind speed attains a one-minute mean of at least 20 kt, during the peak speed period

    c) the wind speed diminishes by at least 5 kt

13) When squalls are observed, "SQ" **shall** be reported in present weather and:

    a) the peak wind speed **shall** be reported as a gust (the speed to be reported is the highest one-minute mean speed)

14) Variations from the mean wind direction where the total variation is 60° or more during the past 10-minutes period **shall** be reported as follows:

    a) when the total variation is between 60° and 180° and the wind speed is 3 kt or more, such directional variation **shall** be reported as the two extreme directions in clockwise order between which the surface wind has varied

    b) when the total variation is between 60° and 180° and the wind speed is less than 3 kt, the wind direction **shall** be reported as variable with no mean wind direction

    c) when the total variation is 180° or more, the wind direction **shall** be reported as variable with no mean wind direction.

12.2.1.1 Examples of wind remarks

Wind remarks may be automatically generated by the wind measurement system. Use WIND MISG when wind data is not available.

12.2.2 Visibility standards

12.2.2.1 Observations and reports

The observation of visibility **shall** meet the following requirements:

1) If the visibility cannot be determined, then it **shall** be reported as missing (`VIS MISG`)
2) The reportable values of visibility **shall** be:
   a) 0, ⅛, ¼, ⅜, ½, ⅝ and ¾ of an international statute mile for visibility up to but not including 1 mi.
   b) by increments of ¼ mi. for visibility of 1 mi. up to and including 2 ½ mi.
   c) increments of 1 mi. from 3 mi. up to and including 15 mi.
   d) increments of 5 mi. above 15 mi. onward
3) If the observed value of visibility is between two reportable values, then the lower value **shall** be reported

12.2.2.2 Instruments

Instruments used for the measurement of visibility **shall** meet or exceed the following standards:

1) Instruments **shall** incorporate a background luminance sensor that is accurate to within 10% with a confidence level of at least 90%
2) The Meteorological Optical Range, as defined by the World Meteorological Organization, **shall**:
   a) be determined within ¼ mi. of the value of a reference transmissometer (instrument for measuring the extinction coefficient of the atmosphere, and for the determination of visual range) from ¼ mi. to 1 mi. at least 80% of the time
   b) be determined within ¼ mi. above and within ½ mi. below the value of a reference transmissometer, or clinical human observations (qualified meteorological observers) from 1 ¼ mi. to 1 ¾ mi. at least 80% of the time
   c) be determined within ± ½ mi. of the value of a reference transmissometer, or clinical human observations, from 2 mi. to 2 ½ mi. at least 80% of the time
   d) be determined within ½ mi. above or within 1 mi. below the value of a reference transmissometer, or clinical human observations, from 3 mi. to 3 ½ mi. at least 80% of the time
   e) be determined within ± 1 mi. of the value of a reference transmissometer, or clinical human observations, from 4 mi. to 6 mi. at least 80% of the time
   f) meet criteria established and documented by the service provider for visibility greater than 6 mi.

12.2.2.3 Examples of visibility remarks

Visibility remarks are automatically generated by the visibility measurement system. Use the remark VIS MISG when visibility data is not available.

12.2.2.4 Runway Visibility Range (RVR)

Runway visibility range is reported at sites equipped with RVR sensors; refer to 0

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12.2.3 Present weather standards

12.2.3.1 Instruments

The observation of present weather **shall** meet or exceed accuracy standards, as follows, with reference to clinical human observations:

1) Instruments **shall** correctly detect the presence of precipitation at water equivalent rate of at least 0.2 mm per hour, other than drizzle, at least 90% of the time
2) Instruments **shall** correctly report the presence of and distinguish between liquid or frozen precipitation, at a water equivalent rate of at least 0.2 mm per hour, at least 80% of the time
3) Instruments **shall** correctly report at least a 90% probability of detection of the presence of ice accretion or freezing precipitation, of at least a light intensity
4) Instruments **shall** correctly detect and differentiate rain, freezing rain and snow, and (as applicable) determine the intensity (except as permitted in accordance with 8)
5) Instruments **shall** correctly report accretion or freezing precipitation of at least light intensity
6) Should five or more thunderstorm days per year be expected given the climatology of the site, then it is necessary for a station to be able to correctly detect and report, with at least an 80% probability, thunderstorms within 6 mi. of the station
7) Instruments **shall** correctly report the presence of thunderstorm in the vicinity (VCTS), if lightning is detected from greater than 6 mi. to 10 mi.
8) Instruments **shall** indicate unknown precipitation type as UP if the type cannot be determined

12.2.3.2 Examples of present weather remarks

Remark to use when icing data missing: ICE MISG
Remark to use when precipitation data missing: PCPN MISG
Remark to use when thunderstorm/lighting data missing: TS/LTNG TEMPO UNAVBL
Remark to use when weather data missing: WX MISG
Remark to use if lightning is detected between 10 to 30 mi. with octant compass cardinal direction: LTNG DIST E SE
Remark to use if lightning is detected in four or more octants: LTNG DIST ALQDS
Remark to use when icing is detected: ICE, ICE INTMT or ICE PAST HR

12.2.4 Sky condition standards

12.2.4.1 Observations and reports

The following standards **shall** apply to observations and reports of sky condition:

1) Cloud amount and height of base **shall** be reported for each cloud layer or, if the sky is obscured, the observed vertical visibility **shall** be reported
2) If the observed layers aloft or vertical visibility height is between two reportable values, then the lower value **shall** be reported
3) If the observed cloud amount is between two reportable values, then the greater value **shall** be reported
4) When no clouds are detected beyond the limit of the automatic observing system, it **shall** be indicated by using the abbreviation `NCD` or `CLR`
5) When the sky is completely obscured, vertical visibility **shall** be observed and reported, where measured, in lieu of cloud amount, cloud type and height of cloud base
6) The reportable values of cloud base or vertical visibility into an obscuring layer **shall** be:
   a) in increments of 100 ft up to and including 10 000 ft
   b) in increments of 1 000 ft above 10 000 ft
7) For aerodromes, the cloud base height or vertical visibility into an obscuration **shall** be given with reference to the aerodrome elevation as published in the *Canada Flight Supplement*, except:
   a) when the height of the precision approach runway is 50 ft or more below aerodrome elevation
   b) local arrangements **shall** be made so that the height of cloud bases reported to arriving aircraft refers to the threshold elevation
   c) in the case of reports from offshore structures, when the height of cloud base **shall** be given above mean sea level

Note: ICAO/WMO recommend a maximum of 4 cloud layers

12.2.4.2 Instruments

Instruments used for the measurement of sky condition **shall** meet or exceed the following standards:

1) Instruments **shall** incorporate an algorithm that is equivalent to or better than the United States Federal Aviation Administration standard algorithm for ceilometers or demonstrate that an alternative method performs as well or better than this algorithm
2) Instruments **shall** use the aerodrome elevation as published in the *Canada Flight Supplement* as the reference elevation to compute cloud base height or vertical visibility
3) Instruments **shall** have accuracy such that the distance to a solid target is measured to within the greater of 100 ft or 5% up to 10 000 ft with a confidence level of at least 95%; and
    a) within one reportable value of the ceiling value reported by a clinical human observer at least 75% of the time up to and including 900 ft
    b) within two reportable values of the value of the base of the ceiling reported by a clinical human observer at least 70% of the time from 1 000 to 2 500 ft

12.2.4.3 Examples of sky condition remarks

When sky condition (cloud) data is missing: `CLD MISG`

12.2.5 Temperature and dew-point standards

12.2.5.1 Observations and reports

The following standards **shall** apply to observations and reports of temperature and dew-point:

1) Meteorological observations of temperature **shall** be accurate to within 1 °C
2) Meteorological observations of dew-point temperature **shall** be accurate to within 2 °C for dew-point temperatures ranging from –30 °C to +25 °C
3) The temperature **shall** be reported to the nearest whole degree Celsius, with observed values involving 0.5 °C being rounded up to the next warmer whole degree Celsius

12.2.5.2 Instruments

The accuracy requirements **shall** be demonstrated with at least a 95% confidence level during laboratory testing that is traceable to a reference standard.

12.2.5.3 Examples of temperature remarks

Remark to use when temperature data is missing: `T MISG`

Remark to use when dew-point temperature data is missing: `DP MISG`

12.2.6 Atmospheric pressure (altimeter setting) standards

12.2.6.1 Observations and reports

Meteorological observations of atmospheric pressure intended to be provided as meteorological reports of altimeter setting **shall** be measured by a digital barometer containing two or more independently sensors and that has quality checks that, in the event of sensor failure, prevent the report from being issued. A barometer for aviation purposes **shall** contain two or more independently operating sensors, each of which is traceable to a WMO primary standard barometer.

The following standards **shall** apply to reports of atmospheric pressure:

1) The calculated altimeter setting **shall** be:
   a) Computed from the station pressure using the International Civil Aviation Organization (ICAO) Standard Atmosphere and the aerodrome reference elevation in the *Canada Flight Supplement*
   b) Rounded downward to the nearest one hundredth inch of mercury for reporting purposes
   c) The computed sea level pressure **shall** be reported in observations so that the barometric pressures at stations of different elevations can be compared at a common level for synoptic purposes

12.2.6.2 Instruments

Instruments used for the measurement of pressure **shall** meet or exceed the following standards:

1) The sensors **shall** be installed and operated in accordance with the manufacturer's specifications, or equivalent specifications developed by the service provider
2) The sensors **shall** be accurate to within 0.02 inHg (inch of mercury)
3) The accuracy requirement **shall** be demonstrated with at least a 95% confidence level in laboratory testing

12.2.6.3 Examples of pressure remarks

Remark to use when pressure (altimeter) data is missing: `PRES MISG`

This remark is only added when the density altitude is 200 ft or higher than the aerodrome elevation: `DENSITY ALT XXXFT`

Remark to use when density altitude is missing: `DENSITY ALT MISG`

Remark to use when sea level pressure is missing: `SLP MISG`

12.2.6.4 Weather cameras

Most AUTO METAR locations have weather cameras installed to provide additional information. Those operated by NAV CANADA are referred to as WxCam in the Canada Flight Supplement (CFS). A number of web cameras have been installed at other aerodromes or at locations of interest to aviation. These web cameras, referred to as webcam in the CFS, may have differing performance characteristics and limitations. In order for these cameras to be advertised in the Flight Publications, the following **shall** apply:

a) An aviation weather service provider **shall** be identified that accepts responsibility for the provision of the camera service and **shall** provide notification to TC and NAV CANADA of changes to the service, including if they are discontinued, in accordance with the flight publication amendment procedures and the formal arrangements between private aviation weather service providers and NAV CANADA,

b) The images **shall** be clearly labelled with location, date, time the image was taken and the cardinal points in view,

c) Reference images, usable for each season and for day and night (where intended for use at night) **shall** be included showing a number of key distance markers that would be visible when visibility is not restricted, and

d) A summary of the performance characteristics of the camera service **shall** be documented and made available to users and, upon request, to TC

Note: The locations of NAV CANADA WxCam are depicted on their website. Information related to webcam not located at aerodromes must be obtained from the responsible service provider.

12.2.7 AUTO SPECI Standards for observations and reports

Each automated observation program providing METAR AUTO reports **shall** ensure that SPECI reports are reported upon changes in the weather, relative to the current report, in accordance with the following:

1) A SPECI is issued when the mean surface wind direction has shifted by 45° or more in less than 15 minutes and the wind speed at the end of the shift is at least 10 kt
2) A SPECI is issued when the two-minute mean wind speed increases by 10 kt or more
3) A SPECI is issued when the lesser of the vertical visibility into a totally obscuring surface based layer, or the height of the lowest broken or overcast layer aloft, decreases to less than, or if below, increases to equal or exceeds any of the following heights:
    a) 2 500 ft
    b) the threshold between IFR (Instrument Flight Rules) and VFR (Visual Flight Rules) ceiling 1 000 ft
    c) the aerodrome specific alternate minima for ceiling in accordance with the alternate weather requirements table in the most recent Canada Air Pilot
4) A SPECI is issued when a cloud layer aloft is observed below 1 000 ft and no cloud layer was reported below that height in the immediately preceding report
5) A SPECI is issued when visibility decreases to less than, or if below, increases to equal or exceeds:
    a) the no-alternate IFR limit, where applicable
    b) the threshold between IFR and VFR; (visibility 1 mi.)
    c) the aerodrome specific alternate minima for visibility in accordance with the alternate weather requirements table in the Canada Air Pilot
6) A SPECI is issued upon a change in the intensity of freezing precipitation
7) A SPECI is issued when hail, freezing fog, freezing rain, rain, snow, thunderstorms or heavy precipitation of any type begin or end
8) A SPECI is issued for the onset or cessation of precipitation of at least light intensity
9) A SPECI is issued for the onset or cessation of ice accretion
10) A SPECI is issued in accordance with any additional criteria as established and documented by the service provider

The service provider **shall** document the criteria used for the issuance of SPECI, in accordance with the applicable requirements of items 1) to 10) of this section.

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Chapter 13 Glossary of Terms

13.1 General information

This chapter provides definitions of terms used in this manual.

13.2 Glossary

13.2.1 Altimeter setting

The altimeter setting is a computed value of mean sea-level pressure expressed in inches and hundredths of mercury, which is used to set the sub-scale of an altimeter so that the height scale of the altimeter indicates the height of the instrument above mean sea level. Altimeter setting is done in accordance with the ICAO Standard Atmosphere.

13.2.2 ANS (Air Navigation Services)

Air navigation services is the term applied to the bundle of services provided to aircraft to enable safe and efficient flight from one destination to another.

13.2.3 CARs (*Canadian Aviation Regulations*)

The *Canadian Aviation Regulations* are a compilation of regulatory requirements designed to enhance safety and the competitiveness of Canadian aviation.

13.2.4 Climatological day

The climatological day summarizes the 24-hour period ending at 0600 UTC which contains all the following elements: the date, maximum and minimum temperature, maximum and minimum relative humidity, six-hour amount of precipitation, 24-hour amount (rainfall, snowfall, total precipitation), depth of snow on the ground, day with occurrence of thunderstorms, precipitation, obstructions to vision, and strong winds.

13.2.5 Funnel cloud or cold-air funnel

Funnel clouds, or (rarely) small, relatively weak tornadoes, can develop from a small shower or thunderstorm when the air aloft is unusually cold. Cold-air funnels typically do not reach the ground (funnel cloud), but when they do reach the ground as tornadoes, they are much less violent than the other types.

13.2.6 ICAO (International Civil Aviation Organization)

The International Civil Aviation Organization is a UN specialized agency, established by States in 1944 to manage the administration and governance of the *Convention on International Civil Aviation* (Chicago Convention). ICAO works with the Convention's 192 Member States and industry groups to reach consensus on international civil aviation "Standards And Recommended Practices" (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector.

13.2.7 ICAO station identifier

Four-letter identifier beginning with the letter "C", which identifies a Canadian weather observing station.

13.2.8 Mean sea level pressure

Mean sea level pressure is computed from the station pressure and reported in observations so that the barometric pressures at stations of different elevations can be compared at a common level for synoptic purposes.

13.2.9 Obstructions to vision

The following are types of obstructions to vision:

- **Blowing Dust or Blowing Sand**: This obstruction to vision consists of dust or sand, raised by the wind to moderate heights above the ground to reduce the horizontal visibility at eye level to 6 mi. or less
- **Blowing Snow**: This obstruction to vision consists of snow particles raised by the wind to sufficient heights above the ground to reduce the horizontal visibility at eye level to 6 mi. or less
- **Dust Haze**: This obstruction to vision is produced by the suspension in the air of dust or small sand particles, raised from the ground, prior to the time of observation, by a dust storm or sandstorm
- **Dust storm**: This obstruction to vision is produced by dust raised to great heights by a strong turbulent wind. The forward portion of the storm may have the appearance of a wide high wall
- **Dust/Sand Whirls**: This obstruction to vision, commonly known as a dust devil, consists of an ensemble of particles of dust or sand, sometimes accompanied by small litter, raised from the ground by the wind, in the form of a whirling column of varying height with a small diameter and an approximately vertical axis

- **Fog**: This obstruction to vision is formed by the suspension of very small water droplets or ice crystals in the air, reducing the visibility to ½ mi. or less at the earth's surface. The ice crystals in the fog may produce phenomena such as small haloes and luminous pillars around lights, the sun or the moon.
- **Freezing fog**: This obstruction to vision consists mainly of super-cooled droplets that usually deposit rime or glaze on objects or surfaces with below freezing temperatures. The definition of freezing fog is the same as for fog, except that it occurs when the temperature is in the range of -0.1 °C to -30.0 °C and the visibility is ½ mi. or less. It may be reported at temperatures colder than -30.0 °C when there is clear physical evidence of ice accretion from the fog and the visibility is ½ mi. or less.
- **Haze**: This obstruction to vision consists of a suspension of extremely small, dry particles invisible to the naked eye and sufficiently numerous to give the air an opalescent (milky or pearly) appearance
- **Mist**: The definition of mist is the same as for fog, except that mist reduces visibility to the range ⅝ mi. to 6 mi. inclusive
- **Fog covering part of aerodrome:** Consists of a fog bank or area of fog (or freezing fog) which may have small breaks, however within the area of fog at least 50% of the ground must be covered(see Appendix 2)
- **Fog patches**: Consists of fog extending to at least 1.5 m above ground level with a coverage of less than 50% of the ground normally visible from the observing point (see Appendix 2)
- **Shallow fog patches**: A suspension of very small water droplets in the air, reducing the visibility at the earth's surface, but not appreciably reducing the visibility at eye level (see Appendix 2)
- **Sandstorm**: This obstruction to vision is produced by sand raised to great heights by a strong turbulent wind. The forward portion of the storm may have the appearance of a wide high wall.
- **Smoke**: A suspension in the air of small particles produced by combustion
- **Volcanic Ash**: Volcanic ash consists of fine particles of rock powder that have been blown out from a volcano. The ash may remain suspended in the atmosphere for long periods, producing red sunsets thousands of kilometres away.

13.2.10 Other hydro-meteorological deposits

The following are other forms of hydro-meteorological deposits:

- **Dew**: This deposit forms when water is condensed on grass and other objects near the ground. The surface on which the dew forms has been cooled by radiation during the night, to a temperature below the dew-point of the surrounding air, but is still above freezing
- **Glaze**: This deposit is a coating of ice, generally clear and smooth, formed on exposed objects by the freezing of a film of super cooled water deposited by rain, drizzle, fog or possibly condensed from super cooled water vapour. Glaze is denser, harder and more transparent than either rime or frost.
- **Hoar frost**: This deposit, commonly called frost, forms when air with a dew-point temperature below freezing is brought to saturation by cooling. Hoar frost is a deposit of interlocking ice crystals formed by direct sublimation on objects, usually of small diameter, such as tree branches, plant stems, leaf edges, wires, and poles.
- **Rime**: This deposit is a white or milky and opaque "granular" deposit of ice formed by the rapid freezing of super-cooled water drops as they contact an exposed object

13.2.11 Pilot reports

Reports of weather conditions encountered by aircraft during flight. Any important atmospheric phenomenon encountered between reporting points should be reported, either immediately or appended to the position report given over the next reporting point. Pilot reports received by flight service personnel are relayed on meteorological communications circuits to weather offices and other air traffic service units. Pilot reports are no longer a part of MANOBS.

13.2.12 Precipitation

Any product of the condensation of atmospheric water vapour that is deposited on the earth's surface is a type of precipitation. The types of precipitation that originate aloft are classified under liquid precipitation, freezing precipitation, and frozen precipitation.

13.2.13 Precipitation (freezing)

The following are forms of freezing precipitation:

- **Freezing Drizzle**: Drizzle, the drops of which freeze on impact with the ground or with other objects at or near the earth's surface[1]
- **Freezing Rain**: Rain, the drops of which freeze on impact with the ground or with other objects at or near the earth's surface[1]

Note: It is of course assumed that the objects are not artificially heated above or cooled below the temperature of the ambient air.

13.2.14 Precipitation (frozen)

The following are forms of frozen precipitation:

- **Hail**: Precipitation of small balls or pieces of ice (hailstones) with a diameter ranging from 5 mm to 50 mm or sometimes more, and which fall either separately or fused into irregular lumps. Hailstones are composed almost exclusively of transparent ice, or of a series of transparent layers of ice at least 1 mm in thickness, alternating with translucent layers. Hail is generally observed during severe thunderstorms.
- **Small hail**: Precipitation of translucent ice particles that falls from a cloud. These particles are almost always spherical and sometimes have conical tips with a diameter smaller than 5 mm. Small hail consists of snow pellets totally or partially encased in a layer of ice. Gaps within the snow pellets are filled with ice, or ice and water. Small hail always occurs in showers from Cumulonimbus.
- **Ice Crystals**: A fall of non-branched ice crystals, in the form of needles, columns or plates, often so tiny that they seem to be suspended in the air. These crystals may fall from cloud or from a cloudless sky. The crystals are visible mainly when they glitter in the sunshine; they may then produce a luminous pillar or other halo. This hydrometeor, which is frequent in Polar Regions, occurs only at very low temperatures and in stable air masses. In WMO terminology, ice crystals are referred to as "diamond dust."
- **Ice Pellets**: Precipitation of transparent or translucent pellets of ice that are spherical or irregular, rarely conical, having a diameter of 5 mm or less.
    - Frozen raindrops, or snowflakes that have largely melted and then refrozen, the freezing process usually taking place near the ground (they generally fall as continuous precipitation)
- **Snow Grains**: Precipitation of very small white and opaque grains of ice. These grains are fairly flat or elongated; their diameter is generally less than 1 mm. When the grains hit hard ground, they do not bounce or shatter. They usually fall in very small quantities, mostly from Stratus or occasionally from fog, and never in the form of a shower.
- **Snow Pellets**: Precipitation of white and opaque particles of ice; these ice particles are either spherical or conical; their diameter is about 2 mm to 5 mm. Snow pellets are brittle and easily crushed; when they fall on hard ground, they bounce and often break up. Snow pellets always occur in showers and are often accompanied by snowflakes or rain drops, when the surface temperature is around 0 °C.
- **Snow**: Precipitation of mainly hexagonal ice crystals, most of which are branched (star-shaped). The branched crystals are sometimes mixed with unbranched crystals. At temperatures higher than about -5 °C, the crystals are generally clustered to form snowflakes

13.2.15 Precipitation (liquid)

The following are forms of liquid precipitation:

- **Drizzle**: Fairly uniform precipitation composed exclusively of fine drops of water (diameter less than 0.5 mm). Drizzle drops are too small to cause appreciable ripples on the surface of still water. The drops appear almost to float in the air, making visible even slight movements of the air. Drizzle falls from fairly continuous and dense layers of Stratus, usually low, sometimes even touching the ground (fog).
- **Rain**: Precipitation of liquid water particles, either in the form of drops of larger diameter than 0.5 mm, or of smaller widely scattered drops. Rain drops are normally larger than drops of drizzle; nevertheless, drops falling on the edge of a rain zone may be as small as drizzle drops, owing to partial evaporation.

13.2.16 Station elevation

The station elevation is the vertical distance in metres above Mean Sea Level (MSL) of the datum level to which barometer readings are corrected to give station pressure.

13.2.17 Thunderstorm

A thunderstorm is a local storm produced by a Cumulonimbus cloud, and is always accompanied by lightning and thunder, usually with strong gusts of wind, heavy rain, and sometimes with hail.

13.2.18 Tornadoes

Tornadoes are rotating columns of air, extending from the base of a cumuliform cloud (usually Cumulonimbus), and often visible as a condensation funnel in contact with the ground, and/or attendant circulating dust or debris cloud at the ground.

13.2.19 Waterspouts

Waterspouts are tornadoes that occur over water. They are normally a relatively small, weak rotating column of air over open water below a Cumulonimbus or Cumulus congestus (towering Cumulus) cloud.

13.2.20 Visibility reduced below eye level

Drifting dust (DRDU), **drifting sand** (DRSA) and **drifting snow** (DRSN) are phenomena which reduce visibility below eye level. When particles of dust, sand or snow are raised by the wind in such a quantity that very low objects are veiled or hidden and yet the visibility at eye level is not appreciably restricted, the phenomenon is referred to as drifting dust, drifting sand or drifting snow, respectively.

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Part B Standards for synoptic observations and reports

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Chapter 14 The synoptic code—general description

14.1 General information

This chapter provides a general description of the international meteorological code FM 12-XIV Ext. SYNOP. The symbolic form of the synoptic code is given, followed by general operational details for reporting synoptic surface weather observations from land stations.

14.1.1 Purpose of synoptic reports

Weather recognizes no international boundaries. A precise synoptic picture of weather conditions over a vast area of the earth's surface is required in order to provide national and international forecasts and climatological data to satisfy the needs of aviation, agriculture, industry and the public. As a first step in meeting these requirements, surface weather reports are prepared and exchanged throughout the world in an international code developed and agreed upon by member states of the World Meteorological Organization (WMO). Such reports are made at least four times daily and a complete report may contain over 20 pieces of information including measurements of atmospheric pressure, calculated from barometer readings taken at precisely the same time throughout the world, i.e., 0000 UTC, 0600 UTC, 1200 UTC and 1800 UTC. These observations are referred to as synoptic observations.

14.2 The synoptic code

The international meteorological code "FM 12-XIV Ext. SYNOP" is used for reporting synoptic surface weather observations from a land station, either staffed or automatic. The common synoptic code comprises six sections numbered 0 to 5, each of which is primarily composed of five-figure code groups. Most groups in sections 0 to 5 begin with a numerical indicator and these indicators are numbered consecutively within each section. The numerical indicators identify a specific group which always contains the same weather elements. Thus the omission, whether accidental or deliberate, of any one group will not affect the identification of other groups. Indeed, provision is made within the code for omission of groups when their weather elements are either not present or cannot be observed. This also ensures that the code is flexible enough for both staffed and automatic stations.

14.2.1 Symbolic form of the synoptic code

Within a given five-figure code group, the relative position of each code figure, denoting a specific weather element, is constant; thus the synoptic code can be represented symbolically as depicted below.

Note (1): Groups enclosed in square brackets [ ] are not reported in Canada.

Note (2): Symbols shown in bold in the symbolic form are included verbatim as part of the message whenever the relevant group is included in the message. All other symbols are replaced by appropriate data as applicable.

Section 0

SYNOP $M_iM_iM_jM_j$ $YYGGi_w$ $IIiii$

Section 1

i_Ri_xhVV $Nddff$ $(00fff)$ **1**s_nTTT **2**$s_nT_dT_dT_d$ **3**$P_0P_0P_0P_0$ **4**$PPPP$ **5**$appp$ **6**$RRRt_R$ **7**wwW_1W_2 **8**$N_hC_LC_MC_H$ **9**$GGgg$

Section 2 (not reported by land stations)

Section 3

333 [**0**$C_SD_LD_MD_H$] **1**$s_nT_xT_xT_x$ **2**$s_nT_nT_nT_n$ [**3**$Ejjj$] **4**$E'sss$ [**5**$EEEi_E$] [**55**SSS $j_5F_{24}F_{24}F_{24}F_{24}$] **6**$RRRt_R$ **7**$R_{24}R_{24}R_{24}R_{24}$ [**8**$N_sCh_sh_s$] **9**$S_PS_Ps_ps_p$

Section 4 (not reported in Canada)

Section 5

555 **1**$ssss$ **2**$s_ws_ws_ws_w$ **3**$d_md_mf_mf_m$ **4**$f_hf_tf_tf_i$

14.2.2 Interpretation of the symbols

Details and interpretation of each code group and their respective symbols are given in Chapter 15. However, only those sections and code groups which apply to Canadian surface weather observing program standards are detailed.

14.2.3 Content of the coded synoptic message

Main synoptic messages from land stations will normally consist of sections 0, 1, and 3. While some groups are mandatory and must be reported in each synoptic message, other groups may be omitted, depending on specified conditions. At land stations, the communications computer will normally insert the first two groups of Section 0; the observer will code and transmit the remainder of the message. Descriptions of mandatory and optional groups as well as detailed coding instructions follow in Chapter 15.

14.2.3.1 Message separation signal (=)

The message separation signal = **shall** be included as the last character of the last group of each reported synoptic message. The separation signal is always added to the last data group without a space intervening; thus the last group of the reported synoptic message will consist of six characters.

14.2.3.2 Missing data

Elements of missing data are recorded by means of an "X". When entering a synoptic report on a computer or communication system for transmission, replace an "X" with a solidus "/".

14.2.4 Observing schedule

The times of the main synoptic reports are 0000, 0600, 1200 and 1800 UTC. In all cases, the barometer **shall** be read at the hour. The observing, recording and coding of all elements, except the pressure and tendency, should be done in the 10 minutes preceding the hour. In difficult weather it may be necessary to begin 15 minutes before the hour in order to be ready to read the barometer at the hour. All stations **shall** conform to this schedule of observing, unless special permission to deviate is obtained from the ADM.

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Chapter 15 The synoptic code—detailed description

15.1 General information

This chapter provides a detailed description of the international meteorological code FM 12-XIV Ext. SYNOP. A description and the symbolic form of sections 0, 1, 3, and 5 of the synoptic code are provided, followed by section content. Within each section's code group, a detailed interpretation of all particular symbols is given. Detailed descriptions of Section 2 and Section 4 of the synoptic code are both omitted as these sections are, respectively, not used by surface weather stations and not used within Canada.

15.2 Section 0—Reporting identification and units of wind speed used

In the case of land stations (SYNOP report), Section 0 contains the station identifier. It also contains a message type identifier group and a date-time-wind indicator group which is reported once at the beginning of a synoptic message bulletin.

15.2.1 Symbolic form

SYNOP $M_iM_iM_jM_j$ $YYGGi_w$ IIiii

15.2.2 Section content

Section 0 is mandatory for all synoptic reports. For land stations, $M_iM_iM_iM_i$ and $YYGGi_w$ will normally be coded and inserted by the communications computer, whereas IIiii will always be coded by the observer. Other groups in Section 0 are for the identification and location of sea stations, and are not used by land stations.

15.2.3 Interpretation of group $M_iM_iM_jM_j$

This group identifies what type of message is being reported. It is the first group of the second line of the message header. This group is inserted by the communications computer in the message header for identification of synoptic bulletins and is encoded AAXX for synoptic reports from land stations.

15.2.4 Interpretation of group $YYGGi_w$

This group is inserted by the communications computer as the second group of the second line of the message header of a synoptic bulletin originating from a land station.

15.2.4.1 YY—Day of the month (UTC)

The symbol YY indicates the day of the month on which the observation is made.

Note: The date associated with the 0000 UTC observation is that for the day just beginning, not for the day that just ended.

15.2.4.2 GG—Hour of the observation (UTC)

The symbol GG indicates the actual time of the observation to the nearest synoptic hour UTC.

15.2.4.3 i_w—Wind indicator

The symbol i_w indicates whether the wind speed is estimated or is measured by means of an anemometer, and whether the wind speed as reported in the message is in units of metres per second, or knots. Table 15—1 specifies code figures used for indicating the source and units of wind speed. The communications computer will insert the code figure 4 for i_w at Canadian land stations.

Table 15—1: WMO code table 1855—Specification of code figures for i_w

Code figure	Specification
0	Wind speed estimated (metres per second)
1	Wind speed obtained from anemometer (metres per second)
3	Wind speed estimated (knots)
4	Wind speed obtained from anemometer (knots)

15.2.5 Interpretation of group IIiii

15.2.5.1 II—Block number

All Canadian land stations use 71 or 73 for the block number.

15.2.5.2 iii—Station number

The station number is found in METSTAT (Meteorological Stations of Canada).

15.3 Section 1—Reporting data for global exchange

Section 1 contains data for international as well as regional and national exchange.

15.3.1 Symbolic form

$i_R i_x hVV$ Nddff (00fff) $1s_nTTT$ $2s_nT_dT_dT_d$ $3P_0P_0P_0P_0$ 4PPPP 5appp $6RRRt_R$ $7wwW_1W_2$ $8N_hC_LC_MC_H$ 9GGgg

15.3.2 Section content

Standards for inclusion of groups in Section 1 are as follows:

1) Groups $i_R i_x hVV$, Nddff, $1s_nTTT$, $2s_nT_dT_dT_d$, 3P0P0P0P0, 4PPPP and 5appp **shall** always be included
2) Group 00fff **shall** be included only if wind speed equals or exceeds 99 kt
3) Group $6RRRt_R$ **shall** always be included in the message
4) Group $7wwW_1W_2$ **shall** be included only if present or past weather of significance is observed
5) Group $8N_hC_LC_MC_H$ **shall** be included only if clouds are observed

15.3.3 Interpretation of group $i_R i_x hVV$

15.3.3.1 i_R—Precipitation group indicator

The symbol i_R is an indicator to show whether or not the precipitation group $6RRRt_R$ is included in the message and, if included, in what section of the message it appears. Table 15—2 **shall** be used to specify the code figure for i_R.

Table 15—2: WMO code table 1819—Specification of code figures for i_R

Code figure	Precipitation data are reported:	Group $6RRRt_R$
0	In Sections 1 and 3	Included in both sections. Not used in Canada
1	In Section 1	Included
2	In Section 3	Included
3	In neither Sections 1 or 3	Omitted (precipitation amount = 0). Not used in Canada
4	In neither Sections 1 or 3	Omitted (precipitation amount not normally measured)

Code figures 0 and 3 are not used for i_R in Canada. At stations normally measuring precipitation, the group $6RRRt_R$ is always included in Section 1 with i_R being encoded 1 at main synoptic hours. At stations normally measuring precipitation, the group $6RRRt_R$ is always included in Section 3 with i_R being encoded 2 at intermediate synoptic hours.

15.3.3.2 i_x—Station type indicator

The symbol i_X indicates whether the synoptic message has originated from a staffed or an automatic station and, secondly, whether or not the present and past weather group, $7wwW_1W_2$, is included. Table 15—3 **shall** be used to specify the code figure for i_R.

Table 15—3: WMO code table 1860—Specification of code figures for i_x

Code figure	Type of station operation	Group $7wwW_1W_2$
1	Staffed	Included
2	Staffed	Omitted (no significant phenomenon to report)
3	Staffed	Omitted (not observed, data not available)
4	Automatic	Included using code tables 4677 and 4561
5	Automatic	Omitted (no significant phenomenon to report)
6	Automatic	Omitted (not observed, data not available)
7	Automatic	Included using Code tables 4680 and 4531

Note (1): Currently automatic stations do not use indicator $i_x = 4$; they normally use indicator $i_x = 5$, 6, or 7.

Note (2): Insignificant weather phenomena referred to by code figure 2 are defined in 15.3.12.3.

15.3.3.3 h—Base of lowest cloud

The symbol h indicates the height above ground of the base of the lowest cloud observed. When C_L clouds exist, the height of the base of the lowest layer is reported by h. When no C_L clouds exist, h is coded with reference to the height of the base of the lowest C_M cloud. Table 15—4 **shall** be used to specify code figures for h.

Table 15—4: WMO code table 1600—Specification of code figures for h

Code figure	Cloud height (m)	Cloud height (ft)	Coded cloud heights (hourly reports)
0	0 to less than 50	0 to less than 200	0, 1
1	50 m to less than 100	200 ft to less than 400	2, 3
2	100 m to less than 200	300 ft to less than 700	4, 5, 6
3	200 m to less than 300	700 ft to less than 1000	7, 8, 9
4	300 m to less than 600	1000 ft to less than 2000	10 to19
5	600 m to less than 1000	2000 ft to less than 3400	20 to 33
6	1000 m to less than 1500	3400 ft to less than 5000	34 to 49
7	1500 m to less than 2000	5000 ft to less than 6700	50 to 66
8	2000 m to less than 2500	6700 ft to 8300	67 to 83
9	Greater than 2500 or no cloud	Greater than 8300 or no cloud	Greater than 83 or SKC
/	Sky completely obscured	Sky completely obscured	Sky completely obscured

Note (1): If coded cloud height in the hourly report does not fit within the adjacent range of metric heights because of rounding, give precedence to the actual cloud height in selecting the code for h rather than the coded value of the hourly report.
Example: Cloud height 290 m: Code as 10 in hourly report; code h as 3 in synoptic report.

Note (2): When C_H clouds are observed without C_L or C_M clouds being present, h must always be coded as 9.

Note (3): If the sky is partially obscured by fog or other obscuring phenomena, h refers to the base of the lowest cloud observed, if any.

Note (4): If the sky is completely obscured, h is recorded as /; however, if the sky is completely obscured and clouds are visible below the obscuration, h is reported as observed.
Example: if the sky is completely obscured by snow in which the vertical visibility is 300 m and ⅛ of Stratus Fractus is observed at 150 m the coding for h would be 2.

15.3.3.4 VV—Visibility

The symbol VV is used to indicate visibility. Table 15—5 **shall** be used to specify code figures for VV.

Table 15—5: WMO code table 4377—Specification of code figures for VV

Code figure	Visibility (mi.)	Code figure	Visibility (mi.)	Code figure	Visibility
00	0	62	8	90	< 55 yd.
02	1/8	64	9	91	55 yd.
04	1/4	66	10	92	220 yd.
06	3/8	67	11	93	550 yd.
08	1/2	69	12	94	0.5 NM
10	5/8	70	13	95	1 NM
12	3/4	72	14	96	2 NM
16	1	74	15	97	5 NM
20	1 1/4	80	19	98	11 NM
24	1 1/2	81	22	99	≥ 27 NM
28	1 3/4	82	25	–	–
32	2	83	28	–	–
36	2 1/4	84	32	–	–
40	2 1/2	85	35	–	–
48	3	86	38	–	–
56	4	87	41	–	–
58	5	88	44	–	–
59	6	89	More than 44	–	–
61	7	–	–	–	–

Note (1): Code figure 90 to 99 cannot be used except on special instructions from ADM.

Note (2): When an hourly and a synoptic observation are taken at the same time and prevailing visibility is 15+, VV must be reported as code 74.

Note (3): If the visibility recorded falls between two code figures, use the lower code figure. Thus, 20 mi. must be coded as 80, 30 mi. as 83, etc.

15.3.4 Interpretation of group Nddff

15.3.4.1 N—Total cloud amount

The symbol N indicates the fraction of the celestial dome covered by clouds, irrespective of their type. Table 15—6 **shall** be used to specify the code figures for N corresponding to the fraction of the celestial dome covered by clouds in oktas.

Table 15—6: WMO code table 2700—Specification of code figures for N and N_h

Code figure	Specification
0	0
1	1 okta or less, but not zero
2	2 oktas
3	3 oktas
4	4 oktas
5	5 oktas
6	6 oktas
7	7 oktas or more, but not 8 oktas
8	8 oktas
9	Sky completely obscured by fog and/or other meteorological phenomena.
/	Cloud cover is indiscernible for reasons other than fog or other meteorological phenomena, or observation is not made.

15.3.4.1.1 Instructions for coding N when the sky is partially obscured by a surface-based layer

Normally N **shall** be coded with reference to total amount. However, because of some differences in the procedures for coding hourly and synoptic observations, some further instructions are necessary as indicated in the paragraphs that follow.

When blue sky or stars are seen through a layer of fog or other obscuring phenomenon without any trace of cloud above this layer, N is reported as 0.

If clouds are seen through fog or other obscuring phenomenon, their amount **shall** be evaluated as though the obscuration did not exist. In other words, partial obscuration may be disregarded and N is determined by considering that portion of the sky which is not obscured to be the entire sky.

Example (1): The sky is partially concealed by fog. In the portion that is not concealed, there are equal parts of blue sky and cloud; the code for N would be 4 (4 oktas) in each case (i.e., in coding N the sky is considered to be half covered by cloud)

Example (2): The sky is partially concealed or obscured by snow. The observer notes that the remainder of the sky is 20% clear and 80% cloud covered. In coding N the sky is considered to be 80% covered by cloud; hence the code for N would be 6.

Example (3): The observer reports only a trace of cloud. Total amount is 0, but since cloud is present, the code for N would be 1.

Example (4): The sky is partially concealed by blowing snow. In the portion that is not concealed, there is no cloud. The code for N would be 0 (i.e., in coding N the sky is considered to be clear).

With a mackerel sky (AC or SC perlucidus), breaks between the cloud elements always exist. Hence, even though these clouds extend over the whole celestial dome, the total amount **shall** be reported as N = 7 or less.

N = 9 **shall** be reported when the sky is completely concealed by an obscuring phenomenon, either surface-based or aloft. This instruction also applies when:

- clouds cover part of the sky below the vertical visibility or below an obscuring layer aloft
- clouds are present below the extent of vertical visibility in a surface-based layer which has a summation amount of 8/8

Persistent condensation trails and cloud masses which have obviously developed from condensation trails **shall** be reported as cloud and considered when coding the cloud amount, N. Rapidly dissipating condensation trails **shall not** be considered in coding N.

If the sky is partially obscured by a surface-based layer, the code for N may be obtained from Table 15—7. Determine the total amount of cloud and the total amount of sky being obscured in oktas. After determining these values, use the left side of the table for the total amount of cloud and move to the right until the value of the sky obscured is reached. The figure obtained is the code figure.

Table 15—7: Specification of code figures for N and N_h when the sky is partially obscured by a surface-based layer

Total amount of cloud (oktas)	Amount of sky obscured (oktas)							
	–	**1**	**2**	**3**	**4**	**5**	**6**	**7**
0	0	0	0	0	0	0	0	0
1	1	1	2	2	3	4	8	
2	2	3	3	4	5	8	–	
3	3	4	5	6	8	–	–	
4	5	5	6	8	–	–	–	
5	6	7	8	–	–	–	–	
6	7	8	–	–	–	–	–	
7	8	–	–	–	–	–	–	

15.3.4.2 dd—Mean wind direction

The symbol dd indicates the 10-minute mean direction referred to true north from which the wind is blowing, expressed in tens of degrees on a scale from 00 to 36. Code figures 00 are used when the wind is calm. Code 01 = N 10° E (010°), and so on in ten degree steps through 09 = East (090°), 18 = South (180°), 27 = West (270°), around to 36 = North (360°). 99 = Variable direction (not used when the wind speed is more than 5 kt). Table 15—8 **shall** be used to specify code figures for dd.

Table 15—8: WMO code table 0877—Specification of code figures for dd

Code figure	Degrees	Direction
00	Calm	Calm
01	005° – 014°	N
02	015° – 024°	NNE
03	025° – 034°	NNE

Code figure	Degrees	Direction
04	035° – 044°	NE
05	045° – 054°	NE
06	055° – 064°	ENE
07	065° – 074°	ENE
08	075° – 084°	E
09	085° – 094°	E
10	095° – 104°	E
11	105° – 114°	ESE
12	115° – 124°	ESE
13	125° – 134°	SE
14	135° – 144°	SE
15	145° – 154°	SSE
16	155° – 164°	SSE
17	165° – 174°	S
18	175° – 184°	S
19	185° – 194°	S
20	195° – 204°	SSW
21	205° – 214°	SSW
22	215° – 224°	SW
23	225° – 234°	SW
24	235° – 244°	WSW
25	245° – 254°	WSW
26	255° – 264°	W
27	265° – 274°	W
28	275° – 284°	W
29	285° – 294°	WNW
30	295° - 304°	WNW
31	305° - 314°	NW
32	315° - 324°	NW
33	325° - 334°	NNW
34	335° - 344°	NNW
35	345° - 354°	N
36	355° - 004°	N
99	Wind direction variable	Variable

Note: dd = 99 cannot be used.

15.3.4.3 ff—Mean wind speed

The symbol ff indicates the 10-minutes mean speed of the wind in knots. When the wind is calm, ff is coded 00. If the wind speed equals or exceeds 99 kt (which may occur in a hurricane) ff is coded 99 and the additional group 00fff is added immediately following Nddff (see 15.3.5). Table 15—9 is provided for conversion of miles per hour to knots.

Note: Table 15—9 is not reversible.

Table 15—9: Conversion of miles per hour to knots

Miles per hour	+0 mph	+1 mph	+2 mph	+3 mph	+4 mph	+5 mph	+6 mph	+7 mph	+8 mph	+9 mph
0 mph	0 kt	1 kt	2 kt	3 kt	3 kt	4 kt	5 kt	6 kt	7 kt	8 kt
10 mph	9 kt	10 kt	10 kt	11 kt	12 kt	13 kt	14 kt	15 kt	16 kt	17 kt
20 mph	17 kt	18 kt	19 kt	20 kt	21 kt	22 kt	23 kt	23 kt	24 kt	25 kt
30 mph	26 kt	27 kt	28 kt	29 kt	30 kt	30 kt	31 kt	32 kt	33 kt	34 kt
40 mph	35 kt	36 kt	36 kt	37 kt	38 kt	39 kt	40 kt	41 kt	42 kt	43 kt
50 mph	43 kt	44 kt	45 kt	46 kt	47 kt	48 kt	49 kt	50 kt	50 kt	51 kt
60 mph	52 kt	53 kt	54 kt	55 kt	56 kt	56 kt	57 kt	58 kt	59 kt	60 kt
70 mph	61 kt	62 kt	63 kt	63 kt	64 kt	65 kt	66 kt	67 kt	68 kt	69 kt
80 mph	70 kt	70 kt	71 kt	72 kt	73 kt	74 kt	75 kt	76 kt	76 kt	77 kt
90 mph	78 kt	79 kt	80 kt	81 kt	82 kt	83 kt	83 kt	84 kt	85 kt	86 kt
***100 mph**	87 kt	–	–	–	–	–	–	–	–	–

For example: 10 mph = 9 kt; 11 mph = 10 kt; 34 mph = 30 kt; 35 mph = 30 kt; 110 mph* = (87 kt + 9 kt) = 96 kt

15.3.5 Interpretation of group 00fff

This supplementary group is included in all synoptic reports when the wind speed, in the units indicated by i_w, is 99 or more. The group, when required, **shall** be included immediately following the Nddff group.

15.3.5.1 00—Indicator figure

The symbol 00 indicates that the 00fff group is included in the synoptic report.

15.3.5.2 fff—Wind speed, in units indicated by i_w, of 99 units or more

When the synoptic speed is 99 kt or more, the fff of the 00fff group **shall** contain the actual wind speed and the ff of the Nddff group **shall** be coded as 99.

Examples:
An east wind of 118 kt **shall** be coded: N0999 00118
A south wind of 99 kt **shall** be coded: N1899 00099

15.3.6 Interpretation of group $1s_nTTT$

15.3.6.1 1—Numerical indicator figure

The figure 1 indicates that group $1s_nTTT$ is included in the report.

15.3.6.2 s_n—Indicator of whether temperatures are positive or negative

The symbol s_n indicates whether temperatures are positive or negative. It is coded as follows:

- $s_n = 0$: temperature is 0 °C, or positive (above 0 °C)
- $s_n = 1$: temperature is negative (below 0 °C)

15.3.6.3 TTT—Dry-bulb temperature

The symbol TTT indicates the dry-bulb temperature in tenths of a degree Celsius. Code the absolute value of the temperature for TTT as read, filling in a zero for the tens and units digit, if required. Examples are given in Table 15—10.

Table 15—10: Examples of dry-bulb temperature coded for $1s_nTTT$

Temperature (°C)	s_n	TTT	$1s_nTTT$
15.3	0	153	10153
-15.3	1	153	11153
4.5	0	045	10045
-0.9	1	009	11009
0.0	0	000	10000

15.3.7 Interpretation of group $2s_nT_dT_dT_d$

15.3.7.1 2—Numerical indicator figure

The figure 2 indicates that group $2s_nT_dT_dT_d$ is included in the report.

15.3.7.2 s_n—Indicator of whether temperatures are positive or negative

The symbol s_n indicates whether temperatures are positive or negative. It is coded as follows:

- $s_n = 0$: temperature is 0 °C, or positive (above 0 °C)
- $s_n = 1$: temperature is negative (below 0 °C)

15.3.7.3 $T_dT_dT_d$—Dew-point temperature

The symbol $T_dT_dT_d$ indicates the dew-point temperature in degrees and tenths of a degree Celsius. Code the absolute value of the dew-point for $T_dT_dT_d$, filling in a zero for the tens and units digit, as required. Examples are given in Table 15—11.

Table 15—11: Examples of dew-point temperature coded for $2s_nT_dT_dT_d$

Dew-point temperature (°C)	s_n	$T_dT_dT_d$	$2s_nT_dT_dT_d$
12.1	0	121	20121
-10.0	1	100	21100
1.9	0	019	20019
-0.1	1	001	21001
0.0	0	000	20000

15.3.8 Interpretation of group $3P_0P_0P_0P_0$

This group **shall** be included in main synoptic reports only.

15.3.8.1 3—Numerical indicator figure

The figure 3 indicates that group $3P_0P_0P_0P_0$ is included in the report.

15.3.8.2 $P_0P_0P_0P_0$—Air pressure at station level

Obtain the station pressure and code directly if the station pressure is less than 1000.0 hPa, omitting the decimal point.

Table 15—12: Examples of coding for $P_0P_0P_0$ when station-level pressure is less than 1 000.0 hPa

Station pressure (hPa)	$3P_0P_0P_0P_0$
987.2	39872
964.3	39643
999.0	39990

If the station pressure is 1000.0 hPa or greater, code $3P_0P_0P_0P_0$ by omitting the thousands digit and record the hundreds, tens, units, and tenths digits directly, omitting the decimal point.

Table 15—13: Examples of coding for $P_0P_0P_0P_0$ when station-level pressure is more than 1000.0 hPa

Station pressure (hPa)	$3P_0P_0P_0P_0$
1000.0	30000
1012.4	30124
1004.2	30042

15.3.9 Interpretation of group 4PPPP

15.3.9.1 4—Numerical indicator figure

The figure 4 indicates that group 4PPPP is included in the report.

15.3.9.2 PPPP—Air pressure at mean sea-level

The symbol PPPP indicates mean sea-level air pressure in tenths of a hectopascal. When sea-level pressure is less than 1 000 hPa, record and use all four digits. When sea-level pressure is 1 000 hPa or more, omit the thousands digit and record the hundreds, tens, units, and tenths digits directly. The decimal is always omitted.

Table 15—14: Examples of how to code sea-level pressure for PPPP

Sea-level pressure (hPa)	4PPPP
996.2	49962
1015.4	40154

15.3.10 Interpretation of group 5appp

This group **shall** be included whenever the three-hourly pressure tendency is available.

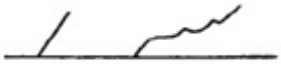
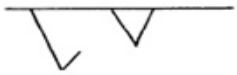
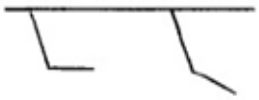
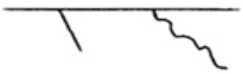
15.3.10.1 5—Numerical indicator figure

The figure 5 indicates that group 5appp is included in the report.

15.3.10.2 a—Characteristic of the tendency

The symbol a indicates the characteristic of pressure tendency during the three-hour period preceding the time of observation. The three-hour characteristic **shall** be obtained from the pressure trace and coded in accordance with Table 15—15.

Table 15—15: WMO code table 0200—Specification of code figures for [a]

Code figure	Graphic representation	Characteristic	Atmospheric pressure
0		Increasing, then decreasing	Same as or higher than three hours ago
1		Increasing, then steady; or increasing then increasing more slowly	Higher than three hours ago
2		Increasing (steadily or unsteadily)	Higher than three hours ago
3		Decreasing or steady, then increasing; or increasing then increasing more rapidly	Higher than three hours ago
4		Steady	Same as three hours ago
5		Decreasing, then increasing	Same as or lower than three hours ago
6		Decreasing, then steady; or decreasing, then decreasing more slowly	Lower than three hours ago
7		Decreasing (steadily or unsteadily)	Lower than three hours ago
8		Steady or increasing, then decreasing; or decreasing, then decreasing more rapidly	Lower than three hours ago

15.3.10.3 ppp—Net amount of atmospheric pressure change

The symbol ppp indicates the net amount of pressure tendency change during the three hours preceding the time of observation, expressed in tenths of a hectopascal. Obtain the three-hour tendency amount, and code directly for ppp inserting a zero in place of the tens digit if the amount is less than 10 hPa, and two zeros in the places of the tens and units digits if the amount is less than 1 hPa. Always omit the decimal point.

Table 15—16: Examples of how to code net pressure change for ppp

Net three-hour pressure change (hPa)	ppp
11.2	112
9.3	093
0.8	008

15.3.11 Interpretation of group $6RRRt_R$

This group **shall** always be included in main and intermediate synoptic reports, unless otherwise directed by the Regional Director General (see 15.3.3.1on the use of the symbol i_R) on the use of the symbol i_R).

15.3.11.1 6—Numerical indicator figure

The figure 6 indicates that group $6RRRt_R$ is included in the report.

15.3.11.2 RRR—Amount of precipitation

The symbol RRR indicates the amount of precipitation which has fallen during the period preceding the time of observation, as indicated by t_R. Amounts are usually for a six-hour period at the main synoptic observation and a three-hour period at the intermediate observation. Six-hour amounts and three-hour amounts **shall** be obtained from an intermediate reading of the standard rain gauge (see 15.5.7.2).

Table 15—17 **shall** be used to specify code figures for RRR.

Table 15—17: WMO code table 3590—Specification of code figures for RRR

Code figure	Specification
000	0 mm
001	1 mm
002	2 mm
988	988 mm
989	989 or more mm
990	Trace
992	0.2 mm
993	0.3 mm
994	0.4 mm
995	0.5 mm
996	0.6 mm
997	0.7 mm
998	0.8 mm
999	0.9 mm
///	Precipitation not measured

Note (1): Code figure 991 which is used to indicate precipitations of 0.1 mm is not shown in Table 15—17 because this code is not to be used in Canada.

Note (2): Precipitation amounts which are greater than 1.0 mm have to be rounded to the nearest whole millimetre prior to coding.

Note (3): When precipitation amounts are normally measured but are not available for the current report, RRR will be coded as /// (three solidi).

15.3.11.3 t_R—Duration of period of reference

The symbol t_R indicates the duration of period of reference for amount of precipitation, ending at the time of the report. Table 15—18 **shall** be used to specify code figures for t_R.

Table 15—18: WMO code table 4019—Specification of code figures for t_R

Code figure	Specification
1	Total precipitation during the 6 hr preceding the observation.
2	Total precipitation during the 12 hr preceding the observation.
3	Total precipitation during the 18 hr preceding the observation.
4	Total precipitation during the 24 hr preceding the observation.
5	Total precipitation during the 1 hr preceding the observation
6	Total precipitation during the 2 hr preceding the observation.
7	Total precipitation during the 3 hr preceding the observation.
8	Total precipitation during the 9 hr preceding the observation.
9	Total precipitation during the 15 hr preceding the observation.

Note (1): At stations where main synoptic observations and precipitation measurements are made every six hours, t_R must be coded as 1.

Note (2): At stations where fewer than four main synoptic observations are made daily, code figures 2 to 4 may be used for t_R.

Note (3): At stations where intermediate synoptic observations are taken and reported, the 6-group must be included, using code figures 5 to 9 for t_R.

15.3.12 Interpretation of group $7wwW_1W_2$

This group **shall** be included only if present and/or past weather phenomena of significance are observed. The 7-group is omitted when weather of no significance is observed (when ww may be coded 00, 01, 02, or 03 and past weather code figures 0, 1 or 2 apply).

15.3.12.1 7—Numerical indicator figure

The figure 7 indicates that group $7wwW_1W_2$ is included in the report.

15.3.12.2 ww—Present weather

The term "present weather" refers to the atmospheric phenomena that are occurring at the time of observation, or which have occurred during the hour (60 minutes) preceding the time of observation. The atmospheric phenomena reported for present weather include precipitation (rain, drizzle, hail, etc.), obstructions to vision (fog, mist, haze, smoke, dust storm, sandstorm, drifting and blowing snow, and dust whirls), squalls, thunderstorms, lightning, and funnel clouds. Proper usage of the present weather ww codes requires a complete knowledge of "Definitions and Descriptions of Meteors" as given in the *International Cloud Atlas*.

Codes 00 to 49 (inclusive) of the symbol ww are used to code present weather when there is no precipitation at the station at the time of observation.

Codes 50 to 99 (inclusive) of the symbol ww are used to code present weather when precipitation is occurring at the station at the time of observation. Codes 50 to 99 are used not only to indicate the type of precipitation but also the intensity (light, moderate or heavy), and the character (continuous, intermittent or showery).

The first figure of the ww code corresponds to the ten principal categories of weather. Firstly, the decade most suitable to the general state of the weather is chosen; then, from that decade, the code figure is chosen which best describes the weather at the time of observation or during the one-hour period immediately preceding it (where specifically mentioned in the code).

When deciding on a decade or in determining the complete code figure for ww, do not take into account meteorological phenomena experienced more than one hour before the official time of observing the weather (with the exception of thunder, which may have been heard up to 75 minutes before the official time of the weather observation, see ww codes 29 and 91 to 94).

If more than one specification of the ww codes is applicable, the highest code figure is chosen, except that code 17 **shall** be given preference over codes 20 to 49.

Note: If a tornado is at or within sight of a station at the time of observation or within the past hour, the plain language word "TORNADO" must be recorded and transmitted as the last group of Section 3. A tornado may also be reported in the $7wwW_1W_2$ group simultaneously if ww = 19 is the highest present weather code applicable at the time. This coding applies to both main and intermediate synoptic reports, if applicable.

Figure 15—1 is a graphic guide in which priority is indicated by the relative position of the block. This guide may be used to assist in the selection of codes for present weather. An abbreviated description of each of the code figures follows the chart.

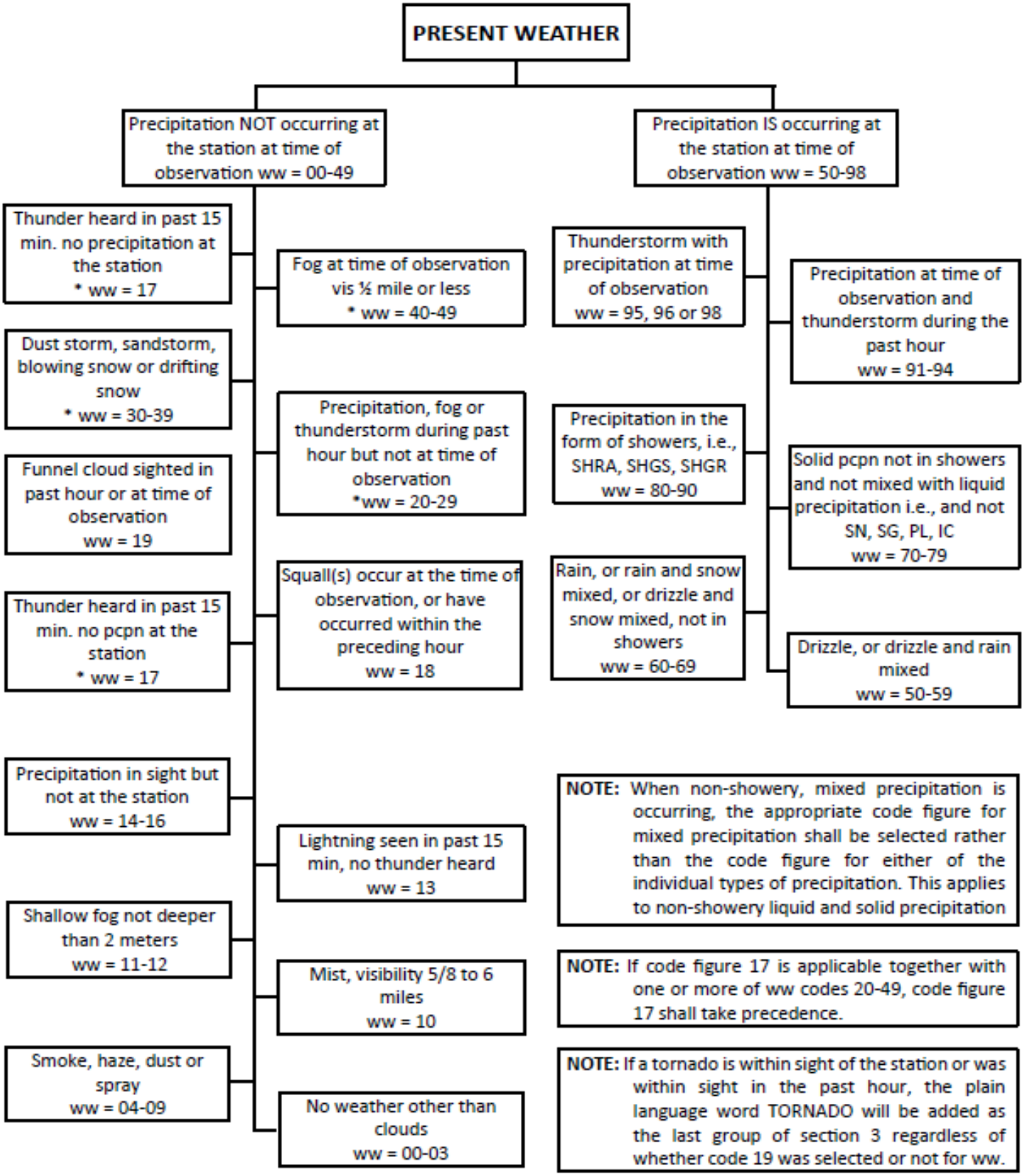


Figure 15—1: Chart for assisting in the selection of codes for present weather

15.3.12.2.1 WMO code table 4677—General description of present weather code figure ww

Code figures 00, 01, 02, and 03 represent phenomena of little significance. When these code figures are applicable for ww, combined with a code figure of 2 or less for past weather (W_1W_2), then ww is neither recorded nor transmitted, see 15.3.12.

Code figures 00, 01, 02 and 03 describe the general trend of changes in the state of the sky during the hour preceding the time of observation. The development (shown by increasing vertical extent or thickening) or dissolution (shown by decreasing vertical extent or thinning) is the most important factor that must be considered when choosing the most suitable number. The variation in sky cover is less important and should be used as the criterion when there is no general development or dissolution observable (ww = 00, 01 and 02 can each be used when the sky is clear at the time of observation). In this case, the following interpretation **shall** apply:

- 00: when the preceding conditions are not known
- 01: when the clouds have dissolved during the past hour
- 02: when the sky has been continuously clear during the past hour

Present weather code figures normally refer to the weather occurring at the time of observation. The following present weather codes are applicable to the one-hour period preceding the official time of observation: ww = 00, 01, 02, 03, 18, 19, 20 to 28, 30 to 35, and 40 to 47. Codes 29 and 90 to 94 apply for a period of up to 1 hr and 15 minutes preceding the official time of observation.

Although specifications for 04, 05 and 06 do not require visibility limits, smoke, haze and dust are usually associated with visibilities of 6 mi. or less. Specifications for 07 and 10 require that the visibility be restricted to 6 mi. or less.

Code figures 20 to 27 and 29 **shall** never be used when precipitation is occurring at the station at the time of observation.

Code figures 80 to 90 are used only when the precipitation is showery in character and is occurring at the station at the time of observation.

The expressions "during the past hour" and "during the preceding hour" used in the ww code table refer to the full hour (60 minutes) preceding the official time at which the weather is observed for the synoptic observation.

15.3.12.2.2 WMO code table 4677—Detailed specification of present weather code figure WW

Note: Throughout the detailed descriptions in this section, the term "slight," when referring to precipitation intensity, must be considered to mean light.

Code figure 00 **shall** be used when the cloud development during the preceding hour is unknown or has not been observed.

Code figure 01 **shall** be used when the clouds have shown a tendency to dissolve or to decrease in vertical development during the preceding hour (e.g. code figure 01 is applicable to the decrease of fine weather Cumulus late in the day).

Code figure 02 **shall** be used when there has been no appreciable change in the state of the sky during the preceding hour.

Code figure 03 **shall** be used when the clouds have shown a tendency to form or develop during the preceding hour (e.g. this figure is applicable when cumulus clouds are forming and also when fair weather Cumulus is developing into Cumulus Congestus).

Code figure 04 **shall** be used when the prevailing visibility is restricted by smoke (e.g. forest fire, industrial smoke or volcanic ash).

Code figure 05 **shall** be used when the obstruction to vision consists of lithometeors, generally known as "haze."

Code figure 06 **shall** be used when the prevailing visibility is restricted by dust suspended in the air, not raised by wind.

Code figure 07 **shall** be used when blowing dust or blowing sand is observed at or near the station at the time of observation and the prevailing visibility is observed to be not more than 6 mi., but no well-developed dust whirl(s) or sand whirl(s) and no dust storm or sandstorm is seen.

Code figure 08 **shall** be used when well developed dust whirls or sand whirls are seen at or near the station during the preceding hour or at the time of observation, but no dust storm or sandstorm.

Code figure 09 **shall** be used when a dust storm or sandstorm is within sight at the time of observation or has occurred at the station during the preceding hour and the estimated or observed visibility in the dust storm or sandstorm is/was less than ⅝ mi.

Code figure 10 **shall** be used when mist (e.g. fog or freezing fog) is observed and the prevailing visibility is 6 mi. or less but not less than ⅝ mi.

Code figure 11 **shall** be used when patches of shallow fog or freezing fog are observed at the station at the time of observation. The depth of the fog **shall not** restrict visibility at eye level; however, the fog must be dense enough so that the apparent visibility in the fog is less than ⅝ mi.

Code figure 12 **shall** be used when more or less continuous shallow fog or freezing fog is observed at the station at the time of observation. The depth of the fog **shall not** restrict visibility at eye level; however, the fog must be dense enough so that the apparent visibility in the fog is less than ⅝ mi. Code figure 12 **shall** be used in preference to code figure 11 when shallow fog is observed to cover more than half of the ground normally visible.

Code figure 13 **shall** be used when lightning is seen at the time of observation or within 15 minutes preceding the time of observation, but no thunder is heard.

Code figure 14 **shall** be used to report Virga (i.e. precipitation within sight, but not reaching the ground or the surface of the sea).

Code figure 15 **shall** be used when precipitation is within sight and is reaching the ground or the surface of the sea, at an estimated distance of more than 3 mi. from the station.

Code figure 16 **shall** be used when precipitation is within sight and is reaching the ground or the surface of the sea, at an estimated distance of 3 mi. or less from the station, but not at the station.

Code figure 17 **shall** be used when thunder is heard at the time of observation, or within 15 minutes preceding the time of observation, and no precipitation is occurring at the station at the time of observation.[1]

Note (1): Whenever ww can be coded 17, this code figure must be given preference over code figures 20 to 49.

Code figure 18 **shall** be used when squalls occur at the time of observation, or have occurred within the preceding hour.

Code figure 19 **shall** be used when a funnel cloud, waterspout, or tornado is within sight of the station at the time of observation or was observed during the preceding hour. In the case of a tornado, the plain language word "TORNADO" **shall** be recorded and transmitted as the last group of Section 3, whether or not ww is encoded as 19.

Code figure 20 **shall** be used when drizzle or snow grains have occurred at the station during the preceding hour, but are not occurring at the time of observation. If freezing drizzle has occurred during the preceding hour, use code figure 24.

Code figure 21 **shall** be used when rain (not rain showers) has occurred at the station during the preceding hour, but is not occurring at the time of observation. If freezing rain has occurred during the preceding hour, use code figure 24.

Code figure 22 **shall** be used when snow (not snow showers) or ice crystals have occurred at the station during the preceding hour, but are not occurring at the time of observation.

Code figure 23 **shall** be used when mixed rain and snow, or ice pellets have occurred at the station during the preceding hour but are not occurring at the time of observation.

Code figure 24 **shall** be used when freezing rain (non-showery) or freezing drizzle has occurred at the station during the preceding hour, but is not occurring at the time of observation.

Code figure 25 **shall** be used when a rain shower has occurred at the station during the preceding hour, but is not occurring at the time of observation.

Code figure 26 **shall** be used when a snow shower or a shower of rain and snow has occurred at the station during the preceding hour, but is not occurring at the time of observation.

Code figure 27 **shall** be used when a shower of hail, or of hail and rain, has occurred at the station during the preceding hour, but is not occurring at the time of observation. For purposes of reporting code figure 27, hail may be considered to mean any one, or any combination of hail or, snow pellets.

Code figure 28 **shall** be used when fog or freezing fog, with visibility less than ⅝ mi. has occurred at the station during the preceding hour, but is not occurring at the time of observation.

Code figure 29 **shall** be used when a thunderstorm with or without precipitation, has occurred at the station during the preceding hour, but neither thunder nor precipitation is occurring at the time of observation. This requires that the last thunder be heard 15 minutes or more before the time of observation. For purposes of reporting this code figure, the "preceding hour" is from 1 hour and 15 minutes ago to 15 minutes ago.

Code figure 30 **shall** be used when a dust storm or sandstorm is occurring at the station at the time of observation, the intensity of the phenomenon has decreased during the past hour, and the visibility is less than ⅝ mi. but not less than 5/16 mi.[3]

Code figure 31 **shall** be used when a dust storm or sandstorm is occurring at the station at the time of observation, the intensity has shown no appreciable change during the past hour, and the visibility is less than ⅝ mi. but not less than 5/16 mi.[3]

Code figure 32 **shall** be used when a dust storm or sandstorm is occurring at the station at the time of observation, the phenomenon has begun or increased in intensity during the past hour, and the visibility is less than ⅝ mi. but not less than 5/16 mi.[3]

Code figure 33 **shall** be used when a dust storm or sandstorm is occurring at the station at the time of observation, the intensity of the phenomenon has decreased during the past hour, and the visibility is less than 5/16 mi.[3]

Code figure 34 **shall** be used when a dust storm or sandstorm is occurring at the station at the time of observation, the intensity has shown no appreciable change during the past hour, and the visibility is less than 5/16 mi.[3]

Code figure 35 **shall** be used when a dust storm or sandstorm is occurring at the station at the time of observation, the phenomenon has begun or increased in intensity during the past hour, and the visibility is less than 5/16 mi.[3]

Code figure 36 **shall** be used when drifting snow of light or moderate intensity is occurring at the station at the time of observation.[2]

Code figure 37 **shall** be used when heavy drifting snow is occurring at the station at the time of observation.[2]

Note (2): No quantitative criterion is given for determining the intensity of drifting snow. Observers must use their own judgment in reporting ww = 36 or 37, keeping in mind that drifting snow does not affect visibility at eye level, regardless of intensity.

Code figure 38 **shall** be used when blowing snow is occurring at the station at the time of observation, and the visibility is 5/16 mi. or more.[3]

Code figure 39 **shall** be used when blowing snow is occurring at the station at the time of observation, and the visibility is less than 5/16 mi.[3]

Note (3): In using codes 30 to 35 and 38 and 39, an observed visibility of 5/16 mi. is used as a threshold value. A prevailing visibility of exactly 5/16 mi., because it is exactly half-way between two reportable values, would be coded as ¼ mi., or VV = 04.

Code figure 40 **shall** be used when a bank of fog or freezing fog estimated to be more than 2 m in depth is observed at a distance from the station at the time of observation but not at the station during the preceding hour. The observer must estimate that the visibility appears to be restricted in the fog to less than 5/8 mi. to justify the use of ww = 40.

Code figure 41 **shall** be used when fog or freezing fog, more than 2 m deep, is occurring in patches at the time of observation, and the prevailing visibility is restricted to less than ⅝ mi.

Code figure 42 **shall** be used when fog or freezing fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is visible, and the fog has become thinner during the past hour.

Code figure 43 **shall** be used when fog or freezing fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is not visible, and the fog has become thinner during the past hour.

Code figure 44 **shall** be used when fog or freezing fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is visible, and the fog has shown no appreciable change in intensity during the past hour.

Code figure 45 **shall** be used when fog or freezing fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is not visible, and the fog has shown no appreciable change in intensity during the past hour.

Code figure 46 **shall** be used when fog or freezing fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is visible, and the fog has begun or become thicker during the past hour.

Code figure 47 **shall** be used when fog or freezing fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is not visible, and the fog has begun or become thicker during the past hour.

Code figure 48 **shall** be used when fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is visible, and the fog is depositing rime.

Code figure 49 **shall** be used when fog is occurring at the station at the time of observation, the visibility is less than ⅝ mi., the sky is not visible, and the fog is depositing rime.

Code figure 50 or 51 **shall** be used when slight drizzle is occurring at the station at the time of observation:

- code figure 50 **shall** be used when the drizzle is intermittent
- code figure 51 **shall** be used when the drizzle is continuous

Code figure 52 or 53 **shall** be used when moderate drizzle is occurring at the station at the time of observation:

- code figure 52 **shall** be used when the drizzle is intermittent
- code figure 53 **shall** be used when the drizzle is continuous

Code figure 54 or 55 **shall** be used when heavy drizzle is occurring at the station at the time of observation:

- code figure 54 **shall** be used when the drizzle is intermittent
- code figure 55 **shall** be used when the drizzle is continuous

Code figure 56 or 57 **shall** be used when freezing drizzle is occurring at the station at the time of observation:

- code figure 56 **shall** be used when the freezing drizzle is slight
- code figure 57 **shall** be used when the freezing drizzle is moderate or heavy

Code figure 58 **shall** be used when drizzle and rain are occurring together at the station at the time of observation, and both types of precipitation are of slight intensity.

Code figure 59 **shall** be used when drizzle and rain are occurring together at the station at the time of observation, and either the rain, or the drizzle, or both, are of moderate or heavy intensity.

Code figure 60 or 61 **shall** be used when slight rain is occurring at the station at the time of observation:

- code figure 60 **shall** be used when the rain is intermittent
- code figure 61 **shall** be used when the rain is continuous

Code figure 62 or 63 **shall** be used when moderate rain is occurring at the station at the time of observation:

- code figure 62 **shall** be used when the rain is intermittent
- code figure 63 **shall** be used when the rain is continuous

Code figure 64 or 65 **shall** be used when heavy rain is occurring at the station at the time of observation:

- code figure 64 **shall** be used when the rain is intermittent
- code figure 65 **shall** be used when the rain is continuous

Code figure 66 or 67 **shall** be used when freezing rain is occurring at the station at the time of observation:

- code figure 66 **shall** be used when the freezing rain is slight
- code figure 67 **shall** be used when the freezing rain is moderate or heavy

Code figure 68 **shall** be used when snow, accompanied by drizzle or freezing drizzle, or by rain or freezing rain, is occurring at the station at the time of observation and each of the precipitation types is of slight intensity.[4]

Code figure 69 **shall** be used when snow, accompanied by drizzle or freezing drizzle, or by rain or freezing rain, is occurring at the station at the time of observation and at least one of the precipitation types is of moderate or heavy intensity.[4]

Note (4): For the purpose of reporting code figures 68 and 69, the term "snow" must include ice pellets.

Code figure 70 or 71 **shall** be used when slight snow, in flakes, is occurring at the station at the time of observation:

- code figure 70 **shall** be used when the snow is intermittent
- code figure 71 **shall** be used when the snow is continuous

Code figure 72 or 73 **shall** be used when moderate snow, in flakes, is occurring at the station at the time of observation:

- code figure 72 **shall** be used when the snow is intermittent
- code figure 73 **shall** be used when the snow is continuous

Code figure 74 or 75 **shall** be used when heavy snow, in flakes, is occurring at the station at the time of observation:

- code figure 74, when the snow is intermittent
- code figure 75, when the snow is continuous

Code figure 76 **shall** be used when ice crystals (diamond dust) are occurring at the station at the time of observation, whether or not fog or freezing fog is present at the same time.

Code figure 77 **shall** be used when snow grains are occurring at the station at the time of observation, whether or not fog or freezing fog is present at the same time.

Code figure 78 **shall** be used when isolated star-like snow crystals are occurring at the station at the time of observation, whether or not fog or freezing fog is present at the same time.

Code figure 79 **shall** be used when ice pellets are occurring at the station at the time of observation.

Code figure 80 **shall** be used when slight rain showers are occurring at the station at the time of observation.

Code figure 81 **shall** be used when moderate or heavy rain showers are occurring at the station at the time of observation.

Code figure 82 **shall** be used when exceptionally heavy or torrential rain showers are occurring at the station at the time of observation.[5]

Note (5): Such showers occur only occasionally in temperate regions, and observers should use their own judgment in deciding whether the showers are heavy enough to justify the use of code figure 82.

Code figure 83 **shall** be used when showers of mixed rain and snow are occurring at the station at the time of observation, and both types are slight.

Code figure 84 **shall** be used when showers of mixed rain and snow are occurring at the station at the time of observation, and either one or both of the precipitation types are moderate or heavy.

Code figure 85 **shall** be used when showers of slight snow are occurring at the station at the time of observation.

Code figure 86 **shall** be used when showers of moderate or heavy snow are occurring at the station at the time of observation.

Code figure 87 **shall** be used when showers of slight snow pellets or small hail, with or without rain, or rain and snow mixed, are occurring at the station at the time of observation.

Code figure 88 **shall** be used when moderate or heavy showers of snow pellets or small hail, with or without rain, or rain and snow mixed, are occurring at the station at the time of observation.

Code figure 89 **shall** be used when showers of slight hail, with or without rain, or rain and snow mixed, not accompanied by thunder, are occurring at the station at the time of observation.

Code figure 90 **shall** be used when showers of moderate or heavy hail, with or without rain, or rain and snow mixed, not accompanied by thunder, are occurring at the station at the time of observation.

Thunderstorm during past hour, but not at time of observation

Code figure 91 **shall** be used when slight rain is occurring at the station at the time of observation, and a thunderstorm has occurred during the preceding hour, but is not occurring at the time of observation.[6]

Code figure 92 **shall** be used when moderate or heavy rain is occurring at the station at the time of observation, and a thunderstorm has occurred during the preceding hour, but is not occurring at the time of observation.[6]

Code figure 93 **shall** be used when snow, or rain and snow mixed, or hail, or snow pellets are occurring at the station at the time of observation, and a thunderstorm has occurred during the preceding hour, but is not occurring at the time of observation. This code figure **shall** be used when the precipitation type or types are of slight intensity.[6]

Code figure 94 **shall** be used when snow, or rain and snow mixed, or hail, or snow pellets are occurring at the station at the time of observation, and a thunderstorm has occurred during the preceding hour, but is not occurring at the time of observation. This code figure **shall** be used when one or more of the precipitation types are of moderate or heavy intensity.[6]

Note (6): Regarding codes 91 to 94 inclusive:

- the time of hearing the last thunder must be at least 15 minutes, but not more than 1 hr and 15 minutes before the official time of observation
- these codes refer to either showery or non-showery precipitation at time of observation

Thunderstorm in progress at time of observation

Code figure 95 **shall** be used when a thunderstorm accompanied by rain or snow is occurring at the station at the time of observation.[7, 8]

Code figure 96 **shall** be used when a thunderstorm accompanied by hail or snow pellets is occurring at the station at the time of observation. Rain or snow may occur along with the hail, etc.[7]

Code figure 97 is no longer used in Canada.

Code figure 98 **shall** be used when a thunderstorm, accompanied by a dust storm or sandstorm, is occurring at the station at the time of observation (precipitation occurring). Under these circumstances, the precipitation may not be visible, and the observer must judge whether precipitation is actually occurring.[7, 8]

Code figure 99 is no longer used in Canada.

Note (7): Thunderstorm at the station is considered to be in progress whenever either of the following criteria apply:

- thunder is heard within the 15 minutes preceding the official time of observation
- overhead lightning is observed within the 15 minutes preceding the official time of observation, and the local noise level might prevent hearing thunder (in this case, hail may also be an indicator of a thunderstorm in progress)

Note (8): Codes 95 and 98 allow showery or non-showery precipitation at time of observation.

15.3.12.3 W_1W_2—Past weather

The symbol W_1W_2 indicates the past weather at the station and duration of weather and obstructions to vision as well as other items of previous observations. Two types of past weather may be selected. The highest applicable code figure is assigned to W_1 and the second highest to W_2. Table 15—19 **shall** be used to specify code figures for W_1W_2.

Table 15—19: WMO code table 4561—Specification of code figures for W_1W_2

Code figure	Specification
0	Cloud covering ½ or less of the sky (N ≤ 4) throughout the appropriate period
1	Cloud covering more than ½ of the sky during part of the appropriate period and covering ½ or less during part of the period
2	Cloud covering more than ½ of the sky (N > 4) throughout the appropriate period
3	Sandstorm, dust storm or blowing snow (prevailing visibility less than ⅝ mi.)
4	Fog, freezing fog or thick haze (prevailing visibility less than ⅝ mi.)
5	Drizzle, or freezing drizzle
6	Rain, or freezing rain
7	Snow, or rain and snow mixed (SN, RASN, SG, PL, IC)
8	Shower(s) (SHRA, SHSN, SHGS, SHGR)
9	Thunderstorm(s) with or without precipitation

15.3.12.3.1 Period covered by W_1W_2

The period covered by W_1W_2 normally begins at the actual time of observation of the previous synoptic report and ends at the time the present weather (ww) began and so will cover a maximum of 6 hr for main synoptics.

15.3.12.3.2 Break in weather during period covered by W_1W_2

If during the period covered by W_1W_2 there has been a break in the weather watch exceeding 30 minutes which, in the considered opinion of the observer, makes a reasonable assessment of past weather impossible, W_1W_2 may be recorded as XX.

15.3.12.3.3 Requirement to give a complete description

The code figures for W_1 and W_2 **shall** be selected in such a way that W_1W_2 and ww together give as complete a description as possible of the weather in the time interval concerned, based on their significance according to WMO code tables 4677 and 4561.

15.3.12.3.4 Using W_1W_2 and ww together to give a complete description

The standard for using W_1W_2 and ww to give a complete description of the present and past weather is as follows:

1) If the type of weather undergoes a complete change during the time interval concerned, the code figures selected for W_1 and W_2 **shall** describe the weather prevailing before the type of weather indicated by ww began.
2) If only one type of weather has been occurring throughout the whole period, use that one type for ww, W_1, and W_2.
3) If more than one type of weather has been occurring throughout the whole period, after selecting ww, select the most significant type of past weather
   a) ensure that the selection for W_1 is different from ww, though they may be occurring simultaneously
4) After selecting the first past weather type, select another past weather type for W_2 that is different, if possible, from the first past weather type (W_1) that has occurred during the past weather period
   a) if more than one code figure may be given to past weather, the highest figure **shall** be reported for W_1 and the second highest applicable code figure **shall** be reported for W_2
   b) if only one type of past weather has occurred during the past weather period, encode W_1 and W_2 the same

Note: If precipitation has been continuous at the station throughout the past weather period, do not use codes 0, 1, or 2 for either W_1 or W_2.

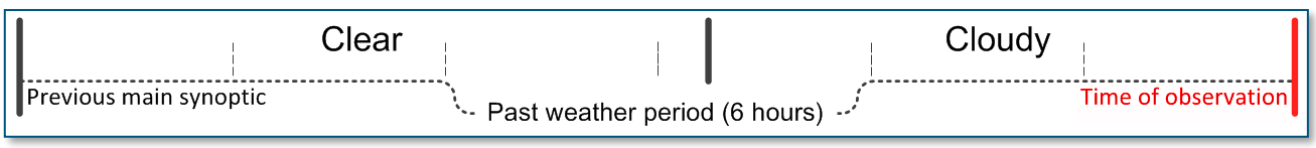
15.3.12.3.5 Examples of how to code for $7wwW_1W_2$

The 7-group gives a qualitative rather than quantitative picture of the weather during the past weather period. It generally does not give the sequence or duration of weather events, unless ww, W_1 and W_2 are all coded the same, in which case only one type of weather has prevailed throughout the period.

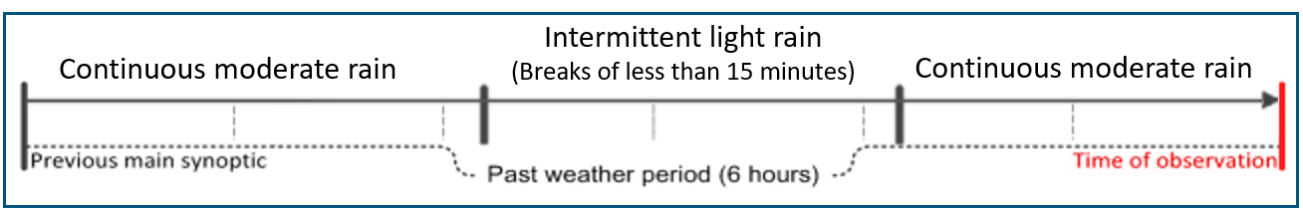
The following examples, shown graphically, of weather conditions during a "past weather" period of six hours illustrate how the rules are applied when coding W_1 and W_2. The proper coding of ww and W_1 and W_2 is given for each example. These examples, where appropriate, also illustrate the coding of the special phenomena group $909R_td_c$ in Section 3 of the synoptic code (see 15.5.9.3).

Users of the 7-group code should be aware that decoding ambiguities are possible. In examples 5 and 6 below, different weather sequences give rise to similar code sequences. Note how W_1 in these examples differs with respect to duration of the snow and rain.

Example (1): Group $7wwW_1W_2$ not included (no weather of significance).

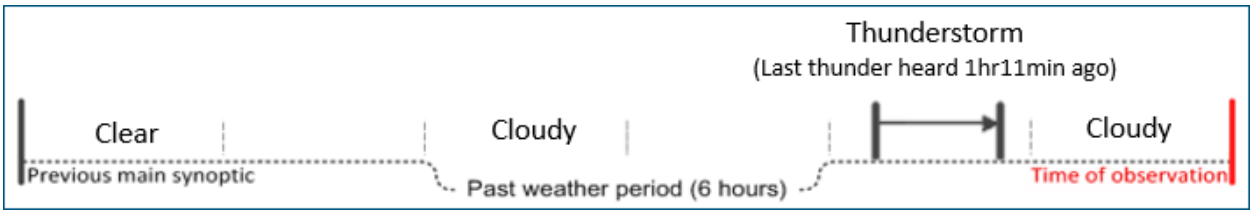


Example (2): $ww = 65$; $W_1 = 6$; $W_2 = 6$



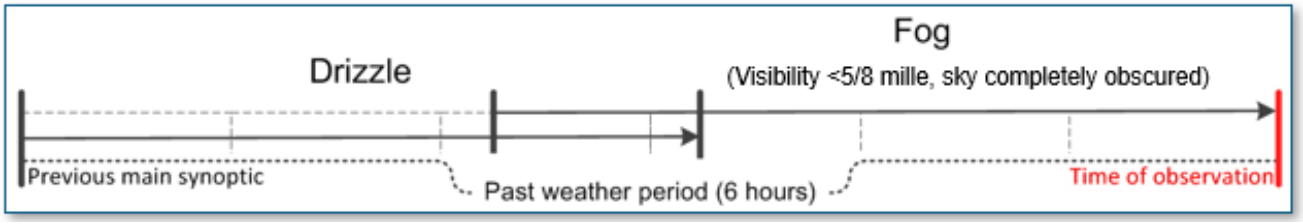
Note: The report of rain in ww, W_1 and W_2, shows that rain has been continuous throughout the entire weather period with no periods of break of 15 minutes or more and no other past weather type has occurred. Group $909R_td_c$ is coded 90973.

Example (3): ww = 29; W_1 = 1; W_2 = 1



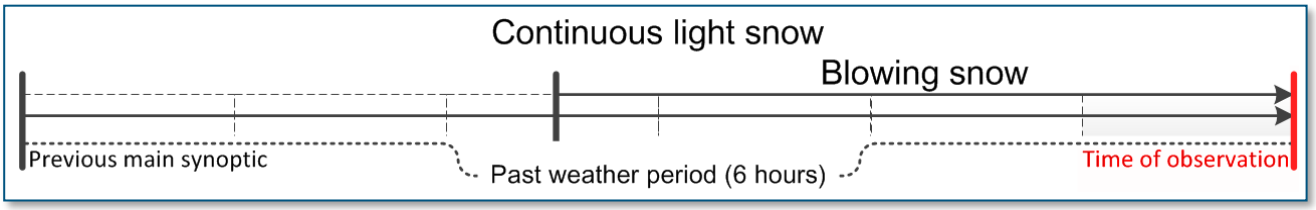
Note: With the last thunder heard 1hr11 minutes ago, the thunderstorm was within 75 minutes (1hr15min) of the main synoptic hour. ww = 29 since the hour before would still be considered within a thunderstorm period and with no other weather to report, the clouds covering more than half the sky for part of the period and less than half during another part would mean coding W_1W_2 = 1. Group $909R_td_c$ is omitted since no precipitation was recorded.

Example (4): ww = 45; W_1 = 5; W_2 = 5



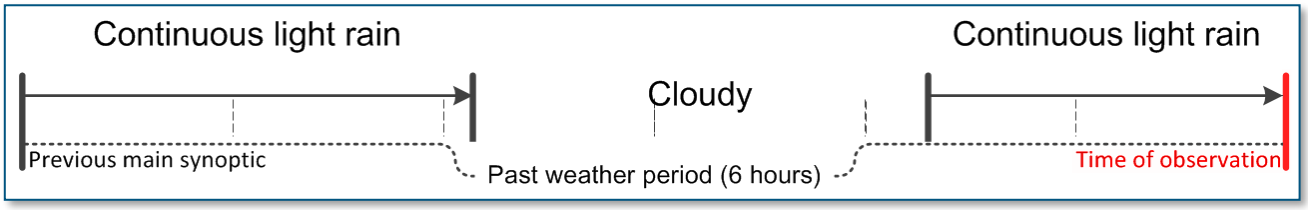
Note: Present weather is sky completely obscured, visibility < ⅝ mi. in fog for the past hour or more, so ww is encoded 45. W_1 and W_2 are used to report the weather prevailing before ww (fog) began, i.e., drizzle, and are thus encoded 55. Group $909R_td_c$ is coded 90932.

Example (5): ww = 71; W_1 = 7; W_2 = 3



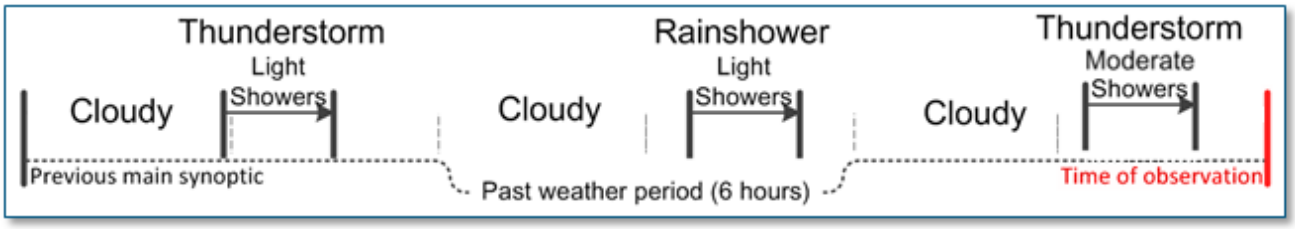
Note: In addition to continuous light snow throughout the period, blowing snow is the only other reportable weather type. If the snowfall began at the time of the previous main synoptic hour, group $909R_td_c$ would be coded 90972.

Example (6): ww = 61; W_1 = 6; W_2 = 2



Note: Group 909$R_t d_c$ is coded 90927 which indicates that the rain reported by ww and W_1 are separate occurrences.

Example (7): ww = 29; W_1 = 9; W_2 = 8

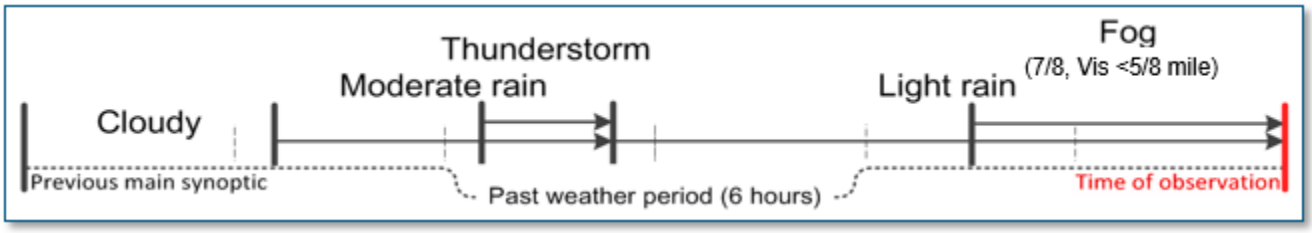


Note: The past weather consists of occasional thunderstorms with showers and cloudy sky. The highest past weather code figure is assigned to thunderstorms, so W_1 is coded 9, and W_2 is coded 8. Group 909$R_t d_c$ is coded 90916, which indicate that the thunderstorm and the rain showers reported by ww and W_2 are separate occurrences.

Example (8): ww = 29; W_1 = 8; W_2 = 2

Note: The thunderstorm and showers, which ended in the past hour. The highest code figure applicable to present weather would be ww = 29. The other weather conditions consisted of showers and the cloudy skies prevailing since the thunderstorm ended. The highest past weather code figure is assigned to showers, so W_1 is coded 8, and W_2 is coded 2. Group 909$R_t d_c$ is coded 90931, which indicate the time the showers began since it ended in the past hour. Refer to 15.5.9.3.1 para 1).

Example (9): ww = 61; W_1 = 9; W_2 = 4

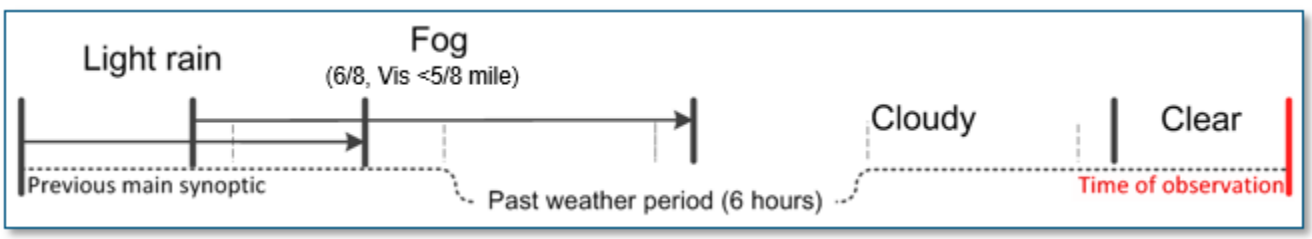


Note: Group 909$R_t d_c$ is coded 90952.

Example (10): ww = 61; W_1 = 8; W_2 = 1

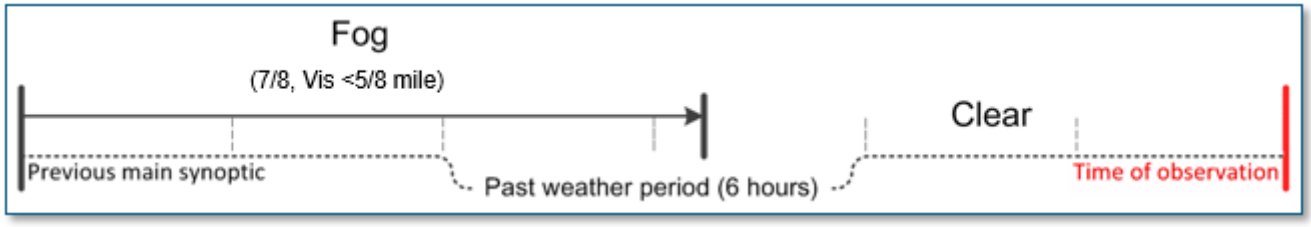
Note: Group 909$R_t d_c$ is coded 90936.

Example (11): ww = 01; W_1 = 6; W_2 = 4



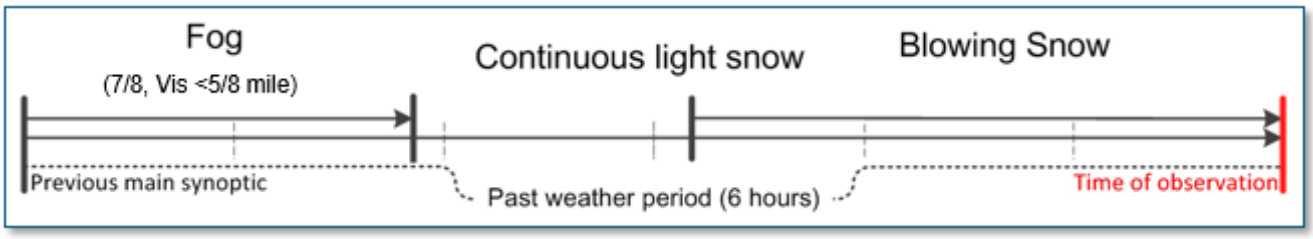
Note: The clouds have generally dissolved in the past hour, so ww is coded 01. In the past weather code, rain has a higher code figure than fog, therefore W_1 is coded 6 and W_2 is coded 4. Group 909$R_t d_c$ is coded 90951.

Example (12): ww = 02; W_1 = 4; W_2 = 4



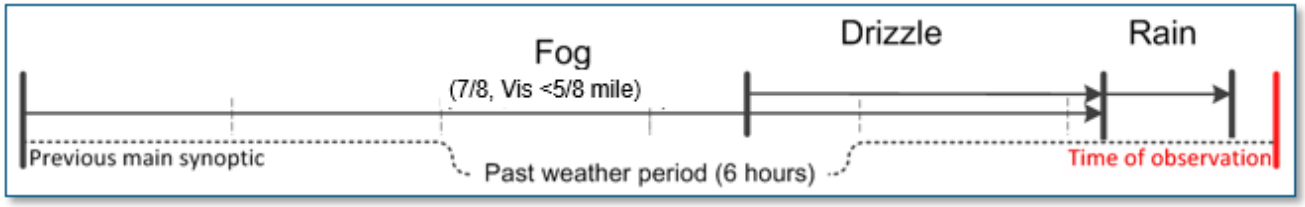
Note: The clear skies during the hour preceding the time of observation are reported by ww = 02. The significant weather necessitating the encoding of the 7-group is the fog in the past weather. Since fog was the only weather type prevailing before the weather reported by ww, both W_1 and W_2 are encoded 4.

Example (13): ww = 71; W_1 = 4; W_2 = 3



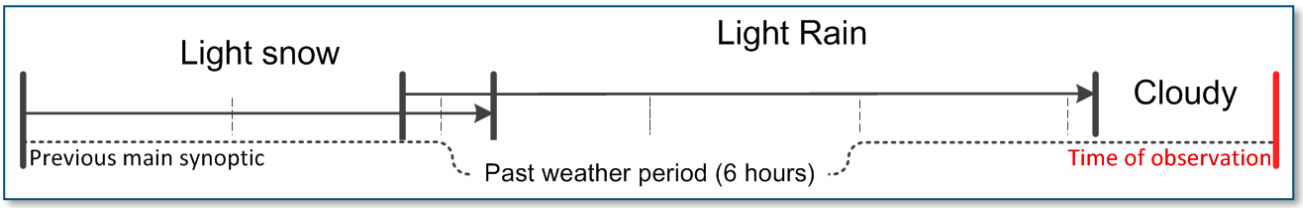
Note: Although the light snow has been falling continuously throughout the period, it is not repeated in W_1 and W_2 because of the occurrence of two other weather types that are coded. Group $909R_td_c$ is coded 90973 and this indicates that the snow reported by ww has been continuous throughout the period.

Example (14): ww = 28; W_1 = 6; W_2 = 5



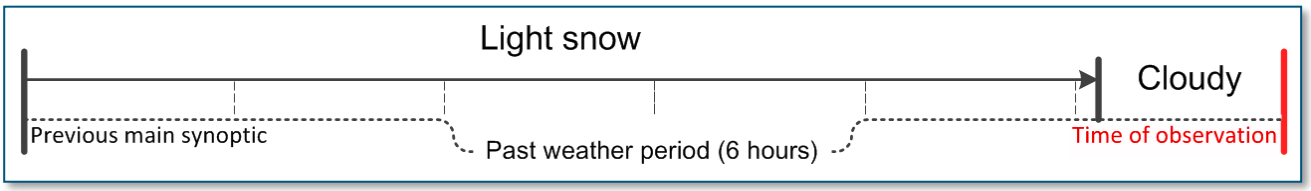
Note: Fog ending in the past hour is the highest code figure that can be used for present weather, hence ww = 28. Although the fog has been continuous up to its description by ww, two other past weather types are coded for W_1 and W_2. If the rain restarted during transmission of the report, the observer might well change the coding of the 7-group to 76054. Group $909R_td_c$ is coded 90911.

Example (15): $ww = 21$; $W_1 = 7$; $W_2 = 2$



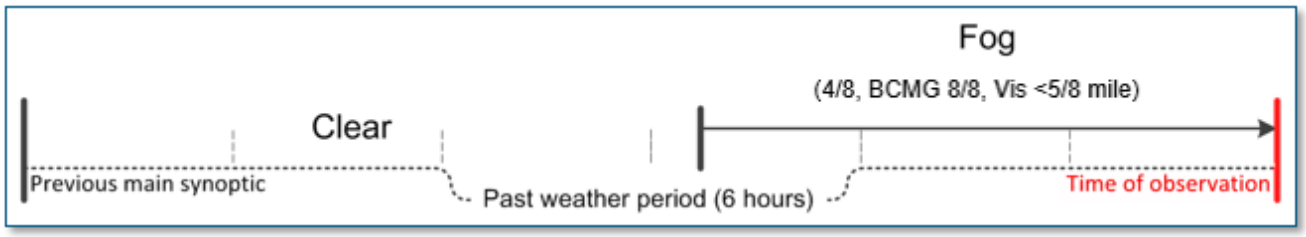
Note: The light rain which ended in the past hour is the highest code figure applicable to present weather, so $ww = 21$. Other reportable weather consisted of snow and the cloudy skies prevailing since the rain ended. Thus W_1 and W_2 are coded 7 and 2, respectively. Group $909R_td_c$ is coded 90972.

Example (16): $ww = 22$; $W_1 = 7$; $W_2 = 2$



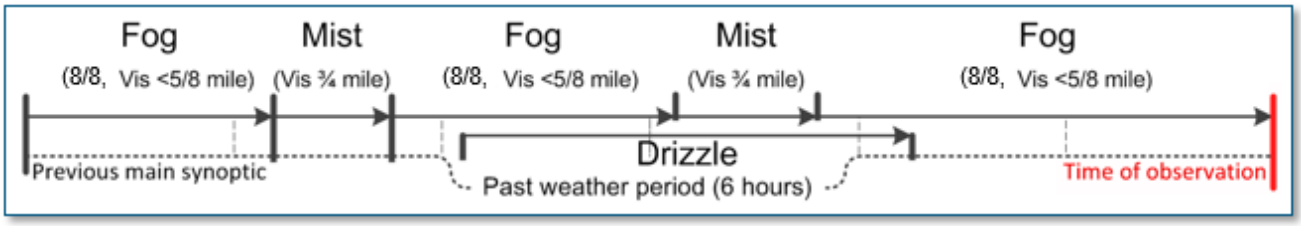
Note: Group $909R_td_c$ is coded 90973 (the light snow was continuous for more than six hours).

Example (17): $ww = 47$; $W_1 = 0$; $W_2 = 0$



Note: By the time of observation, the sky had become completely obscured by thickening fog, preceded only by clear skies.

Example (18): $ww = 45$; $W_1 = 5$; $W_2 = 4$



Note: Reportable past weather consisted of drizzle and fog; therefore W_1 and W_2 are coded 5 and 4, respectively. Group $909R_td_c$ is coded 90921.

In the case of a six-hour period of mist, in which visibilities vary upward from ⅝ mi. and during which there has been no significant past weather, encode the 7-group as follows:

- ww =10
- W_1 and W_2 = 0, 1, or 2 (select the most appropriate code figure even if the sky has been obscured)

15.3.13 Interpretation of group $8N_hC_LC_MC_H$

This group **shall** be omitted when the sky is clear (N = 0), or when the sky is completely obscured (N = 9) and no cloud is visible below the obscuration.

The observer must keep in mind that the analysis of sky condition by layers and individual cloud types is not always directly applicable to coding the clouds in this group of the synoptic code. For example, when coding clouds in the C_L category, if CB is present in any amount, the coding must be 3 or 9 (see 15.3.13.3.1). Similarly, when coding clouds in the C_M category, if turreted or tufted Altocumulus is present it must be reported using code figure 8 (unless code 9 applies) even though another type of Altocumulus or Altostratus covers a greater portion of the celestial dome (see 15.3.13.4.1). In the 8-group, three categories of clouds can be coded along with the amount of one category.

15.3.13.1 8—Numerical indicator figure

The figure 8 indicates that group $8N_hC_LC_MC_H$ is included in the report.

15.3.13.2 N_h—Amount of cloud

The symbol N_h indicates the amount of cloud. The amount coded for N_h **shall** be the total amount of all cloud in the C_L category, or in the absence of C_L cloud, it **shall** be the total amount of all cloud in the C_M category. If C_H clouds alone are present, N_h **shall** be coded as 0. Table 15—6 **shall** be used to specify code figures for N_h.

15.3.13.2.1 Obscuring phenomena

When blue sky or stars are seen through a layer of fog or other obscuring phenomena, without any trace of cloud above or within this layer, the group $8N_hC_LC_MC_H$ **shall** be omitted. If clouds are seen through the fog or other obscuring phenomena, their amount **shall** be evaluated as though the obscuration did not exist. In other words, partial obscuration is not considered and N_h is evaluated in terms of the visible portion of the sky. Table 15—7 may be helpful in determining N_h under partially obscured conditions.

Note: The synoptic code makes no provision for reporting partial obscuration aloft, such as smoke, except where authorized as "special phenomena," and so they should be treated as surface based layers. Example: FEW020 BKN060… RMK SC2FU4, $N_hC_LC_MC_H$ would be coded 84500 (using table 15-7)

15.3.13.2.2 Sky is completely obscured

If the sky is completely obscured, and no cloud is visible, the group $8N_hC_LC_MC_H$ **shall** be omitted. If the sky is completely obscured and clouds are visible below the obscuration or below the extent of vertical visibility in the obscuration, N_h is reported as observed. For example, if the sky is completely obscured and ⅛ okta of Stratus Fractus is observed, the cloud elements would be recorded as $N = 9$, $N_h = 1$, $C_L = 7$ and both C_M and $C_H = X$, unless the obscuration is a layer aloft based above the middle cloud level, in which case $C_M = 0$.

15.3.13.2.3 Height restrictions

In the coding of N_h, there are no height restrictions for clouds of the C_L or C_M categories (i.e., convective type clouds, CU, TCU or CB which based at 12 000 ft (3 600 m) would be reported as cloud of the C_L category and would be added to all C_L clouds present).

15.3.13.2.4 Condensation trails

Persistent condensation trails and cloud masses that have obviously developed from condensation trails **shall** be reported as cloud, using the appropriate C_H or C_M code figure. Rapidly dissipating condensation trails **shall not** be reported.

15.3.13.2.5 Mackerel sky

With a mackerel sky (AC or SC perlucidus), breaks between the cloud elements always exist. Hence, even when such a layer extends over the whole celestial dome, N_h **shall** be coded as 7 or less.

15.3.13.3 C_L—Low cloud types

The symbol C_L indicates the type of low cloud present of the genera stratocumulus, stratus, cumulus and cumulonimbus. Code figures for C_L are given in **Table** 15—20 followed by the corresponding specification.

Table 15—20: WMO code table 0513—Specification of code figures for C_L

Code figure	Specification
0	No Stratocumulus, Stratus, Cumulus, or Cumulonimbus
1	Cumulus with little vertical extent and seemingly flattened, or ragged Cumulus other than of bad weather or both
2	Cumulus of moderate or strong vertical extent, generally with protuberances in the form of domes or towers, either accompanied or not by other Cumulus or by Stratocumulus, all having their bases at the same level
3	Cumulonimbus, the summits of which, at least partially, lack sharp outlines, but are clearly fibrous (Cirriform) but not in the form of an anvil. Cumulus, Stratocumulus or Stratus may also be present
4	Stratocumulus formed by the spreading out of Cumulus. Cumulus may also be present
5	Stratocumulus not formed from the spreading out of Cumulus
6	Stratus in a more or less continuous sheet or layer, or in ragged shreds, or both; but no ragged Stratus of bad weather[1]
7	Ragged Stratus of bad weather or ragged Cumulus of bad weather[1], or both; usually occur below Altostratus or Nimbostratus
8	Cumulus and Stratocumulus other than formed by the spreading out of Cumulus; the base of the Cumulus is at a different level from that of the Stratocumulus
9	Cumulonimbus, the upper part of which is clearly fibrous (Cirriform), often in the form of an anvil, either accompanied or not by Cumulonimbus without anvil or fibrous upper part, or by Cumulus, Stratocumulus or Stratus
/	Stratocumulus, Stratus, Cumulus, or Cumulonimbus are invisible owing to darkness, or cannot be seen (e.g. on an oil drilling rig at night due to glare of lights)

Note (1): The term "bad weather" denotes the conditions that generally exist during precipitation and a short time before and after.

15.3.13.3.1 Priority of reporting for C_L clouds

Two or more types of low cloud are often present in the sky at the same time. To assist the observer in this situation, the following ordered list showing the priority of code figures for C_L has been developed. If two or more code figures are applicable, go down the following list and report the first figure that is applicable, no matter how small the amount of this type may be, and regardless of the presence of other types having a lower priority.

Ordered list showing the priority of code figures for C_L and coding criteria:

1) If Cumulonimbus is present, with or without other C_L-clouds, then:
   a) $C_L = 9$ if the upper part of at least one of the Cumulonimbus clouds is clearly fibrous or striated[1]
   b) $C_L = 3$ if the upper part of none of the Cumulonimbus clouds is clearly fibrous or striated
2) If there is no Cumulonimbus present, then:
   a) $C_L = 4$ if Stratocumulus formed by the spreading out of Cumulus is present
   b) $C_L = 8$ if the C_L code figure 4 is not applicable and if Cumulus/Towering Cumulus and Stratocumulus clouds with bases at different levels are present
   c) $C_L = 2$ if the C_L code figures 4 and 8 are not applicable and if Cumulus clouds of moderate extent or Towering Cumulus are present
   d) if the C_L code figures 4, 8 and 2 are not applicable:
      i. $C_L = 1$ if the C_L clouds present are predominantly[2] Cumulus with little vertical extent and seemingly flattened or Cumulus Fractus other than of bad weather, or both
      ii. $C_L = 5$ if among the C_L clouds present, Stratocumulus other than that formed by the spreading out of Cumulus is predominant[2]
      iii. $C_L = 6$ if the C_L clouds present are predominantly[2] Stratus in a more or less continuous sheet or layer, or Stratus Fractus (other than Stratus Fractus of bad weather), or both
      iv. $C_L = 7$ if the C_L clouds present are predominantly[2] Stratus Fractus of bad weather[3] or Cumulus Fractus of bad weather, or both

3) C_L = 0 if there is no Stratocumulus, Stratus, Cumulus or Cumulonimbus

C_L = / (use " / " only under conditions outlined in Table 15—20)

Note (1): Consult WMO Cloud Atlas on the specification C_L = 9.

Note (2): In the present case, consideration of the predominance is restricted to the clouds corresponding to C_L code figures 1, 5, 6 and 7, which have the same priority. Clouds of any one of these four specifications are said to be predominant when their sky cover is greater than that of the clouds of any of the three other specifications.

Note (3): The term **"**bad weather" denotes the conditions that generally exist during precipitation and a short time before and after which are responsible for the formation of the cloud.

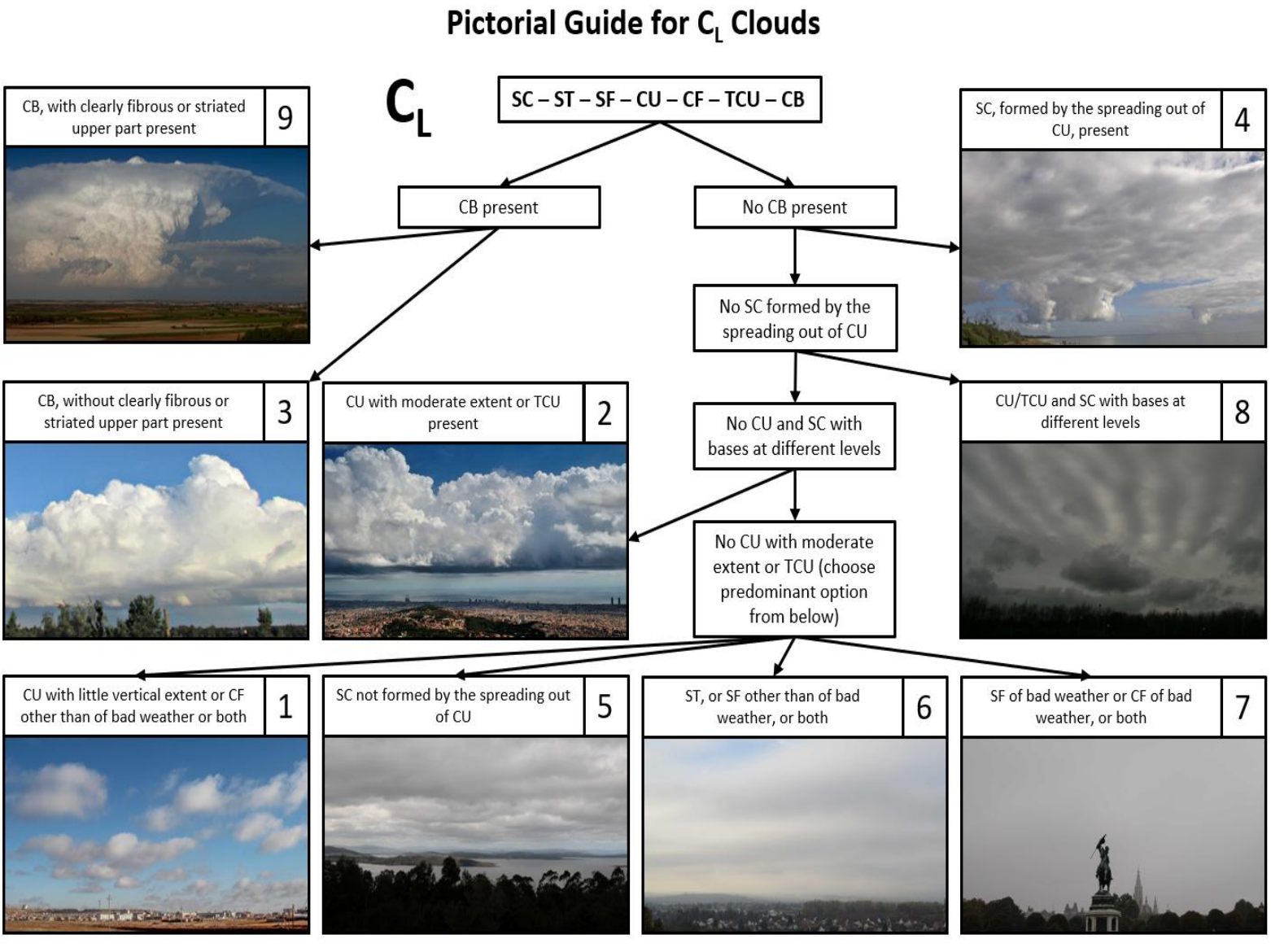


Figure 15—2: Pictorial guide for coding C_L clouds

15.3.13.4 C_M—Middle cloud types

The symbol C_M indicates the type of middle cloud present of the genera Altocumulus, Altostratus, and Nimbostratus. Code figures for C_M are given in Table 15—21 followed by the corresponding specification.

Table 15—21: WMO code table 0515—Specification of code figures for C_M

Code figure	Specification
0	No Altocumulus, Altostratus, or Nimbostratus present
1	Altostratus, the greater part of which is semi-transparent; through this part, the sun or moon may be weakly visible as though through ground glass
2	Altostratus, the greater part of which is sufficiently dense to hide the sun or moon or Nimbostratus
3	Altocumulus, the greater part of which is semi-transparent; the various elements of the cloud change only slowly and are all at a single level
4	Patches (often in the form of almonds or fishes) of Altocumulus, the greater part of which are semi-transparent; the clouds appear at one or more levels and the elements are constantly changing in appearance
5	Semi-transparent Altocumulus in bands; or Altocumulus in one or more fairly continuous layers (semi-transparent or opaque), progressively invading the sky; these Altocumulus clouds generally thicken as a whole
6	Altocumulus resulting from the spreading out of Cumulus or Cumulonimbus
7	Altocumulus in two or more layers, usually opaque in places, and not progressively invading the sky or opaque layer of Altocumulus not progressively invading the sky or Altocumulus together with Altostratus, or Nimbostratus
8	Altocumulus with the sproutings of small towers or battlements, or Altocumulus having the appearance of cumulus-shaped tufts
9	Altocumulus of a chaotic sky, generally at several levels
/	Altocumulus, Altostratus or Nimbostratus are invisible owing to darkness, or cannot be seen (e.g. on an oil drilling rig at night, due to glare of lights), or more often because of the presence of an overcast layer of C_L cloud

15.3.13.4.1 Priority of reporting for C_M clouds

Two or more types of middle cloud are often present in the sky at the same time. To assist the observer in this situation, the following ordered list showing the priority of code figures for C_M has been developed. If two or more code figures are applicable, go down the following list and report the first figure that is applicable, no matter how small the amount of this type may be, and regardless of the presence of other types having a lower priority.

Ordered list showing the priority of code figures for C_M and coding criteria:

1) If Altocumulus is present (Altostratus or Nimbostratus may be present), then:
   a) C_M = 9 if the sky is chaotic
   b) C_M = 8 if the C_M code figure 9 is not applicable and if Altocumulus Castellanus or Altocumulus having the appearance of small cumuliform tufts is present
   c) C_M = 7 if the C_M code figures 9 and 8 are not applicable and if Altostratus or Nimbostratus is present together with Altocumulus
2) If Altocumulus is present (no Altostratus or Nimbostratus present), then:
   a) C_M = 6 if the C_M code figures 9, 8 and 7 are not applicable and if Altocumulus formed by the spreading out of Cumulus or Cumulonimbus is present
   b) C_M = 5 if the C_M code figures 9, 8, 7 and 6 are not applicable, and if the Altocumulus present is progressively invading the sky
   c) C_M = 4 if the C_M code figures 9, 8, 7, 6 and 5 are not applicable and if the Altocumulus present is continually changing in appearance
   d) C_M = 7 if the C_M code figures 9, 8, 6, 5 and 4 are not applicable and if the Altocumulus present occurs at two or more levels
   a) C_M = 7 or 3 if the C_M code figures 9, 8, 6, 5 and 4 are not applicable and if the Altocumulus present occurs at one level, use C_M = 7 or 3 depending on whether the greater part of the Altocumulus is respectively opaque or semi-transparent

3) If no Altocumulus is present:

   a) C_M = 2 if Nimbostratus is present or if the greater part of the Altostratus present is opaque

   b) C_M = 1 if there is no Nimbostratus and if the greater part of the Altostratus present is semi-transparent

4) C_M = / if C_M clouds invisible owing to continuous layer of lower clouds or because of fog, blowing dust or other similar phenomena (use only under the conditions given in Table 15—21)

5) C_M = 0 if there is no Altocumulus, Altostratus or Nimbostratus

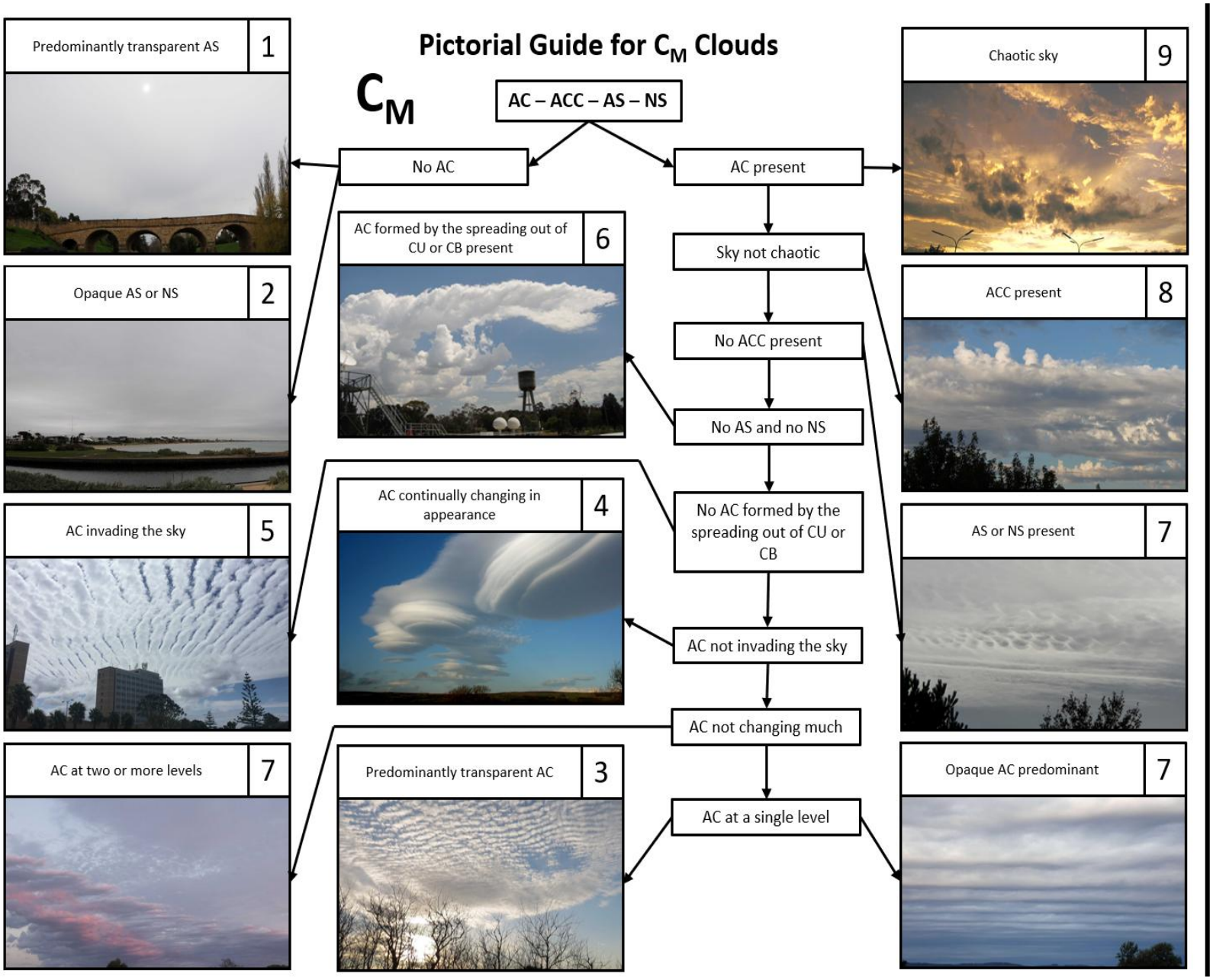


Figure 15—3: Pictorial guide for coding C_M clouds

15.3.13.5 C_H—High cloud types

The symbol C_H indicates the type of high cloud present of genera Cirrus, Cirrocumulus and Cirrostratus. Code figures for C_H are given in Table 15—22 followed by the corresponding specification.

Table 15—22: WMO code table 0509—Specification of code figures for C_H

Code figure	Specification
0	No Cirrus, Cirrocumulus or Cirrostratus present
1	Cirrus in the form of filaments, strands or hooks; not progressively invading the sky
2	Dense cirrus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a Cumulonimbus or Cirrus with sproutings in the form of small turrets or battlements, or Cirrus having the appearance of cumulus-shaped tufts
3	Dense Cirrus, often in the form of an anvil, being the remains of the upper part of Cumulonimbus
4	Cirrus in the form of hooks or filaments, or both, progressively invading the sky; they generally become denser as a whole
5	Cirrus (often in bands converging towards one point or two opposite points of the horizon) and Cirrostratus; or Cirrostratus alone. In either case, they are progressively invading the sky, and generally grow denser as a whole, but the continuous veil does not reach 45° above the horizon
6	Cirrus and Cirrostratus, or Cirrostratus alone as in 5 above, except that the continuous veil extends more than 45° above the horizon without the sky being totally covered
7	Veil of Cirrostratus covering the celestial dome completely
8	Cirrostratus not progressively invading the sky and not completely covering the celestial dome

Code figure	Specification
9	Cirrocumulus alone, or Cirrocumulus accompanied by Cirrus, or Cirrostratus or both, but Cirrocumulus is predominant
/	Cirrus, Cirrocumulus, and Cirrostratus are invisible owing to darkness or cannot be seen (e.g. on an oil drilling rig at night, due to glare of lights) or more often because of the presence of a continuous layer of lower cloud

15.3.13.5.1 Priority of reporting for C_H clouds

Two or more types of high cloud are often present in the sky at the same time. To assist the observer in this situation, the following ordered list showing the priority of code figures for C_H has been developed. If two or more code figures are applicable, go down the following list and report the first figure that is applicable, no matter how small the amount of this type may be, and regardless of the presence of other types having a lower priority.

Ordered list showing the priority of code figures for C_H and coding criteria:

1) $C_H = 9$ if Cirrocumulus is present alone or if the amount of the Cirrocumulus is more than the combined sky cover of any Cirrus and Cirrostratus present

   a) if $C_H = 9$ is not applicable and Cirrostratus present with or without Cirrus or Cirrocumulus, then:

      i) $C_H = 7$ if the Cirrostratus covers the whole sky

      ii) $C_H = 8$ if the Cirrostratus does not cover the whole sky and is not invading the celestial dome

      iii) $C_H = 6$ if the Cirrostratus is progressively invading the sky and if the continuous veil extends more than 45° above the horizon but does not cover the whole sky

      iv) $C_H = 5$ if the Cirrostratus is progressively invading the sky but the continuous veil does not reach 45° above the horizon

b) if C_H = 9 is not applicable and no Cirrostratus present, then:

i) C_H = 4 if the Cirrus clouds are invading the sky

ii) C_H = 3 if the C_H code figure 4 is not applicable and if dense Cirrus which originated from Cumulonimbus is present in the sky

iii) if C_H = 4 or 3 are not applicable:

(1) C_H = 2 if the combined sky cover of dense Cirrus, of Cirrus with sproutings in the form of small turrets or battlements and of Cirrus in tufts is greater than the combined sky cover of Cirrus in the form of filaments, strands or hooks

(2) C_H = 1 if the combined sky cover of Cirrus in the form of filaments, strands or hooks is greater than the combined sky cover of dense Cirrus, of Cirrus with sproutings in the form of small turrets or battlements and of cirrus in tufts

2) C_H = / if C_H clouds invisible owing to continuous layer of lower clouds or because of fog, blowing dust or other similar phenomena (code / only under the conditions given in Table 15—22)

3) C_H = 0 if there is no Cirrus, Cirrostratus or Cirrocumulus

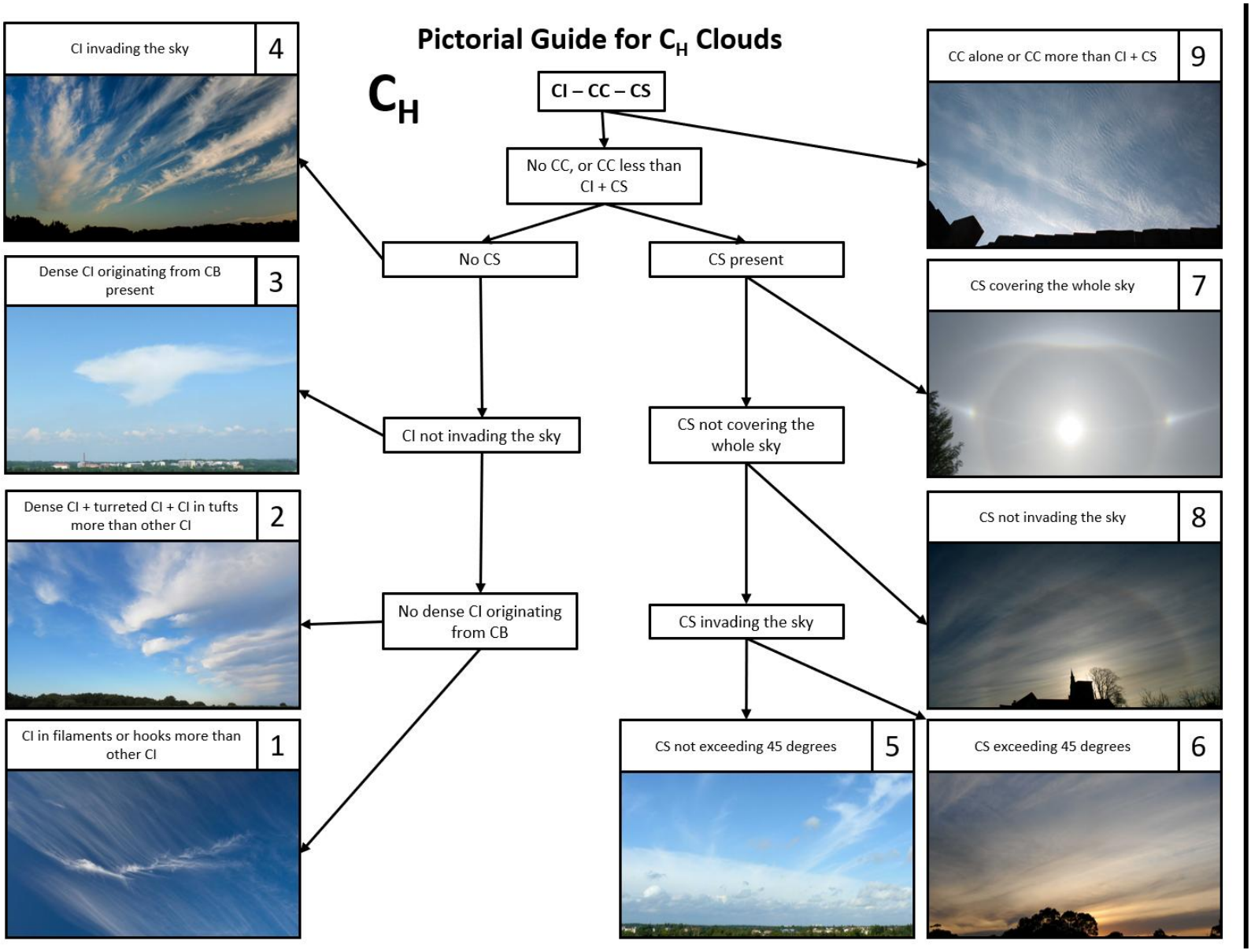


Figure 15—4: Pictorial guide for coding C_H clouds

15.3.14 Interpretation of group 9GGgg

15.3.14.1 9—Numerical indicator figure

The figure 9 indicates that group 9GGgg is included in the report.

15.3.14.2 GGgg—Actual time of observation if different than GG

The symbols GGgg indicate the actual time of observation at a data platform when this time differs from the scheduled synoptic hour UTC. This group **shall** be included when the actual time of observation differs by more than 10 minutes from the standard time GG reported in Section 0 (see 15.2.4.2).

15.4 Section 2—Reporting data for sea stations

Section 2 contains maritime data pertaining to sea stations. Standards and procedures for Section 2 of the Synoptic code may be found in *Manual of Marine Weather Observations* (MANMAR).

15.5 Section 3—Reporting data for regional and national exchange

Section 3 contains data for regional and national exchange only. It is always included in reports from Canadian land stations.

15.5.1 Symbolic form

333 $1s_nT_xT_xT_x$ $2s_nT_nT_nT_n$ 4E′sss $6RRRt_R$ $7R_{24}R_{24}R_{24}R_{24}$ $9S_PS_Ps_ps_p$

15.5.2 Section content

Standards for inclusion of reported groups in Section 3 are as follows:

1) In the main synoptic report, the indicator group 333 and groups $1s_nT_xT_xT_x$, $2s_nT_nT_nT_n$ and $7R_{24}R_{24}R_{24}R_{24}$ **shall** always be included

2) Group 4E′sss is included when there is snow or ice on the ground

3) Group $9S_PS_Ps_ps_p$ **shall** be included if precipitation has occurred

4) Group $9S_PS_Ps_ps_p$ is included if there are special phenomena to report

If a tornado is at or within sight of a station at the time of observation or within the past hour, the plain language word "TORNADO" **shall** be recorded and transmitted as the last group of Section 3. A tornado may also be reported in the 7-group simultaneously if ww = 19 is the highest present weather code applicable at the time. This coding **shall** apply to both main and intermediate synoptic reports, if applicable.

15.5.3 333—Numerical indicator figure group

The three-figure group 333 indicates the beginning of Section 3. This three-figure group must precede the code groups of Section 3 which follow.

15.5.4 Interpretation of group $1s_nT_xT_xT_x$

15.5.4.1 1—Numerical indicator figure

The figure 1 indicates that the group $1s_nT_xT_xT_x$ is included in the report.

15.5.4.2 s_n—Indicator of whether temperatures are positive or negative

The symbol s_n is used to indicate whether the temperature given by $T_xT_xT_x$ is positive or negative. It **shall** be coded as follows:

- $s_n = 0$ if the temperature is 0 °C, or positive (above 0 °C)
- $s_n = 1$ if the temperature is negative (below 0 °C)

15.5.4.3 $T_xT_xT_x$—Maximum temperature

The symbols $T_xT_xT_x$ indicate the maximum temperature, in degrees and tenths of a degree Celsius. This group **shall** always be reported. Maximum temperature **shall** be reported according to the following schedule:

- at 1200 UTC, report the maximum temperature for the 24-hour period ending 6 hours ago, i.e. 0600 UTC
- at 1800 UTC and 0000 UTC, report the maximum temperature for the previous 12 hours
- at 0600 UTC, report the maximum temperature for the previous 24 hours (this is the same maximum temperature reported 6 hours later in the 1200 UTC synoptic report)

Table 15—23 shows examples of maximum temperature coded for $1s_nT_xT_xT_x$.

Table 15—23: Examples of maximum temperature coded for $1s_nT_xT_xT_x$

Temperature (°C)	s_n	$T_xT_xT_x$	$1s_nT_xT_xT_x$
25.3	0	253	10253
4.5	0	045	10045
0.0	0	000	10000
-0.2	1	002	11002
-5.0	1	050	11050

15.5.5 Interpretation of group $2s_nT_nT_nT_n$

15.5.5.1 2—Numerical indicator figure

The figure 2 indicates that group $2s_nT_nT_nT_n$ is included in the report.

15.5.5.2 s_n—Indicator of whether temperatures are positive or negative

The symbol s_n indicates whether the temperature given by $T_nT_nT_n$ is positive or negative. It **shall** be coded as follows:

- $s_n = 0$ if the temperature is 0 °C or positive (above 0 °C)
- $s_n = 1$ if the temperature is negative (below 0 °C)

15.5.5.3 $T_nT_nT_n$—Minimum temperature

The symbols $T_nT_nT_n$ indicate the minimum temperature in degrees and tenths of a degree Celsius. The examples shown in Table 15—23 also apply to minimum temperature. This group **shall** always be reported. Minimum temperature **shall** be reported according to the following schedule:

- at 1200 UTC, report the minimum temperature for the previous 12 hours
- at 1800 UTC and 0600 UTC, report the minimum temperature for the previous 24 hours
- at 0000 UTC, report the minimum temperature for the previous 18 hours

15.5.6 Interpretation of group 4E′sss

This group **shall** be included in each main synoptic report when there is snow, ice, or any other form of solid precipitation such as hail, ice pellets, or snow pellets on the ground at the time of the observation and precipitation has occurred since the previous main synoptic observation.

Note: An accumulation of ice which is the product of freezing precipitation only is not included in group 4E′sss.

Group 4E′sss **shall** also be included in the 1200 UTC observation whenever there is solid precipitation on the ground at the time of observation, regardless of when it occurred. If the 1200 UTC synoptic observation is not taken, the group is included in the next main synoptic observation.

15.5.6.1 4—Numerical indicator figure

The figure 4 indicates that group 4E′sss is included in the report.

15.5.6.2 E′—State of the ground with snow or measurable ice

The symbol E′ indicates the state of the ground with snow or measurable ice cover. Table 15—24 **shall** be used to specify code figures for E′ conforming to the following criteria:

- the highest applicable code figure is always reported
- the definitions in the table apply to an open, representative area
- the term "ice," as used in the table, also includes solid precipitation other than snow

Table 15—24: WMO code table 0975—Specification of code figures for E′

Code figure	Specification
0	Ground predominately covered by ice (as opposed to snow)
1	Compact or wet snow (with or without ice) covering less than one-half of the ground
2	Compact or wet snow (with or without ice) covering at least one-half of the ground but ground not completely covered
3	Even layer of compact or wet snow covering ground completely
4	Uneven layer of compact or wet snow covering ground completely
5	Loose, dry snow covering less than one-half of the ground
6	Loose, dry snow covering at least one-half of the ground (but not completely)
7	Even layer of loose, dry snow covering ground completely
8	Uneven layer of loose, dry snow covering ground completely
9	Snow covering ground completely; deep drifts (50 cm or more above the general snow surface)

15.5.6.3 sss—Total depth of snow or ice

The symbol group sss indicates the total depth of snow, or ice, on the ground, in whole centimetres. The depth of snow **shall** be coded according to Table 15—25.

Table 15—25: WMO code table 3889—Specification of code figures for sss

Code figure	Specification
000	Not used
001	1 cm
Etc.	Etc.
996	996 cm
997	Less than 0.5 cm (trace)
998	Snow cover, not continuous
999	Measurement impossible or inaccurate (not used in Canada)

15.5.7 Interpretation of group $6RRRt_R$

This group **shall** be included in intermediate synoptic reports at stations that normally measure precipitation (see 15.3.3.1on the use of the symbol i_R) on the use of the symbol i_R).

15.5.7.1 6—Numerical indicator figure

The figure 6 indicates that the group $6RRRt_R$ is included in the report. This group is included in Section 3 only in intermediate synoptic reports.

15.5.7.2 RRR—Amount of precipitation

The symbol RRR indicates the amount of precipitation which has fallen during the period preceding the time of observation (which is indicated by t_R). Amounts are usually for a three-hour period at the intermediate observation. Precipitation amounts should be obtained from an intermediate reading of the standard rain gauge, without emptying its contents. In cold weather, if the contents of the gauge are frozen, it may be necessary to replace the funnel and graduate with a spare, and measure the amount. Precipitation amounts **shall** be coded according to Table 15—17: WMO code table 3590—Specification of code figures for RRR.

Note: Precipitation amounts which are greater than 1.0 mm must be rounded to the nearest whole millimetre prior to coding.

15.5.7.3 t_R—Period of observation

The symbol t_R indicates the duration of the period of reference ending at the time of the report for the amount of precipitation. Table 15—26 **shall** be used to specify code figures for t_R.

Table 15—26: WMO code table 4019 (abridged)—Specification of code figures for t_R

Code figure	Specification
5	Total precipitation during the 1 hour preceding the observation
6	Total precipitation during the 2 hours preceding the observation
7	Total precipitation during the 3 hours preceding the observation
8	Total precipitation during the 9 hours preceding the observation
9	Total precipitation during the 15 hours preceding the observation

15.5.8 Interpretation of group $7R_{24}R_{24}R_{24}R_{24}$

This group **shall** be included in each main synoptic observation to report total amount of measurable precipitation during the preceding 24 hours.

15.5.8.1 7—Numerical indicator figure

The figure 7 indicates that group $7R_{24}R_{24}R_{24}R_{24}$ is included in the report.

15.5.8.2 $R_{24}R_{24}R_{24}R_{24}$—Total amount of precipitation during the 24-hour period

The symbol $R_{24}R_{24}R_{24}R_{24}$ indicates the total amount of precipitation during the 24-hour period ending at the time of observation. The amount **shall** be coded in tenths of millimetres. Table 15—27 provides examples of how to code for $R_{24}R_{24}R_{24}R_{24}$.

Table 15—27: Examples of how to code for $R_{24}R_{24}R_{24}R_{24}$

24-hour Precipitation (mm)	$7R_{24}R_{24}R_{24}R_{24}$
Nil	70000
Trace	79999
0.2	70002
25.3	70253
105.8	71058
999.8 or more	79998

15.5.9 Interpretation of group $9S_pS_ps_ps_p$

This group is used to give supplementary information on special phenomena. Although the codes provide for the reporting of various special phenomena, unless special instructions are received from the ADM, only two 9-groups **shall** be used:

1) $909R_td_c$: This special phenomena group **shall** be used indicate the time at which precipitation began or ended and duration and character of precipitation, and:
   a) this information **shall** be reported using the group $909R_td_c$ whenever group $6RRRt_R$ is encoded and the RRR value of this group is not coded as 000
   b) the symbol R_t **shall** be encoded in accordance with Table 15—28 and the symbol d_c **shall** be encoded according to Table 15—30
2) 931ss: This special phenomena group **shall** be used indicate the depth of newly fallen snow (the depth of newly fallen snow is the amount of snow that would have accumulated, had it not been disturbed by the wind or melted—it is essentially the rounded value of the amount recorded), and:
   a) the measurement is reported in the group 931ss, where ss is the measurement in whole centimetres, up to 55 cm
   b) measurements above 55 cm **shall** be encoded in accordance with Table 15—31
   c) the group **shall** be included at the discretion of the Regional Director General, but only by stations that take four staffed synoptic observations daily and when the rounded measurement is 1 cm or more

15.5.9.1 9—Numerical indicator figure

The figure 9 indicates that group $9S_PS_Ps_ps_p$ is included in the report.

15.5.9.2 S_PS_P—Supplementary information group indicator

The symbol S_PS_P indicates which supplementary information group is included in the report.

Table 15—28 **shall** be used to specify code figures for S_PS_P.

Table 15—28: WMO code table 3778 (abridged)—Specification of code figures for supplementary information groups

Code figure	Group	Specification
09	R_td_c	Time at which precipitation given by RRR began or ended and duration and character of precipitation
31	ss	Depth of newly fallen snow

15.5.9.3 Group $909R_td_c$—Supplemental precipitation information

15.5.9.3.1 R_t—Time at which precipitation began or ended

The symbol R_t indicates the time at which precipitation given by RRR began or ended. R_t **shall** be coded with reference to the official time of observation. When precipitation is occurring at the time of observation, R_t **shall** refer to the "time precipitation began." When precipitation is not occurring at the time of observation, R_t **shall** refer to the "time precipitation ended," except:

1) if the coding of ww (ww codes 20 to 27) or weather duration when coding ww code (29) indicates that precipitation has ended during the preceding hour, Rt **shall** be coded to indicate the "time precipitation began"
2) when two or more periods of precipitation occur during a six-hour period preceding the observation, then the time (beginning or ending) of the last period of precipitation **shall** be reported using Rt (occurrences of precipitation **shall** be considered as separate periods of precipitation when separated by 15 minutes or more)

Table 15—29 **shall** be used to specify code figures for R_t.

Table 15—29: WMO code table 3552—Specification of code figures for R_t

Code figure	Specification
0	Not used
1	RRR began or ended less than 1 hour ago
2	RRR began or ended 1 to 2 hours ago
3	RRR began or ended 2 to 3 hours ago
4	RRR began or ended 3 to 4 hours ago
5	RRR began or ended 4 to 5 hours ago
6	RRR began or ended 5 to 6 hours ago
7	RRR began or ended 6 to 12 hours ago
8	RRR began or ended more than 12 hours ago
9	Unknown

Note (1): If a choice exists, use the smaller code figure. For example: if rain ended exactly four hours ago, use code figure 4.

Note (2): When a station has not been continuously staffed and a recording rain gauge was not in operation throughout the period, it may be necessary to code R_t as 9.

15.5.9.3.2 d_c—Duration and character of precipitation

The symbol d_c indicates the duration and character of precipitation given by RRR. Occurrences of precipitation **shall** be considered as separate periods of precipitation when separated by intervals of 15 minutes or more. Table 15—30 **shall** be used to specify code figures for d_c.

Table 15—30: WMO code table 0833—Specification of code figures for d_c

Code figure	Specification
0	Lasted less than 1 hour (only one period of precipitation has occurred during the past 6 hours)
1	Lasted 1–3 hours (only one period of precipitation has occurred during the past 6 hours)
2	Lasted 3–6 hours (only one period of precipitation has occurred during the past 6 hours)
3	Lasted more than 6 hours (only one period of precipitation has occurred during the past 6 hours)
4	Lasted less than 1 hours (two or more periods of precipitation have occurred during the past 6 hours)
5	Lasted 1–3 hours (two or more periods of precipitation have occurred during the past 6 hours)
6	Lasted 3–6 hours (two or more periods of precipitation have occurred during the past 6 hours)
7	Lasted more than 6 hours (two or more periods of precipitation have occurred during the past 6 hours)
8	Not used
9	Unknown

Note (1): If a choice exists, use the smaller code figure (e.g., if a single period of precipitation lasted exactly three hours, use code figure 1).

Note (2): If only one period of precipitation has occurred during the past six hours, and is still occurring at the time of observation, the duration is defined as the time elapsed from the beginning of precipitation until the time of observation. If precipitation is not occurring at the time of observation, the duration is the interval from beginning to end of the precipitation (see 15.3.12.3.5 examples 2 to 5, 8, 9, 11, 13 to 16, and 18).

Note (3): If two or more periods of precipitation have occurred during the past six hours, and precipitation is occurring at the time of observation, the duration is defined as the time elapsed from the beginning of the first period of precipitation, all or part of which occurred during the past six hours, until the time of observation. If precipitation is not occurring at the time of observation, the duration is defined as the interval from the beginning of the first period of precipitation to the end of the last period of precipitation (see 15.3.12.3.5, examples 6, 7, and 10).

15.5.9.4 Group 931ss

15.5.9.4.1 ss—Depth of newly fallen snow

The symbol ss indicates the depth of newly fallen snow. Table 15—31 **shall** be used to specify code figures for ss.

For depth of Newly fallen snow, code figure for ss represent the rounded whole centimetre. The WMO code table 3870 specifies the depth of newly fallen snow in millimetres. This doesn't represent the water equivalent.

Table 15—31: WMO code table 3870—Specification of code figures for ss

Code figure	Specification (mm)	Specification (cm)	Code figure	Specification (mm)	Specification (cm)
00	Not used	Not used	**13**	130	13
01	10	1	**14**	140	14
02	20	2	**15**	150	15
03	30	3	**16**	160	16
04	40	4	**17**	170	17
05	50	5	**18**	180	18
06	60	6	**19**	190	19
07	70	7	**20**	200	20
08	80	8	**21**	210	21
09	90	9	**22**	220	22
10	100	10	**23**	230	23
11	110	11	**24**	240	24
12	120	12	**25**	250	25

Code figure	Specification (mm)	Specification (cm)	Code figure	Specification (mm)	Specification (cm)
26	260	26	**53**	530	53
27	270	27	**54**	540	54
28	280	28	**55**	550	55
29	290	29	**56**	600	60
30	300	30	**57**	700	70
31	310	31	**58**	800	80
32	320	32	**59**	900	90
33	330	33	**60**	1000	100
34	340	34	**61**	1100	110
35	350	35	**62**	1200	120
36	360	36	**63**	1300	130
37	370	37	**64**	1400	140
38	380	38	**65**	1500	150
39	390	39	**66**	1600	160
40	400	40	**67**	1700	170
41	410	41	**68**	1800	180
42	420	42	**69**	1900	190
43	430	43	**70**	2000	200
44	440	44	**71**	2100	210
45	450	45	**72**	2200	220
46	460	46	**73**	2300	230
47	470	47	**74**	2400	240
48	480	48	**75**	2500	250
49	490	49	**76**	2600	260
50	500	50	**77**	2700	270
51	510	51	**78**	2800	280
52	520	52	**79**	2900	290

Code figure	Specification (mm)	Specification (cm)
80	3000	300
81	3100	310
82	3200	320
83	3300	330
84	3400	340
85	3500	350
86	3600	360
87	3700	370
88	3800	380
89	3900	390
90	4000	400
91	Not used	Not used
92	Not used	Not used
93	Not used	Not used
94	Not used	Not used
95	Not used	Not used
96	Not used	Not used
97	Not used	Not used
98	More than 4000	More than 400
99	Measurement impossible or inaccurate	Measurement impossible or inaccurate

Note: For 56 and 57 cm, use code 55. For values over 57 cm, round to the nearest 10 cm.

15.6 Section 4—Data for national use for clouds with base below station level, included by national decision

Section 4 is not used in Canada.

15.7 Section 5—Reporting data for national exchange

Section 5 is used by land stations to transmit data for national exchange only.

15.7.1 Symbolic form

555 1ssss $2s_ws_ws_ws_w$ $3d_md_mf_mf_m$ $4f_hf_tf_tf_i$

15.7.2 Section content

The groups in this section pertain to summarized daily climatological data and distribution is within Canada only. Standards for inclusion of Section 5 are as follows:

1) Data of Section 5 **shall** be reported once daily as the last section of the 0600 UTC synoptic message by all stations
2) If Section 5 data are not normally available, the group is omitted
3) At stations where the data for Section 5 are available at 1200 UTC, but not at 0600 UTC, reports including Section 5 should be reported at 1200 UTC
4) The data **shall** always pertain to the same 24-hour period ending at the most recent 0600 UTC time

15.7.3 555—Numerical indicator figure group

The three-figure group 555 indicates the beginning of Section 5. This figure group must always precede the code groups of Section 5.

15.7.4 Interpretation of group 1ssss

15.7.4.1 1—Numerical indicator figure

The figure 1 indicates that group 1ssss is included in the report.

15.7.4.2 ssss—Amount of snowfall

The symbol ssss indicates the amount of snowfall, in tenths of a centimetre, for the 24-hour period ending at 0600 UTC. Amount of snowfall **shall** be reported as follows:

1) The amount of the snowfall reported **shall** be the total amount recorded, omitting the decimal
2) A "trace" **shall** be encoded as 19999
3) If there has been no snowfall in the 24-hour period, the group **shall** be coded 10000
4) If snowfall could not be measured, the group **shall** be coded as 1////

Examples of how to code amount of snowfall for ssss are given in Table 15—32.

Table 15—32: Examples of how to code amount of snowfall for ssss

Snowfall amount (cm)	Coded value
0.6	10006
43.8	10438
120.8	11208
0.0	10000
Unable to measure	1////

15.7.5 Interpretation of group $2s_ws_ws_ws_w$

15.7.5.1 2—Numerical indicator figure

The figure 2 indicates that group $2s_ws_ws_ws_w$ is included in the report.

15.7.5.2 $s_ws_ws_ws_w$—Amount of water equivalent of snowfall

The symbol $s_ws_ws_ws_w$ indicates the amount of water equivalent, in tenths of a millimetre, of the 24-hour snowfall ending at 0600 UTC. Amount of water equivalent **shall** be reported as follows:

1) The amount of the water equivalent **shall** be the total amount recorded, omitting the decimal
2) A "trace" **shall** be coded as 29999
3) If there has been no snowfall in the 24-hour period, the group **shall** be coded as 20000
4) If snowfall water equivalent could not be measured, the group **shall** be coded as 2////

Examples of how to code the amount of water equivalent of snowfall for $s_w s_w s_w s_w$ are given in Table 15—33.

Table 15—33: Examples of how to code amount of water equivalent of snowfall for $s_w s_w s_w s_w$

Water equivalent (mm)	Coded value
0.8	20008
30.2	20302
110.8	21108
0.0	20000
Unable to measure	2////

15.7.6 Interpretation of group $3d_m d_m f_m f_m$

The group is reported only when $f_m f_m$ exceeds 16 kt. If a station has no serviceable wind speed detector for any period during the climatological day, data must be reported as missing, and the group **shall** be recorded as 3xxxx. A case where wind direction is missing, but wind speed is available would be recorded as $3xxf_m f_m$.

15.7.6.1 3—Numerical indicator figure

The figure 3 indicates that the group $3d_m d_m f_m f_m$ is included in the report.

15.7.6.2 $d_m d_m$—Direction of the maximum wind

The symbol $d_m d_m$ indicates the direction, in tens of degrees, of the maximum wind for the 24-hour period ending at 0600 UTC. The direction encoded is the direction associated with the maximum wind speed for the period.

15.7.6.3 $f_m f_m$—Maximum wind speed for 24-hour period

The symbol $f_m f_m$ indicates the maximum wind speed, in knots, for the 24-hour period ending at 0600 UTC. The speed may be either a mean or gust speed, but $f_m f_m$ is encoded only when the maximum speed for the period exceeds 16 kt. The units and tens values recorded **shall** be the value encoded for $f_m f_m$.

15.7.7 Interpretation of group $4f_hf_tf_tf_i$

This group is reported whenever group $3d_md_mf_mf_m$ is reported. At stations equipped to record entries, or at stations where there has been a period of wind equipment unserviceability, the group $4f_hf_tf_tf_i$ **shall** be reported only when f_i can be coded as a 2 or 3 (i.e., recorded in the format $4xxxf_i$).

15.7.7.1 4—Numerical indicator figure

The figure 4 indicates that group $4f_hf_tf_tf_i$ is included in the report.

15.7.7.2 f_h—Hundreds digit of the maximum wind speed

The symbol f_h indicates the hundreds digit of the maximum wind speed for the 24-hour period ending at 0600 UTC. Normally f_h is encoded 0; however, if, for example, a gust of 108 kt was observed, f_h would be encoded 1.

15.7.7.3 f_tf_t—Time of occurrence of maximum wind speed

The symbol f_tf_t indicates the time of occurrence, UTC, of the maximum wind speed reported by group $3d_md_mf_mf_m$. The time encoded **shall** be derived from the time of the last occurrence.

15.7.7.4 f_i—Speed range of the maximum wind speed

The symbol f_i indicates the index value that is used to identify the speed range of the maximum two-minute mean wind speed for the 24-hour period ending at 0600 UTC. Table 15—34 **shall** be used to specify code figures for f_i.

Table 15—34: Specification of code figures for f_i

Code figure	Specification
0	16 kt or less
1	17–27 kt
2	28–33 kt
3	34 kt or more

Note: The highest code possible is always selected for f_i.

Appendix 1 Stations where SPECI reports are required for temperature changes

This appendix contains a list of NAV CANADA designated sites that are required to issue special (SPECI) reports when temperature changes occur. In accordance with ICAO (International Civil Aviation Organization) Procedures for Air Navigation Services – Meteorology (PANS-MET), Section 2.1.2.1, designated sites are required to issue SPECI reports when temperature changes occur that are of concern to aviation operations. Designated sites include the following airports:

- Calgary Intl., AB
- Edmonton Intl., AB
- Prince George, BC
- Vancouver Intl, BC
- Victoria Intl., BC
- Winnipeg Intl., MB
- Fredericton Intl, NB
- Moncton, Greater Moncton Roméo Leblanc Intl., NB
- Saint John, NB
- Gander Intl., NL
- St. John's Intl., NL
- Halifax Intl., NS
- Yellowknife, NT
- London, ON
- Ottawa, Macdonald-Cartier Intl., ON
- Thunder Bay, ON
- Toronto, Lester B. Pearson Intl., ON
- Charlottetown, PE
- Montréal Intl, Mirabel, QC
- Montréal, Pierre Elliot Trudeau Intl., QC
- Québec City, Jean Lesage Intl., QC
- Regina Intl., SK
- Saskatoon, John G. Diefenbaker Intl., SK
- Whitehorse Intl., YT

Appendix 2 METAR Weather Phenomena

Tornadoes, Thunderstorms and Precipitation

Tornado	+FC (TORNADO in Remarks)
Waterspout	+FC (WATERSPOUT in Remarks)
Funnel Cloud	FC (FUNNEL CLOUD in Remarks)
Thunderstorm	TS
Rain	-RA, RA, +RA
Rain Showers	-SHRA, SHRA, +SHRA
Drizzle	-DZ, DZ, +DZ
Freezing Rain	-FZRA, FZRA, +FZRA
Freezing Drizzle	-FZDZ, FZDZ, +FZDZ
Snow	-SN, SN, +SN
Snow Showers	-SHSN, SHSN, +SHSN
Snow Grains	-SG, SG, +SG
Ice Crystals	IC
Ice Pellets	-PL, PL, +PL
Hail (diameter of largest stone ≥ 5 mm)	-SHGR, SHGR, +SHGR
Small Hail (diameter of largest stone < 5 mm)	-SHGS, SHGS, +SHGS
Snow Pellets	-SHGS, SHGS, +SHGS

Obstructions to Vision (visibility 6 mi. or less)

Fog (vis. < 5/8 mi.)	FG
Freezing Fog (vis. < 5/8 mi., temp < 0 to -30°C)	FZFG
Mist (vis. 5/8 to 6 mi.)	BR
Haze	HZ
Smoke	FU
Blowing Snow	BLSN
Blowing Sand	BLSA
Blowing Dust	BLDU
Dust storm (vis. 3/8 to 6 mi.)	-DS, DS
Heavy Dust storm (vis. < 3/8 mi.)	+DS
Sandstorm (vis. 3/8 to 6 mi.)	-SS, SS
Heavy Sandstorm (vis. < 3/8 mi.)	+SS
Dust haze	DU
Volcanic Ash	VA

Additional Phenomena (visibility greater than 6 mi.)

Shallow Fog Patches	MIFG
Fog Patches	BCFG
Fog covering part of aerodrome	PRFG
Drifting Dust	DRDU
Drifting Sand	DRSA
Drifting Snow	DRSN
Dust/Sand Whirls	PO
Volcanic Ash	VA

In the Vicinity Phenomena

Showers in the Vicinity..... VCSH
Dust storm in the Vicinity..... VCDS
Sandstorm in the Vicinity..... VCSS
Fog in the Vicinity.... VCFG
Dust/Sand whirls in the Vicinity ..... VCPO
Blowing Dust in the Vicinity..... VCBLDU
Blowing Sand in the Vicinity..... VCBLSA
Blowing Snow in the Vicinity..... VCBLSN
Volcanic Ash in the Vicinity..... VCVA

Appendix 3 Limited Aviation Weather Observations (LAWO)

Services provided in accordance with this appendix do not meet the requirements for routine or special aerodrome reports (METAR / SPECI).

A Limited Aviation Weather Observation or LAWO is an observation issued by an airport controller. It is designed to provide details on the observation of limited elements in order to support local flight operations.

These limited observations are normally included in the local ATIS recording and updated as required or passed verbally to aircraft arriving and departing the local airport.

These observations provide an indication of the conditions present at the airport from the vantage point of the tower cab. This indication can sometimes be slightly different from an observation that would be conducted from a regular exterior observation point. Distribution for use beyond the local control zone **shall** be in accordance with methods established by NAV CANADA.

Parameters that are required for the LAWO service are restricted to:

1) Tower visibility
2) Tower Ceiling

Definitions

Tower visibility

The prevailing visibility observed from inside the control tower cab.

Tower ceiling

A ceiling observed from inside the control tower cab.

Tower Visibility

Prevailing visibility is the maximum visibility value common to sectors comprising one half or more of the horizon circle.

Requirements

In order to be able to report a tower prevailing visibility, the following requirements **shall** be met:

1) Visibility markers **shall** be used to determine the tower prevailing visibility.
2) A visibility marker chart with suitable markers **shall** be displayed at each LAWO site.
3) Only the markers shown on the visibility chart can be used in the determination of the tower visibility

Procedures

1) To determine prevailing tower visibility, the horizon circle **shall** be divided into as many sectors as there are different values of visibility. The highest visibility value that is common to sectors which cover one half or more of the horizon circle **shall** be taken as the prevailing visibility.
2) The tower visibility **shall** be reported in statute miles and the following values **shall** be used:

Increments of ⅛ SM	0	⅛	¼	⅜	½	⅝	¾
Increments of ¼ SM	1	1 ¼	1 ½	1 ¾	2	2 ¼	2 ½
Increments of 1 SM	3	4	5	6	7	8	up to 15
Increments of 5 SM	20	25	30	35	etc. – **shall** be used only if suitable markers are available.		

3) If the observed prevailing tower visibility is between two reportable values, the lower value **shall** be used.
4) Visibility at night **shall** be determined with the aid of markers in the form of lights. Very powerful or focused light should be used with caution, as their great penetrating power tends to result in too high a value for the visibility. However, obstruction lights on towers and buildings and the various marker lights around an airport may be used for visibility markers. Additionally, extreme caution must be used when determining visibility at night due to the fact that you observe from the inside of a lighted area (tower cab) that may affect your ability to properly assess the visibility value.
5) If suitable markers beyond 15 SM are lacking, 15 SM is the maximum reportable value.
6) Optical devices such as binoculars **shall not** be used by the observer when determining tower visibility.
7) If the observed tower visibility appears to be different from the prevailing visibility that would be observed at ground level, a remark indicating that the ground visibility is likely higher or lower than the tower visibility must be included in the information passed to pilots. When practical, the observer should provide an estimate of the ground visibility.
8) Should the visibility in one or more sector be different by half or less or by double or more than the reported prevailing visibility, the observer **shall** make every effort to supplement the prevailing visibility with a sector visibility remark to pilots as per *NC-SWOP* 3.7.
9) The use of other tools such as weather camera images to help determine tower visibility **shall** be approved by the competent authority before being allowed.
10) The reported tower visibility report **shall** be updated when the tower visibility decreases to less than or if below, increases to equal or exceed the following values:
    a) 3 SM
    b) 1 SM

c) ¾ SM*
d) ½ SM
e) ¼ SM*
f) The additional limits as specified in the Unit Operations Manual

Note: Criteria marked with an asterisk (*) are applicable only at aerodromes with approved precision approaches and only down to and including the lowest published minima for these aerodromes

Tower ceiling

Requirements

In order to be able to report a tower ceiling, the following requirements **shall** be met:

1) The layer **shall** be measured either by a laser ceilometer or when available by a known feature such as a mountain top, a pilot report or radar altitude readings for visually identified aircraft entering the layer.

2) The layer seen from the cab **shall** be either broken (BKN) or Overcast (OVC) or the vertical visibility (VV).

3) The controller **shall** be able to visually assess the layer extent from your observation point.

Procedures

1) An observation of the tower ceiling requires the examination and identification of the clouds and obscuring phenomena (fog, smoke, precipitation, etc.) which prevent an uninterrupted view of the sun, moon, stars or the clear blue of the celestial dome viewed from the inside of the tower cab.

2) Each layer is evaluated individually and then coded into a sky condition in accordance with the rules and procedures for coding sky condition included in *NC-SWOP* Chapter 5.

3) The tower ceiling to be reported is the height above the ground of the first layer that is coded as being broken or OVC or is the value of the VV into a surface-based layer that completely obscures the sky.

4) Layers that are present below the ceiling height **shall** also be reported. Should these layers not be detected by the ceilometer they **shall** be reported as layers below (example: Tower ceiling 3500 BKN, SCT below).

5) When all layers are measured, they **shall** be reported from the lowest to the highest (example: 1500 SCT, tower ceiling 2500 BKN, 4000 OVC).

6) If the ceilometer is unserviceable or does not identify the height of the ceiling layer, the controller **shall** be limited to report the tower ceiling as indeterminate unless you obtain a pilot reported ceiling, can use known measured features (mountains, buildings…) or radar altitude readings for visually identified aircraft at the local airport entering the layer.

7) If the airport lights prevent you from making an observation of the sky condition during night observations and the ceilometer is giving you a measurement then the controller **shall** report the ceiling as indeterminate (example: tower ceiling indeterminate, layer detected at 1900 feet).

8) The reported tower ceiling report **shall** be updated whenever ceiling decreases to less than, or if below, increases to equal or exceed the following values of height:

- 1500 feet
- 1000 feet
- 500 feet
- The additional limits as specified in the Unit Operations Manual

Appendix 4 Specified non-METAR/SPECI aviation weather services

The provision of METAR / SPECI, by human or automated methods, and LWIS must be in full compliance with the requirements of The Standards for Weather Observing Programs in Part A of The Manual of Surface Weather Observation Standards.

Note: An Approach UNICOM (AU) is an air-ground communications service that can provide approach and landing information to IFR pilots. The AU operator may provide a station altimeter setting for the conduct of an instrument procedure based upon part A.1 of this appendix. The estimated wind speed and direction may be provided based upon part A.2 of this appendix.

For automated weather observation services, except for NAV CANADA services that provide AUTO METAR / SPECI and LWIS, the service provider **shall** either meet the requirements of QAMS Chapter 2.2 of MANOBS or the alternative quality assurance requirements below in part A.3 of this appendix.

Aviation weather service providers **shall** enter into formal arrangements with the AIS service provider (NAV CANADA) in order for information related to a MET service to be included in the flight publications. These arrangements **shall** be inclusive of the acceptance of responsibility for services, a commitment to continuous compliance with regulatory standards and to provide notification of changes to services. In the case of service interruption or inability to meet performance standards, immediate notification to support the issuance of a NOTAM is obligatory.

Note: Further details can be found in Advisory Circular AC 803-011 -Formal Arrangements – Aeronautical Data/Information.

Notification Requirements for all specified non-METAR/SPECI aviation weather services:

a) the name, address and telephone number (and e-mail address, as applicable) of the service provider (The person named is responsible for all aspects of the service being provided and is liable for meeting all requirements);
b) the aerodrome or meteorological station, its elevation and the elevation of any pressure sensor with reference to a survey result or benchmark and its geographical coordinates, where the meteorological reports originate;
c) a summary description of the service to be provided including specification of the meteorological elements to be reported;
d) method(s) by which meteorological reports will be disseminated;
e) the schedule (including specification of an 'on request' basis, as applicable), at which meteorological reports will be provided;

And, as applicable, each of the following:

f) the manufacturer, model, and type of meteorological instrumentation used to make the meteorological observations, as applicable;
g) a summary description of any irregularities with respect to the exposure of meteorological instruments;
h) the name, address, telephone number and e-mail address (as applicable), of the person providing calibration of the altimeters to be used;
i) the name, address and telephone number (and e-mail as applicable) of the person who inspected the aircraft altimeters to ensure compliance with the accuracy and quality control requirements of section 3 of part A.1 of this appendix.

Note (1): It should be clear who is working for whom in the provision of services (an organizational chart may be helpful).

Note (2): Further information and contact with TC can be obtained from:
Email: TC.ANSWeatherInfo-InfoMeteoSNA.TC@tc.gc.ca

A.1 Use of Dual Altimeters to report altimeter setting for Approach UNICOM

Meteorological observations of atmospheric pressure measured by dual aircraft altimeters shall not be used in the preparation of aviation routine aviation weather reports (METAR/SPECI).

Any services being provided in compliance with the exemption to The Manual of Surface Weather Observation Standards, as referenced by CAR 804.01 (1) (c), signed 1 April 2007, pertaining to the use of dual aircraft altimeter to provide reports of altimeter settings, will be deemed to be in compliance with these provisions upon publication.

1 Installation, Siting, Testing and Maintenance

1.1 The service provider **shall** establish and follow all practices, procedures and specifications for safe operation and maintenance.

1.2 The service provider **shall** document all the practices, procedures and specifications established and followed in accordance with section 1.1 and **shall** provide all the relevant information to the Minister upon reasonable notice given by the Minister.

1.3 The service provider **shall** obtain written authorization to measure and report station atmospheric pressure from the operator of the aerodrome or station, where the services are being provided, and **shall** notify the operator of the aerodrome or station of any change to the level of service being provided.

1.4 The following **shall** apply to the installation, siting, safe operation and maintenance of the aircraft altimeters used to obtain station meteorological observations of atmospheric pressure and provided as meteorological reports of the current altimeter setting for an aerodrome or station:

(a) A minimum of two independent aircraft altimeters, each meeting the requirements of Technical Standard Order (TSO) C-10b or C10c, or successor version, as adopted by the Airworthiness Manual Chapter - 537 Airworthiness Standards Appliances and Parts Subchapter B - Technical Standard Orders 537.103 **shall** be used;

(b) The altimeters **shall** be of similar make, model and performance;

(c) The altimeters **shall** each be located so as to measure supply data which is representative of the aerodrome or station for which the altimeter setting is required;

(d) The altimeters **shall** be mounted in a box or instrument rack that precludes damage from mishandling and ensures a permanent location;

(e) The position and height of the altimeters **shall** minimize reading errors due to parallax when viewed from the front and a step **shall** be available to offset such errors as necessary;

(f) The altimeters **shall** be kept away free from sources of moisture or sources of forced ventilation or drafts near windows, and kept at a consistent temperature;

(g) The altimeters **shall not** be located within a pressurized building or in a location within a building that may experience fluctuations in ambient air pressure due to wind venting or, forced air heating and/or cooling systems, or other causes that may induce an error of greater than one hundredth of an inch of mercury, equivalent;

(h) The altimeters **shall** be vented to an outside vent, or a static source, should they not meet the conditions of paragraph (g);

(i) The altimeters **shall** both be tagged, or otherwise marked, in plain view showing the following;

  (i) the elevation of the altimeters above Mean Sea Level:

  (ii) the date of the last inspection of both altimeters;

  (iii) that they are "NOT FOR USE IN AIRCRAFT"; and

  (iv) that they are not to be used and **shall** be marked "UNSERVICEABLE" to provide the altimeter setting if the altimeter comparison differs by more than 5 hundredths of an inch of mercury.

(j) The altimeters **shall** each be calibrated, at an avionics facility or other qualified facility where internal adjustments and repairs to an altimeter can be made, in accordance with the provisions of Canadian Aviation Regulation 571.02 and appendix B to the Airworthiness Manual within one year prior to installation and **shall**:

  (i) meet the allowable scale error tolerances in Table I to Appendix B of the Airworthiness Manual up to and including for the full range of atmospheric pressures expected over the aerodrome for which the altimeters are intended for use;

  (ii) meet requirements for hysteresis up to and including the second test point greater in altitude than the elevation of the aerodrome for which the altimeters are intended for use for after effect and case leak test tolerance in Table II to Appendix B of the Airworthiness Manual and case leak and friction altitude tolerances in Table III to Appendix B of the Airworthiness Manual that are appropriate for the full range of atmospheric pressures and rates of change of atmospheric pressure expected over the aerodrome for which the altimeters are intended for use;

  (iii) meet the barometric scale error requirements of Table IV to Appendix B of the Airworthiness Manual with a tolerance of 25 feet; and

  (iv) include a correction card for each altimeter (if necessary) indicating any corrections that must be applied to obtain an accurate reading.

(k) An on-site inspection by a qualified person **shall** be carried out following installation and prior to the first use of the altimeters to ensure that the accuracy provisions of section 3 to this appendix are met.

2 Observations and Reports

2.1 The reference elevation used to compute the altimeter setting **shall** use the elevation of the aircraft altimeters measured to the nearest foot above or below mean sea level as determined from a nearby benchmark or survey.

2.2 The altimeter setting **shall** be read, from each altimeter, and rounded to the nearest lower hundredth of an inch of mercury.

2.3 The reading from each altimeter, pursuant to section 2.2 **shall** be corrected as indicated by the correction card supplied by the calibration facility in accordance with paragraph 1.4(j).

2.4 The airport or stations official meteorological report of altimeter setting reported by the service provider **shall** use the lower of the altimeter setting readings obtained pursuant to sections 2.1 to 2.3.

2.5 All meteorological reports of altimeter setting **shall** contain the following information:

(a) the location station identifier;

(b) the time of the altimeter reading; and

(c) the altimeter setting rounded to the nearest lower hundredth of an inch of mercury.

2.6 All dates and times entered in a meteorological report **shall** be made with reference to the 24 hour clock in Coordinated Universal Time.

2.7 The meteorological report of altimeter setting **shall** be considered valid for a period of no more than 90 minutes.

2.8 Altimeter settings in excess of 31 inches of mercury **shall** be reported as "ALTIMETER SETTING IN EXCESS OF 31 INCHES".

Note: Altimeter settings below 29 inches of mercury should be referred to as "ALTIMETER SETTING LESS THAN 29 INCHES". Altimeter settings higher than 31 inches, or less than 29 inches, of mercury are commonly stated twice in communications with pilots.

3 Accuracy and Quality Control

3.1 The difference in readings between the altimeters **shall** be 5 hundredths of an inch of mercury equivalent, or less.

3.2 The altimeters **shall** receive on-site inspections at least once each year to:

(a) verify that each altimeter reads within 4 hundredths of an inch of mercury compared to the value of the inspection barometer; and

(b) ensure both altimeters provide atmospheric pressure readings that are representative of the aerodrome or station for which they are intended.

3.3 The person performing the inspection pursuant to section 3.2 **shall**

(a) be independent from the manufacturer of the altimeters or from the service provider; and

(b) have significant experience with meteorological instrumentation, access to an inspection barometer with a pressure standard adequate to verify accuracy to within 1 hundredth of an inch of mercury equivalent and have demonstrated experience in establishing traceability of measurements to a known standard.

3.4 If, following three immediately consecutive attempts to obtain a reading and the altimeters do not meet the tolerance required by section 3.1, then they **shall** be immediately tagged or otherwise clearly marked as unserviceable and **shall** be re-calibrated, or reconditioned or replaced prior to any further use.

3.5 If any of the altimeters do not meet the requirements of section 3.2, then they **shall** be immediately tagged or otherwise clearly marked as unserviceable and **shall** remain unserviceable until such time as an inspection by a qualified person shows that they meet these conditions.

3.6 The service provider **shall** ensure that the accuracy of the timing device used to establish the time of the meteorological observation is accurate to within 1 minute of the Coordinated Universal Time.

3.7 The service provider **shall** establish and maintain documentation containing:

1. the following meteorological station information:

   (i) contact information for the service provider and the qualified person providing maintenance services for the meteorological station;

   (ii) contact information for the qualified person providing inspection services for the aircraft altimeters;

   (iii) contact information for the calibration facility that calibrated the aircraft altimeters;

   (iv) location of the aircraft altimeters within the building;

   (v) station climatological description;

   (vi) the person(s) authorized by the service provider to take observations and disseminate reports;

Note: The inclusion of photographs of the equipment or the details of its location in the service documentation are recommended.

(vii) the following information for each altimeter:

(a) the type including manufacturer, model and serial number;

(b) written confirmation of the date and results of the last calibration;

(c) the correction card resulting from the last calibration; and

(d) written confirmation of the date and results of the last inspection.

4 Training

4.1 The service provider **shall** ensure, and maintain documentation showing, that a qualified person(s) providing meteorological observations of atmospheric pressure obtained from aircraft altimeters, and provided as meteorological reports of the current altimeter setting to be used to permit the execution of instrument procedures, has/have received training which includes, as a minimum:

(a) adjusting the altimeter setting button until the known altitude of the altimeter above mean sea level is indicated on the subscale;

(b) activating any buzzer mechanism or tapping the instrument to eliminate effects due to friction of the mechanism;

(c) reading both the altimeters and interpolating values as necessary;

(d) using the correction cards;

(e) determining the correct reading in accordance with section 3;

(f) established quality assurance routines including the comparison of the determined altimeter setting value with previous or nearby altimeter settings;

(g) approved dissemination methods; and

(h) the use and importance of the altimeter setting in civil aviation.

The service provider **shall** provide to the Minister, upon reasonable notice given by the Minister, a copy of the documentation required by section 5.1

A.2 Assessment of wind direction and speed for Approach UNICOM

Any services being provided in compliance with the exemption to The Manual of Surface Weather Observation Standards, as referenced by CAR 804.01 (1) (c), signed February 1, 2007 pertaining to the assessment and reporting of wind direction and speed for Approach UNICOM, will be deemed to be in compliance with the provisions of this appendix upon its publication.

1.1 No person **shall** assess wind direction and speed in support of a straight in landing from an instrument procedure unless the aerodrome has a wind direction indicator that meets the requirements of subsection 301.06 of the *Canadian Aviation Regulations*.

1.2 The wind direction indicator pursuant to 1.1 **shall** have a functioning light source should the meteorological observation be made at night.

1.3 The wind direction and speed **shall** be specifically reported as "estimated" unless measured in accordance with the full requirements as otherwise set out in Chapter 3 of The Manual of Surface Weather Observation Standards and / or with the use of instrumentation that meets the requirements of Chapter 12 of The Manual of Surface Weather Observations Standards.

1.4 The service provider **shall** obtain authorization to report station wind direction and speed from the operator of the aerodrome or station, where the services are being provided, and **shall** notify the operator of the aerodrome or station of any change to the level of service.

1.5 All meteorological reports and record thereof of estimated wind direction and speed **shall** contain the following information:

(a) aerodrome or station name or location identifier;

(b) time of the meteorological observation, to the nearest minute;

(c) notice that the wind direction and speed are "estimated."

(d) whether the wind direction is based on true or magnetic direction.

1.6 The qualified person **shall** immediately report the wind direction and speed as assessed and the time of the observation to the nearest minute in accordance with 1.5, to the person who requested the report.

1.7 The meteorological observation of wind direction and speed **shall** be considered current for a period not exceeding ten minutes.

1.8 The qualified person estimating wind **shall not** report any other elements of a meteorological report unless done so in accordance with the applicable requirements of The Manual of Surface Weather Observation Standards.

1.9 Wind direction and speed **shall** be estimated:

(a) by a qualified person;

(b) only to the nearest 8 points of the compass from which it is blowing; and

(c) based on its effects upon:

(i) the aerodrome wind direction indicator(s) and;

(ii) using the Beaufort wind scale, in an exposed out-of-doors location.

1.10 The training to estimate wind direction and speed **shall** ensure, at a minimum, that the qualified person:

(a) understands and has successfully demonstrated, under practical conditions, correct procedures for using all appropriate aids to estimate the wind direction and speed, including as applicable:

(i) use of the aerodrome or station wind direction indicator(s);

(ii) use of the Beaufort wind scale;

(iii) use of any instrumental aids; and

(iv) all other available and appropriate aids.

(b) has demonstrated an estimation accuracy that differs by no more than one scale of the Beaufort wind scale or equivalent, from the actual wind speed;

(c) understands and has demonstrated, under practical conditions, how to estimate and report the wind direction and speed;

(d) understands the difference between true and magnetic compass directions and when and how to use each, as applicable;

(e) knows the orientation and numbering of the runway(s) at the aerodrome;

(f) has demonstrated knowledge, to at least the 8 points of the compass, of the directions from the point of observation;

(g) understands and has demonstrated correct use of dissemination procedures for meteorological reports in accordance with section 1.5;

(h) understands the need to keep the wind direction indicator in good condition and free from accumulations of ice, snow, nesting activity or other objects and knows the contact procedures to initiate maintenance, as necessary.

A.3 Quality Control for specified automated weather observations

The provision of METAR / SPECI, by human or automated methods, and LWIS must be in full compliance with the requirements of The Standards for Weather Observing Programs in Part A of The Manual of Surface Weather Observation Standards.

Other service providers who provide aviation weather services consisting of automated observation and reporting of any or all of the following: wind direction, speed and character; visibility; present weather; sky condition; temperature; dewpoint temperature or atmospheric pressure using automated weather observation systems **shall** meet either the requirements for Quality Assurance Management Systems in Section 2.2 of Chapter 2 of the Manual of Surface Weather Observation Standards or the quality assurance established below.

Note: Compliance is required with all other applicable requirements of The Standards for Weather Observing Programs in Part A of The Manual of Surface Weather Observation Standards.

The service provider **shall** establish and maintain a station history at the meteorological station for each station that it operates containing:

(a) the type of the meteorological system;

(b) the following meteorological station information including:

- (i) contact information for the service provider and the person providing maintenance services for the meteorological station;
- (ii) location using geographical coordinates and elevation;
- (iii) descriptions of remote and immediate surroundings and obstacles;
- (iv) instrument layout;
- (v) facilities including data transmissions, power supply and cabling; and
- (vi) climatological description; and

(c) the following individual instrument information including:

- (i) type including manufacturer, model, serial number, and operating principles;
- (ii) performance characteristics;
- (iii) calibration data and time;
- (iv) siting and exposure including location, shielding and height above ground;
- (v) measuring or observing program;
- (vi) time of meteorological observations;
- (vii) data acquisition including sampling and averaging;
- (viii) data processing methods and algorithms;
- (ix) preventive and corrective maintenance; and
- (x) data quality

Note: A description of methods used to ensure ongoing data quality should be provided. WMO No. 8 – Guide to Instruments and Methods of Observation –provides guidance material related to the above and, in particular, volume V related to Quality Assurance and Management of Observing Systems. Section 1.6 on Factors Affecting Data Quality and section 1.7 on Surface Data should be carefully noted.

(d) New or significantly modified meteorological instruments of meteorological system **shall** comply with the respective requirements set in section 2.4 of Chapter 2;

(e) A description of the training provided to any personnel providing commissioning, inspection or maintenance services;

(f) station operation manuals used by staff providing services;

(g) a description of the minimum qualifications, training and currency limitations established by the service provider for staff providing services.