World Meteorological Organization

World Weather Watch Technical Report

Handbook on
CLIMAT and CLIMAT TEMP Reporting

(2009 edition)




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Weather • Climate • Water

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Handbook on CLIMAT and CLIMAT TEMP Reporting

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Contents

1 Introduction

CLIMAT and CLIMAT SHIP, and CLIMAT TEMP and CLIMAT TEMP SHIP are the names of the codes for reporting monthly values of meteorological parameters from land and ocean weather stations and for reporting monthly aerological means from land and ocean weather stations. Henceforward, CLIMAT (SHIP) refers to CLIMAT and CLIMAT SHIP codes and CLIMAT TEMP (SHIP) to CLIMAT TEMP and CLIMAT TEMP SHIP codes. CLIMAT (TEMP) (SHIP) refers to all four codes.

World Meteorological Organization (WMO) currently investigates whether a discontinuation of CLIMAT *TEMP* (SHIP) Reporting is feasible. No decision has been made by the time of finishing the revision of this handbook, therefore, the sections on CLIMAT *TEMP* (SHIP) are still included.

The reported parameters in CLIMAT (SHIP) Reports from weather stations include monthly mean values for atmospheric pressure (henceforth “pressure”) at station level and reduced to sea level or to an agreed datum level or the geopotential of an agreed standard constant pressure level, air temperature, daily minimum and daily maximum air temperatures, vapour pressure, precipitation, sunshine characteristics at station level and some other parameters.

The reported aerological parameters in CLIMAT TEMP (SHIP) Reports from weather stations include monthly mean values for pressure, temperature, dew point depression at station level, and geopotential, air temperature, dew-point depression, wind characteristics at specific pressure surfaces.

The global exchange of monthly CLIMAT (SHIP) and monthly aerological CLIMAT TEMP (SHIP) Reports on the Global Telecommunication System (GTS) is essential for the production of Climate System Monitoring (CSM) products. These products include a continuing series of Monthly Bulletins, the regular publishing of biennial Global Climate System Reviews, annual statements on the global climate, and other information concerning El Niño, drought, and temperature and precipitation extremes. CLIMAT (TEMP) (SHIP) Reports should be transmitted as soon as possible after the end of the month and not later than the fifth day of the following month.

Climate monitoring, prediction and research all rely strongly on CLIMAT (SHIP) and CLIMAT TEMP (SHIP) Reports because they are often based on more complete and comprehensive data than are available for daily reports (codes SYNOP, TEMP, PILOT) transmitted on the GTS.

This document shall provide comprehensive information on the regulations for the different code forms and provides instructions on how to set up Reports and Bulletins in the CLIMAT (TEMP) (SHIP) codes. Following the introduction, the chapters of this document for the codes and their descriptions are chapter 2 for CLIMAT, chapter 3 for CLIMAT SHIP and chapter 4 for CLIMAT TEMP and CLIMAT TEMP SHIP. Chapters 5 to 9 provide additional information on Bulletins, quality control and submission of Reports, monitoring of the GSN and GUAN and the BUFR/CREX codes.

Henceforth, the term “this handbook” will refer to the 2009 version of the *Handbook on CLIMAT and CLIMAT TEMP Reporting* (WMO-No. 1188).

Note that for the CLIMAT (TEMP) codes, a software called “CLIREP” has been programmed to simplify forming and decoding Reports. Once set up, the software provides a user interface to enter data and the actual CLIMAT (TEMP) Report is produced; CLIMAT Reports in the form of .txt-files can also be decoded. CLIREP is distributed via the World Climat Data and Monitoring Programme (WCDMP)[1].

[1] Contact: World Climate Data & Monitoring Programme – World Climate Programme – World Meteorological Organization – P.O. Box 2300 – 7 *bis*, avenue de la Paix – CH-1211 Geneva 2 Switzerland – Fax: +41 22 7308042 – Email: wcdmp@wmo.int.

1.1 Common characteristics of the CLIMAT (TEMP) (SHIP) code forms

The form in which the values of the meteorological parameters of one land or ocean weather station are reported is called “Report” and CLIMAT (TEMP) (SHIP) Reports each are specific alignments of characters which can be identified through their syntax by a data processing software. Syntax in this context relates to the code form “FM” of a code (see *Manual on Codes* (WMO-No. 306) [6]) which for each of the codes define a set of regulations that must be followed by the symbols within the code to be considered correctly and unequivocally by the data processing software.

CLIMAT (TEMP) (SHIP) Reports all contain different so-called Sections. The Sections all comprise different amounts of so-called Groups. The Groups contain the actual encoded data. Every Group contains data for a specific parameter, such as the Month and Year in which the data of the report were obtained or the total precipitation of one month. The partitioning of a Report into different Sections is due to the differing contents of the Groups comprised in each Section; for example, one Section of a Report may contain Groups with monthly average values of some parameters and another Section may contain Groups with monthly extreme values of these parameters. More on the partitioning of CLIMAT (TEMP) (SHIP) Reports into Sections and Groups is explained in the descriptions of the codes.

1.2 Common characteristics of observations and calculations for CLIMAT (TEMP) (SHIP) Reports

1.2.1 Observational times

The monthly observational values which shall be entered into the different codes shall be based on daily observational values. Usually, monthly observational values shall be obtained through averaging or accumulating the daily observational values of one month. The daily observational values shall be based on several daily observations at defined main and intermediate standard observation times in coordinated universal time (UTC). Table 1 may be used to convert the respective UTC time into local time.

Note that for CLIMAT (SHIP), observational days are defined by local time and for stations in the eastern/western hemisphere, observational values of the preceding/following UTC day are required to obtain daily observational values.

As an exception, observational days for precipitation are defined from 0601 UTC to 0600 UTC of the following day (hence, six hours of the following UTC day shall be considered as belonging to the preceding UTC day, with eventual observations at 0600 UTC of the following day attributed to the preceding day).

Note that for stations with an *advance* of local time of more than six hours regarding UTC, this regulation implies that *between ½ and ¾* of the precipitation observations of the *current* day in local time are attributed to the preceding day in local time; note that for stations with a *delay* of local time of more than six hours regarding UTC, this regulation implies that *up to ¼* of the precipitation observations of the *preceding* day in local time are attributed to the current day in local time.

In contrast, for CLIMAT TEMP (SHIP), observational days for all stations are defined by UTC days. More information on observational times can be found in the descriptions of the codes.

Table 1: UTC - Local Time conversion table for several time zones.

Local time zone	Conversion from UTC	Local time at 1200 UTC
ADT - Atlantic Daylight	**-3 hours**	**0900**
AST - Atlantic Standard **EDT - Eastern Daylight**	**-4 hours**	**0800**
EST - Eastern Standard **CDT - Central Daylight**	**-5 hours**	**0700**
CST - Central Standard **MDT - Mountain Daylight**	**-6 hours**	**0600**
MST - Mountain Standard **PDT - Pacific Daylight**	**-7 hours**	**0500**
PST - Pacific Standard **ADT - Alaskan Daylight**	**-8 hours**	**0400**
ALA - Alaskan Standard	**-9 hours**	**0300**
HAW - Hawaiian Standard	**-10 hours**	**0200**
Nome, Alaska	**-11 hours**	**0100**
CET - Central European **FWT - French Winter** **MET - Middle European** **MEWT - Middle European Winter** **SWT - Swedish Winter**	**+1 hour**	**1300**
EET - Eastern European, **USSR Zone 1**	**+2 hours**	**1400**
BT - Baghdad, **USSR Zone 2**	**+3 hours**	**1500**
ZP4 - USSR Zone 3	**+4 hours**	**1600**
ZP5 - USSR Zone 4	**+5 hours**	**1700**
ZP6 - USSR Zone 5	**+6 hours**	**1800**
WAST - West Australian Standard	**+7 hours**	**1900**
CCT - China Coast, **USSR Zone 7**	**+8 hours**	**2000**
JST - Japan Standard, **USSR Zone 8**	**+9 hours**	**2100**
EAST - East Australian Standard **GSTGuam Standard,** **USSR Zone 9**	**+10 hours**	**2200**
IDLE - International Date Line **NZST - New Zealand Standard** **NZT - New Zealand**	**+12 hours**	**0000 (Midnight)**

1.2.2 Missing data

If not indicated other in the descriptions on the respective parameters and symbolic letters, the following regulation shall apply.

When certain observational data are not available, estimated values should be found by interpolation wherever possible, using record data. If it is not possible to obtain a complete series of daily values, a useful value may nevertheless be obtained and transmitted using the data which are available, using

statistical methods. If observations on more than ten days are missing, or if there is a period of five consecutive days without any observations, the symbolic letters for the respective parameter shall be encoded as slashes (“/”).

1.2.3 Normals (CLIMAT (SHIP) only) [5]

WMO Technical Regulations define normals as “period averages computed for a uniform and relatively long period comprising at least three consecutive ten-year periods” and climatological standard normals as “averages of climatological data computed for consecutive periods of 30 years as follows: 1 January 1901 to 31 December 1930, 1 January 1931 to 31 December 1960 etc.” In the case of stations for which the most recent climatological standard normal is not available (either because the station has not been in operation for the entire period of 30 years or for some other reason), ‘adjusted normals’ could be used, i.e. means based on a shorter period than that of the climatological standard normal, and reduced to the reference period. These short-period means should be based on observations extending over a period of at least ten years in the case of surface land stations, or of at least five years in the case of ocean weather stations. Provisional normals based on less than ten years, or less than five years, respectively, should be revised as soon as data for a period of ten years / five years, respectively, become available. Provisional normals based on a period of between tan and 20 years should be revised as soon as data for a period of 20 years become available and, finally, replaced by the most recent ‘climatological standard normals’, as soon as the latter become available.

The normals should be based on observations which are comparable with the observations used for compiling the Reports. For example, if a monthly mean is based on four observations per day at fixed times, the normal with which it is to be compared should also be based on observations made at the same four fixed times.

1.3 Differences in comparison with the *Manual on Codes* (WMO-No. 306) [6] and earlier versions of the *Handbook on CLIMAT and CLIMAT TEMP Reporting* (WMO/TD-No. 1188)

1.3.1 Examples of the codes

Within this handbook, there are two different types of examples for CLIMAT (TEMP) (SHIP) codes. The first type is intended to show the code form with symbolic letters to indicate where data shall be inserted and how many digits the different Groups of data shall comprise. Symbolic letters always are letters, some of which are indexed. Table 2, left demonstrates the first type of examples for the CLIMAT code.

The second type is intended to show examples of real codes with data already inserted. Table 2, right demonstrates the second type of examples for the CLIMAT code. This second type of examples therefore always shows numbers or symbols where the first type of examples shows symbolic letters. Which numbers and symbols can be entered for the symbolic letters is explained in the descriptions of the codes (chapters 2, 3, 4).

Table 2: Difference of examples used in this Handbook: CLIMAT code form (left) and real CLIMAT Report (right). Analogue for CLIMAT SHIP and CLIMAT TEMP (SHIP) Reports.

CLIMAT code form (coding of a CLIMAT Report with symbolic letters)	Example of a real CLIMAT Report with numbers and symbols
CLIMAT MMJJJ IIiii 111 1 $\overline{P_0P_0P_0P_0}$ 2 $\overline{PPPP}$ 3s_n $\overline{TTT}$ $s_ts_ts_t$ 4s_n $\overline{T_xT_xT_x}$ s_x $\overline{T_nT_nT_n}$ 5 $\overline{eee}$ 6$R_1R_1R_1R_dn_rn_r$ 7$S_1S_1S_1p_sp_sp_s$ 8$m_Pm_Pm_Tm_Tm_{Tx}m_{Tn}$ 9$m_em_em_Rm_Rm_Sm_S$ 222 0$Y_bY_bY_cY_c$ 1 $\overline{P_0P_0P_0P_0}$ 2 $\overline{PPPP}$ 3s_n $\overline{TTT}$ $s_ts_ts_t$ 4s_n $\overline{T_xT_xT_x}$ s_x $\overline{T_nT_nT_n}$ 5 $\overline{eee}$ 6$R_1R_1R_1R_1n_rn_r$ 7$S_1S_1S_1$ 8$y_Py_Py_Ty_Ty_{Tx}y_{Tx}$ 9$y_ey_ey_Ry_Ry_Sy_S$ 333 0$T_{25}T_{25}T_{30}T_{30}$ 1$T_{35}T_{35}T_{40}T_{40}$ 2$T_{n0}T_{n0}T_{x0}T_{x0}$ 3$R_{01}R_{01}R_{05}R_{05}$ 4$R_{10}R_{10}R_{50}R_{50}$ 5$R_{100}R_{100}R_{150}R_{150}$ 6$s_{00}s_{00}s_{01}s_{01}$ 7$s_{10}s_{10}s_{50}s_{50}$ 8$f_{10}f_{10}f_{20}f_{20}f_{30}f_{30}$ 9$V_1V_1V_2V_2V_3V_3$ 444 0$s_nT_{xd}T_{xd}T_{xd}y_xy_x$ 1$s_nT_{nd}T_{nd}T_{nd}y_ny_n$ 2$s_nT_{ax}T_{ax}T_{ax}y_{ax}y_{ax}$ 3$s_nT_{an}T_{an}T_{an}y_{an}y_{an}$ 4$R_xR_xR_xR_xy_ry_r$ 5$i_wf_xf_xf_xy_{fx}y_{fx}$ 6$D_{ts}D_{ts}D_{gr}D_{gr}$ 7$i_yG_xG_xG_nG_n$=	CLIMAT 07008 84140 111 10034 2//// 30243/// 402840211 5254 60008404 7057103 8000000 9000000 222 06190 10029 2//// 30233/// 402810199 5/// 6002302 7549 80900040 9300002 333 03005 30200 40000 444 2032828 3018431 4005413 5004051 60000=

Note that symbolic letters for some parameters may seem to appear in more than one Section but by this refer to different entities (e.g., $P_0P_0P_0P_0$ in Section 1 of a CLIMAT Report refers to mean monthly pressure at station level whereas $P_0P_0P_0P_0$ in Section 2 refers to the average mean monthly pressure at station level over a defined normal period of observations at the respective station).

Note that in the text of this handbook, symbolic letters for certain data are given in bold and pink, fixed coding symbols are in bold and black (e.g. Group **MMJJJ**, Group **1** $\overline{\mathbf{P_0P_0P_0P_0}}$, Group **CLIMAT**) and examples of coded material (where data has been entered for the symbolic letters) are indicated by quotation marks, with data in pink and fixed coding symbols in black (an example of Group **MMJJJ** could be “02003”, an example of Group **1** $\overline{\mathbf{P_0P_0P_0P_0}}$ could be “10023”). This formatting is only intended to simplify examples within this handbook and is of no importance to real CLIMAT (TEMP) (SHIP) Reports (Table 2 shows examples without this formatting).

1.3.2 Use of different terms

Generally, the terminology of the *Manual on Codes* (WMO-No. 306) [6] is used. Where the *Manual on Codes* does not define clear terms, it was tried to use one definite term in this handbook.

As noted in 1.3.1, some of the Sections and Groups within the CLIMAT (TEMP) (SHIP) codes are preceded by or composed of specific fixed coding symbols which identify the respective code or specific Sections or Groups. These fixed coding symbols shall not be altered. In the *Manual on Codes* and earlier versions of the *Handbook on CLIMAT and CLIMAT TEMP Reporting*, different terms or no particular terms are used to describe these fixed coding symbols. For the sake of consistency, they are all called “Identifiers” in this handbook (e.g., “Code Identifier”, “Section Identifier”, “Group Identifier”, “End Identifier”).

For the sake of recognition of the subdivisions of CLIMAT (TEMP) (SHIP) Reports, words “Section”, “Group” and “Header” are written with a capital.

The term “slash” is used instead of the term “solidus” to describe the symbol “/”.

2 FM 71–XII CLIMAT: Report of monthly values from a land station

CLIMAT is the name of the code for reporting monthly values from a land station. Its index number in WMO Classification is “FM 71–XII”, where “71” is the number of the code in the WMO code numeration and “XII” is the number of the respective session of the WMO Commission for Basic Systems (CBS) that adopted major amendments to the code.

Each land station should be located so as to provide data which are representative for the surrounding area.

The main standard times for synoptic surface observations shall be 0000, 0600, 1200 and 1800 UTC (coordinated universal time; formerly known as Greenwich Mean Time (GMT)). The intermediate standard times for surface synoptic observations shall be 0300, 0900, 1500 and 2100 UTC.

Every effort should be made to obtain observations at least four times per day at the main standard times.

2.1 CLIMAT: Structure, code form, and general regulations

2.1.1 CLIMAT Report structure

The overall CLIMAT Report structure and a description of the contents related to each Section are shown in Table 3. Note that the so-called ‘End Identifier’ is not a Section like the other Sections but shall always be added after the last Section without a space.

Table 3: Section-based structure and description of respective contents of a CLIMAT Report.

Section number	Section Identifier	Contents
0	-	Report Header. Code name (CLIMAT) and location of observation point in time (month and year) and space (station number). *This Section is mandatory.*
1	**111**	Monthly averaged meteorological values (pressure, temperature etc.) for the month and station referred to in Section 0, including number of days with missing data for the respective parameter. *This Section is mandatory.*
2	**222**	Normal climatological values for the month and station referred to in Section 0, averaged for the respective month over a defined reference period (usually 30 years), including number of years with missing data for the respective month and parameter. *This Section is optional and shall only be reported if the reference period was changed, for the twelve months following that change.*
3	**333**	Number of days with parameters beyond certain thresholds for the month and station referred to in Section 0. *This Section is optional.*
4	**444**	Extreme values and frequency of thunderstorms and hail for the month and station referred to in Section 0. *This Section is optional.*
		End Identifier “=” to indicate the end of the Report, placed after the last Section of the Report without a space. *The End Identifier is mandatory.*

2.1.2 The FM 71–XII CLIMAT code form

Table 4 shows the 5 different Sections of a CLIMAT code and the relating coding material composed by the respective Section Identifier and contents that follow the Section Identifiers.

Table 4: CLIMAT code form. Note that columns "Section Identifier" and "Contents" refer to actual coding material whereas column "Section number" is for easier understanding of the table.

Section number	Section Identifier	Contents
0	**CLIMAT**	MMJJJ IIiii
1	**111**	1 $\overline{P_0P_0P_0P_0}$ 2 $\overline{PPPP}$ 3s_n $\overline{TTT}$ $s_ts_ts_t$ 4s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$ 5 $\overline{eee}$ 6$R_1R_1R_1R_1R_dn_rn_r$ 7$S_1S_1S_1p_sp_sp_s$ 8$m_Pm_Pm_Tm_Tm_{Tx}m_{Tn}$ 9$m_em_em_Rm_Rm_Sm_S$
2	**222**	0$Y_bY_bY_cY_c$ 1 $\overline{P_0P_0P_0P_0}$ 2 $\overline{PPPP}$ 3s_n $\overline{TTT}$ $s_ts_ts_t$ 4s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$ 5 $\overline{eee}$ 6$R_1R_1R_1R_1n_rn_r$ 7$S_1S_1S_1$ 8$y_Py_Py_Ty_Ty_{Tx}y_{Tx}$ 9$y_ey_ey_Ry_Ry_Sy_S$
3	**333**	0$T_{25}T_{25}T_{30}T_{30}$ 1$T_{35}T_{35}T_{40}T_{40}$ 2$T_{n0}T_{n0}T_{x0}T_{x0}$ 3$R_{01}R_{01}R_{05}R_{05}$ 4$R_{10}R_{10}R_{50}R_{50}$ 5$R_{100}R_{100}R_{150}R_{150}$ 6$s_{00}s_{00}s_{01}s_{01}$ 7$s_{10}s_{10}s_{50}s_{50}$ 8$f_{10}f_{10}f_{20}f_{20}f_{30}f_{30}$ 9$V_1V_1V_2V_2V_3V_3$
4	**444**	0$s_nT_{xd}T_{xd}T_{xd}y_xy_x$ 1$s_nT_{nd}T_{nd}T_{nd}y_ny_n$ 2$s_nT_{ax}T_{ax}T_{ax}y_{ax}y_{ax}$ 3$s_nT_{an}T_{an}T_{an}y_{an}y_{an}$ 4$R_xR_xR_xR_xy_ry_r$ 5$i_wf_xf_xf_xy_{fx}y_{fx}$ 6$D_{ts}D_{ts}D_{gr}D_{gr}$ 7$i_yG_xG_xG_nG_n$
		=

2.1.3 General regulations for the FM 71–XII CLIMAT code form

1. CLIMAT Reports of several stations may be combined in a CLIMAT Bulletin. In this case, the Groups **CLIMAT** and MMJJJ shall only be included in the first Report of the Bulletin and shall not be repeated for each (or any) Report that follows. These following Reports shall begin with Group IIiii.
2. In the case of a combination of CLIMAT Reports of several stations in a Bulletin, the Reports shall all be for the same specific month only.
3. Monthly means shall be calculated on the basis of daily means.
4. Sections 0 and 1 are mandatory and shall always be reported.
5. Sections 2, 3 and 4 are optional and shall usually be included in the CLIMAT Report according to National Meteorological Service rules and regulations.
6. The respective Section Identifier ("111", "222", "333" and "444") for Sections 1-4 has to be included in the CLIMAT Report if it contains any of the Groups from the corresponding Section.
7. Each Group has a Group Identifier, from "0" to "9", which has to be included in every Group.
8. If one or several parameters of a Group are missing, the fields for the missing parameters shall be encoded with the appropriate number of slashes ("/"). If all parameters of a Group are missing, the Group shall be omitted from the Report. The numbering of the following Group Identifiers shall not be altered in this case.

9. If all parameters for any of Sections 2-4 are missing, the corresponding Section shall be omitted. The numbering of the Section Identifiers of the remaining Sections shall not be altered in this case.

10. In Section 1, Groups with Group Identifiers “8” and “9” (number of days for which values of certain parameters are missing) shall always be included. If the number of days with missing values for any parameter exceeds 10, or if there is a period of five or more consecutive days with missing values for any parameter, the respective parameter should not be included in the respective Group in Section 1.
    It is, though, common practice at many national meteorological services (USA, Russia, …) to define three days as an acceptable limit of missing days from the record for a parameter during a month for the majority of the parameters included in CLIMAT Reports, and zero days for parameters such as R_1 (total precipitation or snow water equivalent for the month) and S_1 (total sunshine duration for the month) to avoid possible significant observational errors for monthly values.

11. If data for a CLIMAT Report to be included in a Bulletin is not available at the respective editing centre, the CLIMAT Report shall only consist of Section 0 followed by a space and “NIL=”. (Sections 1-4 shall not be included in this case.)

12. If any parameter of Section 0 is missing, the CLIMAT Report shall not be transmitted.

13. If one or more daily values are missing, the corresponding Group in Section 4 (optional Section, containing extreme phenomena) shall be omitted, because of the high probability that the extreme phenomeneon is the resaon for the absence of the daily data.

14. The different Groups in the Report have to be separated from each other by a space (“ ”). No spaces shall be included within any Group.

15. The End Identifier is an equal sign (“=”) and has to be placed after the final Section of the Report without a space.

16. The WMO Technical Regulations provide that CLIMAT Reports shall be transmitted not later than the fifth day of the month following the month to which the data refer.

17. The monthly data shall be encoded in the code form which was in force during the month to which the data refer (e.g. if a CLIMAT code change came into effect on 1 November, the CLIMAT data for October, transmitted in November, will be in the old code form; the first CLIMAT Report in the new code form will be for November data, transmitted in December).

2.2 Recommended algorithm for CLIMAT Report forming

2.2.1 Section 0: Report Header

Section 0 is mandatory for any CLIMAT Report and shall always be included. If the value for any parameter of Section 0 is missing, the respective CLIMAT Report shall not be transmitted. Section 0 consists of three Groups, the Section identifier “CLIMAT” that also is the code Identifier (1st Group), information on the month and year of data collection for the Report (2nd Group) and the block number and station number (3rd Group).

2.2.1.1 Compiling the different Groups of Section 0

A coding example of Section 0, based on examples given within the descriptions of the Groups, and an example highlighting the variability of Section 0 of CLIMAT Reports combined in a CLIMAT Bulletin (see 5, pp. 105 for more information on Bulletins), are given in 2.2.1.2.

2.2.1.1.1 CLIMAT

Section and Code identifier

The invariant Group “CLIMAT” shall be used as the first Group of a single CLIMAT Report or as the first Group of the first CLIMAT Report in a CLIMAT Bulletin (see 5, pp. 105 for more information on Bulletins).

2.2.1.1.2 MMJJJ

Month and year of data collection

MM – Month of data collection

MM shall be encoded as the number of the respective month (UTC) (inclusive preceding zero, if necessary) of the year.

JJJ – Year of data collection

JJJ shall be encoded as the respective year (UTC). Only the hundreds, tens and single digits (hence, the last three digits of the year) of the year shall be encoded in **JJJ** (inclusive preceding zeros, if necessary).

Example 1:

January ➔ **MM** = “01”

1977 ➔ **JJJ** = “977”

The whole Group **MMJJJ** for this example shall be coded “01977”.

Example 2:

November ➔ **MM** = “11”

2004 ➔ **JJJ** = “004”

The whole Group **MMJJJ** for this example shall be coded “11004”.

2.2.1.1.3 IIiii

Block number and station number

II – Block number.

II shall be encoded as the block number that defines the area in which the reporting station is positioned. The block number is allocated to one country or a part of it or more countries in the same region. The list of block numbers for all countries is given in *Weather Reporting* (WMO-No. 9) [10], *Volume A – Observing Stations*.

iii – Station number.

iii shall be encoded as the station number that has been assigned to the reporting station following national and WMO regulations.

Examples:

The whole Group shall be coded as "11035" for the station Vienna (Austria) and "11010" for the station Linz (Austria).

2.2.1.2 A coding example of Section 0

Section 0 of a CLIMAT Report containing the values of the examples given above (2.2.1.1) (station Vienna (index 11035) for January 2004), including the Section and Code Identifier "CLIMAT" shall be:

Example:

"CLIMAT 01004 11035"

The following example of a CLIMAT Bulletin containing two CLIMAT Reports (from Austrian stations Vienna (index 11035) and Linz (index 11010) for January 2004) is intended to highlight the different coding of Section 0 of the first CLIMAT Report of a Bulletin and the following CLIMAT Reports of a Bulletin. (Only Section 0 of both included Reports is written out in this example whereas the following Sections of both Reports are shortened and represented by the italic characters "*Data for …*".)

Example:

"CLIMAT 01004 11035 *Data for Vienna, January 2004*=

11010 *Data for Linz, January 2004*="

More information on CLIMAT Bulletins can be found in chapter 5, pp. 105.

2.2.2 Section 1: Monthly data including number of days missing from the records

Section 1 is mandatory for any CLIMAT Report and shall always be reported (except when it is impossible to form a CLIMAT Report and only the Group "NIL" is coded instead of all Sections 1-4). It contains monthly values of several parameters. Generally, the calculation of these monthly values is based on daily observational values. Hence, for inserting data into the Groups of Section 1 and compiling Section 1, certain parameters have to be available and some calculations have to be conducted.

The number of days missing from the record of the values for a certain parameter shall be obtained as indicated in the respective description in 2.2.2 or as indicated in 1.2.2.

Section 1 consists of the Section Identifier "111" and nine Groups with the Group Identifiers "1", "2", …, "9".

2.2.2.1 Parameters needed

For forming Section 1 of a CLIMAT Report for the respective month, daily values (of days in local time, except for total precipitation, see 1.2 and 2.2.2.1.1) of the following eight parameters which are regularly observed at land stations are needed:

1. mean pressure at station level $P_{0\_day\text{-}j}$ (accuracy of 0.1 hPa)
2. mean pressure reduced to sea level or to an agreed datum level $P_{day\text{-}j}$ (accuracy of 0.1 hPa)
   or mean geopotential of an agreed standard constant pressure level $H_{day\text{-}j}$ (accuracy of 1 gpm)
   (see below for applying regulations and recommended formulae)
3. mean air temperature $T_{day\text{-}j}$ (accuracy of 0.1 ºC)
4. maximum air temperature $T_{max\_day\text{-}j}$ (accuracy of 0.1 ºC)
5. minimum air temperature $T_{min\_day\text{-}j}$ (accuracy of 0.1 ºC)
6. mean vapour pressure $e_{day\text{-}j}$ (accuracy of 0.1 hPa)
7. total precipitation $R_{day\text{-}j}$ (accuracy of 0.1 mm)
8. total sunshine $S_{day\text{-}j}$ (accuracy of 0.1 h)

For calculation advice for these parameters, see below (2.2.2.1.1 - 2.2.2.1.6).

The main standard times for surface synoptic observations are 0000, 0600, 1200 and 1800 UTC. The intermediate standard times for surface synoptic observations are 0300, 0900, 1500 and 2100 UTC. Mean daily values shall be calculated on the basis of observations either at the UTC main standard times for surface synoptic observations or at both the UTC main and intermediate standard times for surface synoptic observations for each day in local time (0000 - 2359). As an exception, observational days for precipitation are defined from 0601 UTC to 0600 UTC of the following day (hence, six hours of the following UTC day shall be considered as belonging to the preceding UTC day). Local time for stations in the eastern hemisphere has a positive offset with respect to UTC, and for stations in the western hemisphere a negative one. That means, that for the calculation of daily values in local time from stations in the eastern hemisphere some observations from the preceding UTC day are required, whereas for stations in the western hemisphere some observations from the following UTC day; see also 1.2.

Table 1 (p. 3) may be used to convert UTC to the respective local time.

2.2.2.1.1 Daily means for pressure at station level, air temperature, and vapour pressure

The daily mean pressure at station level $P_{0\_day\text{-}j}$ is the arithmetic mean of all four or eight pressure values observed during a day j.

The daily mean air temperature $T_{day\text{-}j}$ is the arithmetic mean of all four or eight air temperature values observed during a day j.

The daily mean vapour pressure $e_{day\text{-}j}$ is the arithmetic mean of all four or eight vapour pressure values observed during a day j.

Mean daily values shall be calculated as an average of observation values at the UTC standard times for surface synoptic observations which correspond to a given day j in local time (0000 - 2359 local time) for all days of the respective month. All four or eight observations shall be used for daily averaging.

If any value necessary for the calculation of a mean daily value is missing, the missing value, if possible, should be taken from appropriate autographic records. If this cannot be done, and if it was intended to calculate the mean daily value on the base of eight standard times for surface synoptic observations, then only the four main or intermediate standard times for surface synoptic observations shall be used for calculation. If this cannot be done, the respective daily mean value shall be marked as missing. It is not allowable to use less than four either main or intermediate standard times for surface synoptic observations for the calculation of a mean daily value.

A mean daily value $F_{day\text{-}j}$ for a day j of the respective month for a parameter F (as a placeholder for the parameters pressure, air temperature and vapour pressure) shall be calculated as

$$F_{day-j} = \left(\frac{\sum_{i=1}^{x} f_i}{x} \right) \quad (1)$$

f_i observed value for the respective parameter at observation i

x number of observations on the respective day (4 or 8)

The number of days missing from the records for daily mean pressure, daily mean air temperature and daily mean vapour pressure shall be defined as:

m_P number of days missing from the record for daily mean pressure for the respective month (see also note below)

m_T number of days missing from the record for daily mean air temperature for the respective month

m_e number of days missing from the record for daily mean vapour pressure for the respective month

Note that m_P shall be commonly used for missing values of both daily mean pressure at station level and reduced to sea level or to an agreed datum level or daily mean geopotential of an agreed standard constant pressure level (as indicated in *Weather Reporting* (WMO-No. 9) [10], *Volume A – Observing Stations*), since the calculation of pressure at either levels is based upon pressure at station level. If for any reason the number of days missing from the record for pressure at station level is less than the number of days missing from the record for mean pressure reduced to sea level/an agreed datum level / geopotential of agreed standard constant pressure level, only the number of days missing from the records for pressure at station level shall be considered when encoding m_P. The Group **2** $\overline{\text{PPPP}}$ (Group 2, see 2.2.2.2.2, p. 17) shall be omitted from Section 1 in such a case.

2.2.2.1.2 Daily mean pressure reduced to sea level or to an agreed datum level or geopotential of an agreed standard constant pressure level

The daily mean pressure reduced to sea level or to an agreed datum level $P_{day\text{-}j}$ is the theoretical daily pressure at either of these levels, using daily mean pressure, temperature and vapour pressure values observed at the station for calculation. The daily mean geopotential of an agreed standard constant pressure level $H_{day\text{-}j}$ is the theoretical daily height, in geopotential metres, of a defined pressure level, using daily mean pressure, temperature and vapour pressure values observed at the station for calculation.

It is indicated in *Weather Reporting* (WMO-No. 9) [10], *Volume A – Observing Stations* which parameter is to be calculated for a specific station.

Calculations shall be conducted according to National Meteorological Service regulations. The equations recommended in [2], given below, may also be used.

The geopotential in gpm of the station H_{sta} is needed in all cases (approximative equation) [2]

$$H_{sta} \approx \frac{Z}{\left(1+\frac{Z}{6370\ \mathrm{m}}\right)} \tag{2}$$

Z geometric station elevation above mean sea level [m]

Recommended algorithm for the calculation of $P_{day\text{-}j}$

The daily mean pressure reduced to sea level or to an agreed datum level $P_{day\text{-}j}$ can be calculated with the appropriate of the following two equations[3].

If the geopotential of the station H_{sta} is *greater* than the one of sea level or the agreed datum level H_{fix}

$$P_{day-j} = P_{0\_day-j} \cdot 10^{\left(\frac{0.0148275\frac{K}{gpm}\cdot(H_{sta}-H_{fix})}{T_{day-j}+0.00325\frac{K}{gpm}\cdot(H_{sta}-H_{fix})+e_{day-j}\cdot 1.2\frac{K}{hPa}}\right)} \tag{3}$$

If the geopotential of the station H_{sta} is *less* than the one of sea level or the agreed datum level H_{fix}

$$P_{day-j} = P_{0\_day-j} \cdot 10^{-\left(\frac{0.0148275\frac{K}{gpm}\cdot(H_{fix}-H_{sta})}{T_{day-j}-0.00325\frac{K}{gpm}\cdot(H_{fix}-H_{sta})+e_{day-j}\cdot 1.2\frac{K}{hPa}}\right)} \tag{4}$$

$P_{0\_day\text{-}j}$ daily mean pressure at station level for day j [hPa]

H_{sta} geopotential of the station [gpm]

H_{fix} geopotential of sea level or agreed datum level [gpm]

[2] This equation is a simplification suggested in [2]. Since the required accuracy of the geopotential is full metres, a multiplier representing the variation of the gravitational acceleration in the exact formula can be disregarded. [2]

[3] Derived from [2], 5, using an assumed lapse rate a of 0.0065 K/m or 0.0065 K/gpm, as recommended in [1], 2.9 and [2], Annex 4 and values for the function of the geopotential station elevation C_h of 0.12 K/hPa, as recommended in [2], 5 and a hypsometric constant of 0.0148275 K/gpm, as given in [2], 3.

$T_{day\text{-}j}$ daily mean temperature at station level for day j[4] [K] (if in ºC, add 273.15 K to obtain temperature in K)

$e_{day\text{-}j}$ mean vapour pressure at station level [hPa]

Recommended algorithm for the calculation of $H_{day\text{-}j}$

The daily mean geopotential of an agreed standard constant pressure level can be calculated with the appropriate of the two following two equations[5], as recommended in [1], 2.13 & 2.14 and [2], 8.4.

If the daily mean pressure at station level $P_{0\_day\text{-}j}$ for day j is *less* than the agreed standard constant pressure level P_{stan}

$$H_{day-j} = H_{sta} - \frac{\left(\log\frac{P_{stan}}{P_{0\_day-j}}\right)\cdot\left(T_{day-j} + e_{day-j}\cdot C_h\right)}{\left(0.0148275\ \frac{K}{gpm} - 0.00325\ \frac{K}{gpm}\cdot\log\frac{P_{stan}}{P_{0\_day-j}}\right)} \quad (5)$$

According to [2], 8.4, the following values for C_h in K/hPa shall be used, dependent on the respective geopotential of the station H_{sta}:

C_h = 0.12 for H_{sta} < 2000 gpm
0.15 for 2000 m < H_{sta} < 4000 gpm
0.20 for H_{sta} > 4000 gpm

If the daily mean pressure at station level $P_{0\_day\text{-}j}$ for day j is *greater* than the agreed standard constant pressure level P_{stan}

$$H_{day-j} = H_{sta} + \frac{\left(\log\frac{P_{0\_day-j}}{P_{stan}}\right)\cdot\left(T_{day-j} + e_{day-j}\cdot C_h\right)}{\left(0.0148275\ \frac{K}{gpm} + 0.00325\ \frac{K}{gpm}\cdot\log\frac{P_{0\_day-j}}{P_{stan}}\right)} \quad (6)$$

According to [2], 8.4, the following values for C_h in K/hPa shall be used, dependent on the respective geopotential of the station H_{sta}:

C_h = 0.12 for H_{sta} < 4000 m
0.15 for H_{sta} > 4000 m

P_{stan} agreed standard constant pressure level [hPa]

[4] The daily mean temperature at station level $T_{day\text{-}j}$ shall be corrected as indicated in [1], 2.10, according to the rules of National Meteorological Services, for stations with special orographical situations (e.g. locations in high altitude valleys). Recommendations in [2], 3.4 may be used.
[5] Footnote 4 shall apply.

2.2.2.1.3 Daily maximum air temperature

The daily maximum air temperature $T_{max\_day\text{-}j}$ is the highest air temperature of a specific day j from 0000 - 2359 local time, obtained by maximum thermometer. The following value $T'_{max\_day\text{-}j}$ shall be used as an additional quality check procedure

$$T'_{max\_day\text{-}j} = \max\{T_i, i = 1, \ldots, x\} \quad (7)$$

x number of observations on the respective day (4 or 8)

$T_{max\_day\text{-}j}$ should be greater than or equal to $T'_{max\_day\text{-}j}$.

The number of missing values for daily maximum air temperature shall be defined as:

m_{Tx} number of days missing from the record for daily maximum air temperature for the respective month

2.2.2.1.4 Daily minimum air temperature

The daily minimum air temperature $T_{min\_day\text{-}j}$ is the lowest air temperature of a specific day j from 0000 - 2359 local time, obtained by minimum thermometer. The following value $T'_{min\_day\text{-}j}$ shall be used as an additional quality check procedure

$$T'_{min\_day\text{-}j} = \min\{T_i, i = 1, \ldots, x\} \quad (8)$$

x number of observations on the respective day (4 or 8)

$T_{min\_day\text{-}j}$ should be less than or equal to $T'_{min\_day\text{-}j}$.

The number of missing values for daily minimum air temperature shall be defined as:

m_{Tn} number of days missing from the record for daily minimum air temperature for the respective month

2.2.2.1.5 Total precipitation for the day

The total precipitation for the day $R_{day\text{-}j}$ is the accumulated precipitation of a specific day j from 0601 - 0600 UTC (hence, six hours of the following UTC day shall be considered as belonging to the preceding UTC day), see also 1.2. For non-automatic precipitation gauges, $R_{day\text{-}j}$ shall be calculated as

$$R_{day-j} = \sum_{i=1}^{x} R_i \quad (9)$$

R_i observed precipitation amount between observations i-1 and i

x number of observations on the respective day (4 or 8)

If there were no observations of precipitation over a day j or a part of a day j, $R_{day\text{-}j}$ shall be considered as missing.

The number of missing values for the total precipitation for a day shall be defined as:

m_R number of days missing from the record for total precipitation for the day for the respective month

2.2.2.1.6 Total sunshine for the day

The total sunshine for the day $S_{day\text{-}j}$ is the accumulated sunshine duration of a specific day j from 0000 - 2359 local time. Depending on the used measurement method, duration reading may differ. For non-automatic sunshine gauges $S_{day\text{-}j}$ may be calculated as

$$S_{day-j} = \sum_{i=1}^{x} S_i \quad (10)$$

S_i observed sunshine duration between observations i-1 and i

x number of observations on the respective day (4 or 8)

If there were no observations of sunshine for a day j or a part of a day j, $S_{day\text{-}j}$ shall be considered as missing.

The number of missing values for the total sunshine for the day shall be defined as:

m_S number of days missing from the record for total sunshine for the day for the respective month

2.2.2.2 Compiling the different Groups of Section 1

Monthly mean values shall be calculated on the basis of daily mean values (for the day in local time) and monthly accumulated values shall be calculated as sums of the daily accumulations, as obtained during the respective month (in local time). The monthly values shall be encoded, according to the regulations listed and described below, into the Groups that make up Section 1.

N refers to the number of days of the respective month.

A coding example of Section 1, based on examples given within the descriptions of the Groups, is given in 2.2.2.3.

2.2.2.2.1 1 $\overline{P_0P_0P_0P_0}$

Group 1 – Monthly mean pressure at station level

The mean monthly pressure at station level P_0 shall be calculated as

$$P_0 = \frac{\sum_{j=1}^{N-m_P} P_{0\_day-j}}{N - m_P} \quad (11)$$

$P_{0\_day\text{-}j}$ daily mean pressure at station level for day j of the respective month

$N\text{-}m_P$ number of available values for $P_{0\_day\text{-}j}$

P_0 shall be rounded to tenths of a hectopascal (0.1 hPa).

$\overline{P_0P_0P_0P_0}$ shall be encoded as the value of P_0, with the following regulations. Only the hundreds, tens, singles and tenths digits shall be encoded in $\overline{P_0P_0P_0P_0}$ (inclusive preceding zeros, if necessary), the thousands digit of P_0 shall be omitted in case P_0 is greater than 999.9 hPa ($P_0 \geq 1000$ hPa). The decimal point of P_0 shall be omitted.

Examples:

P_0 = 982.3 hPa ➔ $\overline{P_0P_0P_0P_0}$ = "9823"

P_0 = 1014.2 hPa ➔ $\overline{P_0P_0P_0P_0}$ = "0142"

The Group **1** $\overline{P_0P_0P_0P_0}$, including the Group Identifier "1", for these examples shall be coded "19823" and "10142", respectively.

2.2.2.2.2 2 $\overline{PPPP}$

Group 2 – Monthly mean pressure reduced to sea level or to an agreed datum level or geopotential of an agreed standard constant pressure level

For every station, either the monthly mean pressure reduced to sea level / to an agreed datum level or the geopotential of an agreed standard constant pressure level shall be calculated, as indicated in *Weather Reporting* (WMO-No. 9) [10], *Volume A – Observing Stations*.

The monthly mean pressure reduced to sea level or to an agreed datum level P shall be calculated as

$$P = \frac{\sum_{j=1}^{N-m_P} P_{day-j}}{N - m_P} \qquad (12)$$

P_{day-j} daily mean pressure reduced to sea level or to an agreed datum level for day j of the respective month

$N\text{-}m_P$ number of available values for P_{day-j}

P shall be rounded to tenths of a hectopascal (0.1 hPa).

$\overline{PPPP}$ shall be encoded as the value of P, with the following regulations. Only the hundreds, tens, singles and tenths digits shall be encoded in $\overline{PPPP}$ (inclusive preceding zeros, if necessary), the thousands digit of P shall be omitted in case P is greater than 999.9 hPa ($P \geq 1000.0$ hPa). The decimal point of P shall be omitted.

Examples:

P = 991.5 hPa ➔ $\overline{PPPP}$ = “9915”

P = 1014.1 hPa ➔ $\overline{PPPP}$ = “0141”

The Group **2** $\overline{PPPP}$, including the Group Identifier “2”, for these examples shall be coded “29915” and “20141”, respectively.

The monthly mean geopotential of an agreed standard constant pressure level H shall be calculated as

$$H = \frac{\sum_{j=1}^{N-m_P} H_{day-j}}{N - m_H} \qquad (13)$$

H_{day-j} daily mean geopotential of agreed standard constant pressure level for day j of the respective month

$N-m_H$ number of available values for H_{day-j}

H shall be rounded to geopotential metres (1 gpm).

$\overline{PPPP}$ shall be encoded as the value of H, with the following regulations. The thousands, hundreds, tens and singles digits shall be encoded in $\overline{PPPP}$ (inclusive preceding zeros, if necessary).

2.2.2.2.3 $3s_n\overline{TTT}s_ts_ts_t$

Group 3 – Monthly mean air temperature and standard deviation of daily mean values relative to the monthly mean air temperature

The monthly mean air temperature T shall be calculated as

$$T = \frac{\sum_{j=1}^{N-m_T} T_{day-j}}{N - m_T} \qquad (14)$$

T_{day-j} daily mean air temperature for day j of the respective month

$N-m_T$ number of available values for T_{day-j}

T shall be rounded to tenths of a degree Celsius (0.1ºC).

$s_n\overline{TTT}$ – Monthly mean air temperature

s_n shall be encoded as the algebraic sign of T, according to the following regulation. s_n shall be

0	if T ≥ 0.0ºC (for positive values and zero)
1	if T < 0.0ºC (for negative values)

$\overline{TTT}$ shall be encoded as the absolute value of T, with the following regulations. Only the tens, singles and tenths digits of T shall be encoded in $\overline{TTT}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T shall be omitted.

$s_t s_t s_t$ – Standard deviation of daily mean values relative to the monthly mean air temperature

The standard deviation of the daily mean air temperatures $T_{day\text{-}j}$ over the respective month relative to the calculated mean monthly air temperature T s_t shall be calculated as

$$s_t = \sqrt{\frac{\sum_{j=1}^{N-m_T} \left(T_{day-j} - T\right)^2}{N - m_T - 1}} \qquad (15)$$

$T_{day\text{-}j}$	daily mean air temperature for day j of the respective month
T	monthly mean air temperature
$N\text{-}m_T$	number of available values for $T_{day\text{-}j}$

$s_t s_t s_t$ shall be encoded as the value of s_t, with the following regulations. Only the tens, singles and tenths digits of s_t shall be encoded in $s_t s_t s_t$ (inclusive preceding zeros, if necessary), the decimal point of s_t shall be omitted.

Example 1:

T = 0.5 ºC ➔ s_n = "0"

➔ $\overline{TTT}$ = "005"

s_t = 0.7 ºC ➔ $s_t s_t s_t$ = "007"

The Group **3**s_n $\overline{TTT}$ $s_t s_t s_t$, including the Group Identifier "3", for this example shall be coded "30005007".

Example 2:

T = -21.3 ºC ➔ s_n = "1"

➔ $\overline{TTT}$ = "213"

s_t = 3.4 ºC ➔ $s_t s_t s_t$ = "034"

The Group **3**s_n $\overline{TTT}$ $s_t s_t s_t$, including the Group Identifier "3", for this example shall be coded "31213034".

2.2.2.2.4 4$s_n\ \overline{T_xT_xT_x}\ s_n\ \overline{T_nT_nT_n}$

Group 4 – Mean daily extreme air temperatures of the month

This Group contains information on mean monthly values of both daily maximum air temperature (1st four symbolic letters) and daily minimum air temperature (2nd four symbolic letters).

$s_n\ \overline{T_xT_xT_x}$ – Mean daily maximum air temperature of the month

The mean daily maximum air temperature of the month T_{max} shall be calculated as

$$T_{max} = \frac{\sum_{j=1}^{N-m_{Tx}} T_{max\_day-j}}{N - m_{Tx}} \quad (16)$$

T_{max_day-j} daily maximum air temperature for day j of the respective month

$N\text{-}m_{Tx}$ number of available values for T_{max_day-j}

T_{max} shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T_{max}, according to the following regulation. s_n shall be

0 if $T_{max} \geq 0.0$ºC (for positive values and zero)

1 if $T_{max} < 0.0$ºC (for negative values)

$\overline{T_xT_xT_x}$ shall be encoded as the absolute value of T_{max}, with the following regulations. Only the tens, singles and tenths digits of T_{max} shall be encoded in $\overline{T_xT_xT_x}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{max} shall be omitted.

$s_n\ \overline{T_nT_nT_n}$ – Mean daily minimum air temperature of the month

The mean daily minimum air temperature of the month T_{min} shall be calculated as

$$T_{min} = \frac{\sum_{j=1}^{N-m_{Tn}} T_{min\_day-j}}{N - m_{Tn}} \quad (17)$$

T_{min_day-j} daily minimum air temperature for day j of the respective month

$N\text{-}m_{Tn}$ number of available values for T_{min_day-j}

T_{min} shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T_{min}, according to the following regulation. s_n shall be

0 if $T_{min} \geq 0.0$ºC (for positive values and zero)

1 if $T_{min} < 0.0$ºC (for negative values)

$\overline{T_nT_nT_n}$ shall be encoded as the absolute value of T_{min}, with the following regulations. Only the tens, singles and tenths digits of T_{min} shall be encoded in $\overline{T_nT_nT_n}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{min} shall be omitted.

Example 1:

T_{max} = 8.2 ºC ➔ s_n = "0"

➔ $\overline{T_xT_xT_x}$ = "082"

T_{min} = 0.1 ºC ➔ s_n = "0"

➔ $\overline{T_nT_nT_n}$ = "001"

The Group **4**s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$, including the Group Identifier "4", for this example shall be coded "400820001".

Example 2:

T_{max} = -16.2 ºC ➔ s_n = "1"

➔ $\overline{T_xT_xT_x}$ = "162"

T_{min} = -36.2 ºC ➔ s_n = "1"

➔ $\overline{T_nT_nT_n}$ = "362"

The Group **4**s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$, including the Group Identifier "4", for this example shall be coded "411621362".

s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$ – Regulation for the ensemble of the data of Group 4

If both parts s_n $\overline{T_xT_xT_x}$ *and* s_n $\overline{T_nT_nT_n}$ are missing, e.g. due to ten or more days missing from the record for both daily maximum *and* minimum air temperature at station level, Group 4 shall be omitted from Section 1 of the Report.

2.2.2.2.5 5 $\overline{eee}$

Group 5 – Monthly mean vapour pressure

The monthly mean vapour pressure e shall be calculated as

$$e = \frac{\sum_{j=1}^{N-m_e} e_{day-j}}{N - m_e} \quad (18)$$

e_{day-j} daily mean vapour pressure for day j of the respective month

$N-m_e$ number of available values for e_{day-j}

e shall be rounded to tenths of a hectopascal (0.1 hPa).

eee shall be encoded as the value of e, with the following regulations. The tens, singles and tenths digits of e shall be encoded in **eee** (inclusive preceding zeros, if necessary), the decimal point of e shall be omitted.

Examples:

e = 1.2 hPa ➔ **eee** = "012"

e = 18.1 hPa ➔ **eee** = "181"

The Group **5 eee** , including the Group Identifier "5", for these examples shall be coded "5012" and "5181", respectively.

2.2.2.2.6 6$R_1R_1R_1R_1R_dn_rn_r$

Group 6 – Total precipitation for the month and precipitation characteristics

$R_1R_1R_1R_1$ – Total precipitation for the month

The total precipitation for the month R_1 shall be calculated as

$$R_1 = \sum_{j=1}^{N} R_{day-j} \quad (19)$$

R_{day-j} total precipitation for the day for day j of the respective month

N number of days of the respective month

R_1 shall be rounded to millimetres (1 mm), except if R_1 is greater than 0 mm and less than 1 mm (see Table 5).

$R_1R_1R_1R_1$ shall be encoded as the value of R_1, according to the regulations given in Table 5.

Table 5: Encoding R_1 in $R_1R_1R_1R_1$.

R_1 (calculated value)	$R_1R_1R_1R_1$ (code figure)
0 mm (or no measurable water equivalent of snow cover on the ground)	0000
1 mm	0001
2 mm	0002
…	…
8898 mm	8898
≥ 8899 mm	8899
0 mm < R_1 < 1 mm	9999

R_d – Frequency group in which $R_1R_1R_1R_1$ falls

If the 30-year normal precipitation R_{1_norm} is known (see 2.2.3.2.7, p. 36), as well as all yearly precipitations $R_{1\_year\text{-}k}$ (k = 1,…,30) and the probability distribution of the precipitation for the respective station, R_d shall be derived by assigning the appropriate frequency group (probability distribution quintile) to the calculated value R_1 (see Table 6). These quintiles shall be defined by appropriate tables of the probability distribution (see Table 7 for examples), based on the following regulations:

- The total precipitation for the month for the respective month shall be observed over 30 years.
- These 30 observational values shall be put in ascending order and grouped into five quintiles (hence, six observational values per quintile) of which the first quintile contains the lowest six values and the fifth quintile contains the highest six values.
- The upper and lower limits of the five quintiles shall be determined. Between two quintiles, the boundary is set half-way between the top value of the lower quintile and the first value of the upper quintile.
- For stations where the monthly precipitation during the reference period was zero more than six times and hence, more than one quintile contain the value zero, only the highest of the quintiles that contain the value zero shall be used. (See Table 7, example 2.)

If the 30-year normal total precipitation for the month R_{1_norm} is not available, R_d shall be encoded "/".

Table 6: Assigning the calculated value R_1 to the appropriate frequency group and encoding it into R_d.

R_1 (calculated value) is	R_d (code figure)
smaller than any value in the 30-year period	0
in the 1st quintile	1
in the 2nd quintile	2
in the 3rd quintile	3
in the 4th quintile	4
in the 5th quintile	5
greater than any value in the 30-year period	6

Table 7: Two examples on how to assign the appropriate frequency groups to R_d.

Example 1				Example 2			
Precipitation [mm]	Quintile	Quintile limits [mm]	R_d	Precipitation [mm]	Quintile	Quintile limits [mm]	R_d
		0 - 4.9	R_d = 0				
5		5.0		0		0	
18				0			
38	1st	-	R_d = 1	0	1st		
48	Quintile			0	Quintile		
56				0			
61		62.5		0			R_d = 0 - 2
64		62.6		0		0	shall
69				0			not be used
86	2nd	-	R_d = 2	0	2nd		
104	Quintile			0	Quintile		
105				0			
119		121.5		0			
124		121.6		0		0	
155				0			
163	3rd	-	R_d = 3	0	3rd	-	R_d = 3
164	Quintile			2	Quintile		
175				3			
203		213.5		3		4.0	
224		213.6		5		4.1	
236				5			
236	4th	-	R_d = 4	6	4th	-	R_d = 4
239	Quintile			8	Quintile		
249				8			
254		255.5		9		9.0	
257		255.6		9		9.1	
293				14			
335	5th	-	R_d = 5	19	5th	-	R_d = 5
344	Quintile			20	Quintile		
349				21			
411		411.0		28		28.0	
		>411.0	R_d = 6			>28.0	R_d = 6

n_rn_r – Number of days in the month with precipitation equal to or greater than 1 millimetre

n_r shall be the number of days in the month with precipitation ≥ 1 mm.

n_rn_r shall be encoded as the value of n_r (inclusive preceding zeros, if necessary).

Example 1:

R_1 = 0 mm ➔ $R_1R_1R_1R_1$ = "0000"

R_{1_norm} unavailable ➔ R_d = "/"

n_r = 0 ➔ n_rn_r = "00"

The Group **6**$R_1R_1R_1R_1R_dn_rn_r$, including the Group Identifier "6", for this example shall be coded "60000/00".

Example 2:

R_1 = 671 mm ➔ $R_1R_1R_1R_1$ = "0671"

R_{1_norm} unavailable ➔ $\mathbf{R_d}$ = "/"

n_r = 17 ➔ $\mathbf{n_r n_r}$ = "17"

The Group **6**$\mathbf{R_1R_1R_1R_1R_dn_rn_r}$, including the Group Identifier "6", for this example shall be coded "60671/17".

2.2.2.2.7 7$\mathbf{S_1S_1S_1p_Sp_Sp_S}$ Group 7 – Total sunshine for the month and sunshine characteristics

The total sunshine for the month S_1 shall be calculated as

$$S_1 = \sum_{j=1}^{N} S_{day-j} \tag{20}$$

S_{day-j} total sunshine for the day for day j of the respective month

N number of days of the respective month

S_1 shall be rounded to hours (1 h).

$\mathbf{S_1S_1S_1}$ – Total sunshine for the month

$\mathbf{S_1S_1S_1}$ shall be encoded as the value of S_1 (inclusive preceding zeros, if necessary).

$\mathbf{p_Sp_Sp_S}$ – Percentage of total sunshine for the month relative to the normal

If the 30-year normal total sunshine for the month is available for the respective month, the percentage of the total sunshine for the month relative to the 30-year normal total sunshine for the month p_S shall be calculated as

$$p_S = 100 \cdot \frac{S_1}{S_{norm}} \tag{21}$$

p_S shall be rounded to percent.

$\mathbf{p_Sp_Sp_S}$ shall be encoded as the value of p_S (inclusive preceding zeros, if necessary), with the following additional regulations:

- If 0 % < p_S ≤ 1 %, $\mathbf{p_Sp_Sp_S}$ shall be encoded "001".
- If S_{norm} = 0 h, $\mathbf{p_Sp_Sp_S}$ shall be encoded "999".
- If S_{norm} is not defined, $\mathbf{p_Sp_Sp_S}$ shall be encoded "///".

Example 1:

S_1 = 16 h ➔ $\mathbf{S_1S_1S_1}$ = "016"

p_S = unavailable ➔ $\mathbf{p_Sp_Sp_S}$ = "///"

The Group **7$S_1S_1S_1p_Sp_Sp_S$**, including the Group Identifier "7", for this example shall be coded "7016///".

Example 2:

S_1 = 183 h ➔ **$S_1S_1S_1$** = "183"

p_S = unavailable ➔ **$p_Sp_Sp_S$** = "///"

The Group **7$S_1S_1S_1p_Sp_Sp_S$**, including the Group Identifier "7", for this example shall be coded "7183///".

2.2.2.2.8 8$m_Pm_Pm_Tm_Tm_{Tx}m_{Tn}$

Group 8 – Numbers of days missing from the records for pressure and air temperature parameters

The definitions given in 2.2.2.1 for the numbers of days missing from the records for the respective month for the different pressure and air temperature parameters shall be used (m_P, m_T, m_{Tx} and m_{Tn}). Group 8 shall always be included in Section 1 of a CLIMAT Report.

m_Pm_P – Number of days missing from the record for daily mean pressure

m_Pm_P shall be encoded as the value of m_P (inclusive preceding zero, if necessary).

m_Tm_T – Number of days missing from the record for daily mean air temperature

m_Tm_T shall be encoded as the value of m_T (inclusive preceding zero, if necessary).

m_{Tx} – Number of days missing from the record for daily maximum air temperature

m_{Tx} shall be encoded as the value of m_{Tx}. If the number of days missing from the record for daily maximum air temperature m_{Tx} is 9 or more, **m_{Tx}** shall be encoded as "9".

m_{Tn} – Number of days missing from the record for daily minimum air temperature

m_{Tn} shall be encoded as the value of m_{Tn}. If the number of days missing from the record for daily minimum air temperature m_{Tn} is 9 or more, **m_{Tn}** shall be encoded as "9".

Example:

m_P = 1 ➔ **m_Pm_P** = "01"

m_T = 0 ➔ **m_Tm_T** = "00"

m_{Tx} = 2 ➔ **m_{Tx}** = "2"

m_{Tn} = 1 ➔ **m_{Tn}** = "1"

The Group **8$m_Pm_Pm_Tm_Tm_{Tx}m_{Tn}$**, including the Group Identifier "8", for this example shall be coded "8010021".

2.2.2.2.9 $9m_em_em_Rm_Rm_Sm_S$

Group 9 – Numbers of days missing from the records for daily mean vapour pressure, total precipitation for the day and total sunshine for the day

The definitions given in 2.2.2.1 for the numbers of days missing from the records for the respective month for vapour pressure, total precipitation for the day and total sunshine for the day shall be used (m_e, m_R and m_S). Group 9 shall always be included in Section 1 of a CLIMAT Report.

m_em_e – Number of days missing from the record for vapour pressure

m_em_e shall be encoded as the value of m_e (inclusive preceding zero, if necessary).

m_Rm_R – Number of days missing from the record for total precipitation for the day

m_Rm_R shall be encoded as the value of m_R (inclusive preceding zero, if necessary).

m_Sm_S – Number of days missing from the record for total sunshine for the day

m_Sm_S shall be encoded as the value of m_S (inclusive preceding zero, if necessary).

Example:

$m_e = 1$ ➔ m_em_e = "01"

$m_R = 2$ ➔ m_Rm_R = "02"

$m_S = 0$ ➔ m_Sm_S = "00"

The Group **$9m_em_em_Rm_Rm_Sm_S$**, including the Group Identifier "9", for this example shall be coded "9010200".

2.2.2.3 A coding example of Section 1

Section 1 of a CLIMAT Report containing the values of the examples given above (2.2.2.2) for the different Groups (in case of more than one example, values are obtained from the first Example), including the Section Identifier "111", shall be coded:

Example:

"111 19823 29915 30005007 400820001 5012 60000/00 7016/// 8010021 9010200"

2.2.3 Section 2: Normals for monthly values including number of years missing from the calculation

Section 2 is optional (see below). It contains normals for monthly values of the parameters observed at the respective station for the respective month (the month specified in **MM** of Section 0 of the CLIMAT Report). These normals shall be obtained by averaging the monthly values of all years of a reference period (usually 30 years, defined by WMO Technical Regulations) for the respective month. Section 2 also comprises information on years of that period with missing data for contained parameters. Section 2 shall only be included in the CLIMAT Report for a station if either no normals for monthly values have been submitted to the Secretariat by the time or changes in the normals for monthly values occur (e.g. because of a change in the definition of the reference period or because National Meteorological Services consider it necessary to make amendments to previously published normals). If Section 2 is to be reported, it shall be included in the CLIMAT Reports for all twelve months in a row so that normal data for all twelve months be available for the respective station.

See 1.2.3 for general information on normals.

Section 2 consists of the Section Identifier “222” and ten Groups with prefixes (Group Identifiers) from “0” to “9”.

2.2.3.1 Parameters needed

Monthly values of the required parameters shall be calculated on the basis of daily values, with the algorithms given in 2.2.2 and its sub- and sub-sub-sections. Data should be available for every month of every year of the reference period (the number of years with missing data for a specific parameter shall be reported, too; see below).

For forming Section 2 of a CLIMAT Report, monthly values of the following ten parameters which are regularly observed at land stations are needed for the respective month of every year (year k) of the reference period:

1. mean pressure at station level $P_{0\_year\text{-}k}$ (accuracy of 0.1 hPa)
2. mean pressure reduced to sea level or to an agreed datum level or mean geopotential of an agreed standard constant pressure level $P_{year\text{-}k}$ (accuracy of 0.1 hPa or 1 gpm)
3. mean air temperature $T_{year\text{-}k}$ (accuracy of 0.1 ºC)
4. standard deviation of daily mean values relative to the monthly mean temperature $s_{T\_year\text{-}k}$ (accuracy of 0.1 ºC)
5. mean maximum air temperature $T_{max\_year\text{-}k}$ (accuracy of 0.1 ºC)
6. mean minimum air temperature $T_{min\_year\text{-}k}$ (accuracy of 0.1 ºC)
7. mean vapour pressure $e_{year\text{-}k}$ (accuracy of 0.1 hPa)
8. total precipitation $R_{1\_year\text{-}k}$ (accuracy of 0.1 mm)
9. number of days with precipitation ≥ 1 mm $n_{r\_year\text{-}k}$
10. total sunshine $S_{year\text{-}k}$ (accuracy of 0.1 h)

Note that the indexes of the parameters include “year” but refer to values for the respective *month of that year*.

The same reference period shall apply for all parameters.

The monthly mean pressure at station level and the monthly mean pressure reduced to sea level or to an agreed datum level or the monthly mean geopotential of an agreed standard constant pressure level shall be available for every year of the reference period. If either is missing, the other one shall be considered as missing, too.

The numbers of missing years within the reference period from the calculation of the normal of the respective parameter shall be defined as:

y_P	number of missing years within the reference period from the calculation of the normal for monthly mean air pressure
y_T	number of missing years within the reference period from the calculation of the normal for monthly mean air temperature
y_{Tx}	number of missing years within the reference period from the calculation of the normal for monthly mean extreme (maximum and minimum) air temperatures
y_e	number of missing years within the reference period from the calculation of the normal for monthly mean vapour pressure
y_R	number of missing years within the reference period from the calculation of the normal for total precipitation for the month
y_S	number of missing years within the reference period from the calculation of the normal for total sunshine for the month

2.2.3.2 Compiling the different Groups of Section 2

Normals of monthly values shall be calculated on the basis of monthly values for the *respective* month over the indicated period of years.

Note that most of the Groups of Section 2 may look similar to Groups included in Section 1 but differences exist and calculations should be conducted very attentively on the basis of the instructions and regulations given below.

N_{years} refers to the number of years of the reference period.

A coding example of Section 2, based on examples given within the descriptions of the Groups, is given in 2.2.3.3.

2.2.3.2.1 0$Y_bY_bY_cY_c$

Group 0 – Identification of the reference period

If Section 2 is reported, Group 0 shall always be included.

Y_bY_b – Year of beginning of the reference period

Y_bY_b shall be encoded as the last two digits of the year in which the reference period begins (inclusive preceding zeros, if necessary).

Y_cY_c – Year of ending of the reference period

Y_cY_c shall be encoded as the last two digits of the year in which the reference period ends (including preceding zeros, if necessary).

Example 1:

Beginning in 1961 ➔ Y_bY_b = "61"

End in 1990 ➔ Y_bY_b = "90"

The Group **0**$Y_bY_bY_cY_c$, including the Group Identifier "0", for this example shall be coded "06190".

Example 2:

Beginning in 1971 ➔ Y_bY_b = "71"

End in 2000 ➔ Y_bY_b = "00"

The Group **0**$Y_bY_bY_cY_c$, including the Group Identifier "0", for this example shall be coded "07100".

2.2.3.2.2 1 $\overline{P_0P_0P_0P_0}$

Group 1 – Normal for monthly mean pressure at station level

The normal for monthly mean pressure at station level P_0 shall be calculated as

$$P_{0\_norm} = \frac{\sum_{k=1}^{N_{years}-y_P} P_{0\_year-k}}{N_{years} - y_P} \quad (22)$$

P_{0_year-k} monthly mean pressure at station level for the respective month of year k

N_{years}-y_P number of available values for P_{0_year-k}

P_{0_norm} shall be rounded to tenths of a hectopascal (0.1 hPa).

$\overline{P_0P_0P_0P_0}$ shall be encoded as the value of P_{0_norm}, with the following regulations. Only the hundreds, tens, singles and tenths digits shall be encoded (inclusive preceding zeros, if necessary) in $\overline{P_0P_0P_0P_0}$, the thousands digit of P_{0_norm} shall be omitted in case P_{0_norm} is greater than 999.9 hPa ($P_{0\_norm} \geq 1000$ hPa). The decimal point of P_{0_norm} shall be omitted.

Examples:

P_{0_norm} = 982.3 hPa ➔ $\overline{P_0P_0P_0P_0}$ = "9823"

P_{0_norm} = 1014.2 hPa ➔ $\overline{P_0P_0P_0P_0}$ = "0142"

The Group **1** $\overline{P_0P_0P_0P_0}$, including the Group Identifier "1", for these examples would be coded "19823" and "10142", respectively.

2.2.3.2.3 2 $\overline{PPPP}$

Group 2 – Normal for monthly mean pressure reduced to sea level or to an agreed datum level or normal for monthly mean geopotential of a standard constant pressure level

The normal for monthly mean pressure reduced to sea level or to an agreed constant pressure level or the normal for monthly mean geopotential of a standard constant pressure level P_{norm}, as indicated in *Weather Reporting* (WMO-No. 9) [10], *Volume A – Observing Stations*, shall be calculated as

$$P_{norm} = \frac{\sum_{k=1}^{N_{years}-y_P} P_{year-k}}{N_{years} - y_P} \quad (23)$$

P_{year-k} mean pressure reduced to sea level or to an agreed datum level or mean geopotential of a standard constant pressure level for the respective month of year k

N_{years}-y_P number of available values for P_{year-k}

For mean pressure reduced to sea level or to an agreed datum level:

P_{norm} shall be rounded to tenths of a hectopascal (0.1 hPa).

$\overline{PPPP}$ shall be encoded as the value of P_{norm}, with the following regulations. Only the hundreds, tens, singles and tenths digits shall be encoded in $\overline{PPPP}$ (inclusive preceding zeros, if necessary), the thousands digit of P_{norm} shall be omitted in case P_{norm} is greater than 999.9 hPa ($P_{norm} \geq 1000.0$ hPa). The decimal point of P shall be omitted.

Examples:

P_{norm} = 991.5 hPa ➔ $\overline{PPPP}$ = “9915”

P_{norm} = 1014.1 hPa ➔ $\overline{PPPP}$ = “0141”

The Group **2** $\overline{PPPP}$, including the Group Identifier “2”, for these examples shall be coded “29915” and “20141”, respectively.

For mean geopotential of a standard constant pressure level:

P_{norm} shall be rounded to geopotential metres (1 gpm).

$\overline{PPPP}$ shall be encoded as the value of P_{norm}, with the following regulations. The thousands, hundreds, tens and singles digits shall be encoded in $\overline{PPPP}$ (inclusive preceding zeros, if necessary).

2.2.3.2.4 3s_n $\overline{TTT}$ $s_ts_ts_t$

Group 3 – Normal for monthly mean air temperature and normal for standard deviation of daily mean values relative to the monthly mean air temperature

The normal for monthly mean air temperature T_{norm} shall be calculated as

$$T_{norm} = \frac{\sum_{k=1}^{N_{years}-y_T} T_{year-k}}{N_{years} - y_T} \quad (24)$$

T_{year-k} mean air temperature for the respective month of year k

N_{years}-y_T number of available values for T_{year-k}

T_{norm} shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n $\overline{TTT}$ – Normal for monthly mean air temperature

s_n shall be encoded as the algebraic sign of T_{norm}, according to the following regulation. s_n shall be

0 if $T_{norm} \geq 0.0$ºC (for positive values and zero)

1 if $T_{norm} < 0.0$ºC (for negative values)

$\overline{TTT}$ shall be encoded as the absolute value of T_{norm}, with the following regulations. Only the tens, singles and tenths digits of T_{norm} shall be encoded in $\overline{TTT}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{norm} shall be omitted.

$s_ts_ts_t$ – Normal for the standard deviation of daily mean values relative to the monthly mean air temperature

The normal for the standard deviation of daily mean values relative to the monthly mean temperature s_{t_norm} shall be calculated as

$$s_{t\_norm} = \frac{\sum_{k=1}^{N_{years}-y_T} s_{t\_year-k}}{N_{years} - y_T} \quad (25)$$

s_{t_year-k} standard deviation of daily mean values relative to the monthly mean air temperature over the respective month of year k

N_{years}-y_T number of available values for s_{t_year-k}

$s_ts_ts_t$ shall be encoded as the value of s_{t_norm}, with the following regulations. Only the tens, singles and tenths digits of s_{t_norm} shall be encoded in $s_ts_ts_t$ (inclusive preceding zeros, if necessary), the decimal point of s_t shall be omitted.

Example 1:

T_{norm} = 0.5 ºC ➔ s_n = "0"

➔ $\overline{TTT}$ = "005"

s_{t_norm} = 0.7 ºC ➔ $s_t s_t s_t$ = "007"

The Group **3**s_n $\overline{TTT}$ $s_t s_t s_t$, including the Group Identifier "3", for this example shall be coded "30005007".

Example 2:

T_{norm} = -21.3 ºC ➔ s_n = "1"

➔ $\overline{TTT}$ = "213"

s_{t_norm} = 3.4 ºC ➔ $s_t s_t s_t$ = "034"

The Group **3**s_n $\overline{TTT}$ $s_t s_t s_t$, including the Group Identifier "3", for this example shall be coded "31213034".

2.2.3.2.5 4s_n $\overline{T_x T_x T_x}$ s_n $\overline{T_n T_n T_n}$

Group 4 – Normals for mean daily extreme air temperatures of the month

This Group contains information on normals for both mean monthly values for daily maximum air temperature (1st four symbolic letters) and mean monthly values for daily minimum air temperature (2nd four symbolic letters).

s_n $\overline{T_x T_x T_x}$ – Normal for mean daily maximum air temperature of the month

The normal for mean daily maximum air temperature of the month T_{max_norm} shall be calculated as

$$T_{max\_norm} = \frac{\sum_{k=1}^{N_{years} - y_{Tx}} T_{max\_year-k}}{N_{year} - y_{Tx}} \qquad (26)$$

T_{max_year-k} mean daily maximum air temperature for the respective month of year k

N_{years}-y_{Tx} number of available values for T_{max_year-k}

T_{max_norm} shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T_{max_norm}, according to the following regulation. s_n shall be

0 if $T_{max_norm} \geq 0.0$ºC (for positive values and zero)

1 if $T_{max_norm} < 0.0$ºC (for negative values)

$\overline{T_xT_xT_x}$ shall be encoded as the absolute value of T_{max_norm}, with the following regulations. Only the tens, singles and tenths digits of T_{max_norm} shall be encoded in $\overline{T_xT_xT_x}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{max_norm} shall be omitted.

s_n $\overline{T_nT_nT_n}$ – Normal for mean daily minimum air temperature of the month

The normal for mean daily maximum air temperature of the month T_{min_norm} shall be calculated as

$$T_{min\_norm} = \frac{\sum_{k=1}^{N_{years}-y_{Tx}} T_{min\_year-k}}{N_{years} - y_{Tx}} \quad (27)$$

T_{min_year-k} mean daily minimum air temperature for the respective month of year k

N_{years}-y_{Tx} number of available values for T_{min_year-k}

T_{min_norm} shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T_{min_norm}, according to the following regulation. s_n shall be

0 if $T_{min_norm} \geq 0.0$ºC (for positive values and zero)

1 if $T_{min_norm} < 0.0$ºC (for negative values)

$\overline{T_nT_nT_n}$ shall be encoded as the absolute value of T_{min_norm}, with the following regulations. Only the tens, singles and tenths digits of T_{min_norm} shall be encoded in $\overline{T_nT_nT_n}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{min_norm} shall be omitted.

Example 1:

T_{max_norm} = 8.2 ºC ➔ s_n = "0"

➔ $\overline{T_xT_xT_x}$ = "082"

T_{min_norm} = 0.1 ºC ➔ s_n = "0"

➔ $\overline{T_nT_nT_n}$ = "001"

The Group **4**s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$, including the Group Identifier "4", for this example shall be coded "400820001".

Example 2:

T_{max_norm} = -16.2 ºC ➔ s_n = "1"

➔ $\overline{T_xT_xT_x}$ = “162”

T_{min_norm} = -36.2 °C ➔ s_n = “1”

➔ $\overline{T_nT_nT_n}$ = “362”

The Group **4**s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$, including the Group Identifier “4”, for this example shall be coded “411621362”.

s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$ – Regulation for the ensemble of the Group 4 data

If both parts s_n $\overline{T_xT_xT_x}$ *and* s_n $\overline{T_nT_nT_n}$ are not available, Group 4 shall be omitted from Section 2 of the Report.

2.2.3.2.6 5 $\overline{eee}$

Group 5 – Normal for monthly mean vapour pressure

The normal for monthly mean vapour pressure e_{norm} shall be calculated as

$$e_{norm} = \frac{\sum_{k=1}^{N_{years}-y_e} e_{year-k}}{N_{years} - y_e} \quad (28)$$

e_{year-k} mean vapour pressure for the respective month of year k

N_{years}-y_e number of available values for e_{year-k}

e_{norm} shall be rounded to tenths of a hectopascal (0.1 hPa).

$\overline{eee}$ shall be encoded as the value of e_{norm}, with the following regulations. The tens, singles and tenths digits of e_{norm} shall be encoded in $\overline{eee}$ (inclusive preceding zeros, if necessary), the decimal point of e_{norm} shall be omitted.

Examples:

e_{norm} = 1.2 hPa ➔ $\overline{eee}$ = “012”

e_{norm} = 18.1 hPa ➔ $\overline{eee}$ = “181”

The Group **5** $\overline{eee}$, including the Group Identifier “5”, for these examples shall be coded “5012” and “5181”, respectively.

2.2.3.2.7 6$R_1R_1R_1R_1n_rn_r$ Group 6 – Normals for total precipitation for the month and precipitation characteristics

$R_1R_1R_1R_1$ – Normal for total precipitation for the month

The normal for total precipitation of the month R_{1_norm} shall be calculated as

$$R_{1\_norm} = \frac{\sum_{k=1}^{N_{years}-y_R} R_{1\_year-k}}{N_{years} - y_R} \quad (29)$$

R_{1_year-k} total precipitation for the month for the respective month of year k

N_{years}-y_R number of available values for R_{1_year-k}

R_{1_norm} shall be rounded to millimetres (1 mm), except if R_{1_norm} is greater than 0 mm and less than 1 mm (see Table 8).

$R_1R_1R_1R_1$ shall be encoded as the value of R_{1_norm}, according to the regulations given in Table 8.

Table 8: Encoding R_{1_norm} in $R_1R_1R_1R_1$.

R_{1_norm} (calculated value)	$R_1R_1R_1R_1$ (code figure)
0 mm (or no measurable water equivalent of snow cover on the ground)	0000
1 mm	0001
2 mm	0002
…	…
8898 mm	8898
≥ 8899 mm	8899
0 mm < R_{1_norm} < 1 mm	9999

n_rn_r – Normal for number of days in the month with precipitation equal to or greater than 1 millimetre

The normal for number of days in the month with precipitation ≥ 1 mm n_{r_norm} shall be calculated as

$$n_{r\_norm} = \frac{\sum_{k=1}^{N_{years}-y_R} n_{r\_year-k}}{N_{years} - y_R} \quad (30)$$

n_{r_year-k} number of days in the month precipitation ≥ 1 mm for the respective month of year k

N_{years}-y_R number of available values for n_{r_year-k}

n_{r_norm} shall be rounded to whole days (1 d).

n_rn_r shall be encoded as the value of n_{r_norm} (inclusive preceding zeros, if necessary).

Example 1:

R_{1_norm} = 0 mm ➔ $\mathbf{R_1R_1R_1R_1}$ = "0000"

n_{r_norm} = 0 d ➔ $\mathbf{n_rn_r}$ = "00"

The Group $\mathbf{6R_1R_1R_1R_1n_rn_r}$, including the Group Identifier "6", for this example shall be coded "6000000".

Example 2:

R_{1_norm} = 671 mm ➔ $\mathbf{R_1R_1R_1R_1}$ = "0671"

n_{r_norm} = 17 d ➔ $\mathbf{n_rn_r}$ = "17"

The Group $\mathbf{6R_1R_1R_1R_1n_rn_r}$, including the Group Identifier "6", for this example shall be coded "6067117".

2.2.3.2.8 $\mathbf{7S_1S_1S_1}$ Group 7 – Normal for total sunshine for the month

The normal for total sunshine for the month S_{1_norm} shall be calculated as

$$S_{1\_norm} = \frac{\sum_{k=1}^{N_{years}-y_S} S_{1\_year-k}}{N_{years} - y_S} \quad (31)$$

S_{1_year-k} total sunshine for the month for the respective month of year k

N_{years}-y_S number of available values for S_{1_year-k}

S_{1_norm} shall be rounded to hours (1 h).

$\mathbf{S_1S_1S_1}$ shall be encoded as the value of S_{1_norm} (inclusive preceding zeros, if necessary).

Examples:

S_{1_norm} = 16 h ➔ $\mathbf{S_1S_1S_1}$ = "016"

S_{1_norm} = 183 h ➔ $\mathbf{S_1S_1S_1}$ = "183"

The Group $\mathbf{7S_1S_1S_1}$, including the Group Identifier "7", for these examples shall be coded "7016" and "7183", respectively.

2.2.3.2.9 8$y_P y_P y_T y_T y_{Tx} y_{Tx}$

Group 8 – Numbers of missing years within the reference period from the calculation of normals for pressure and air temperature parameters

The definitions given in 2.2.3.1 for the numbers of missing years within the reference period for the respective month for the calculation of the different pressure and air temperature parameters shall be used (y_P, y_T and y_{Tx}). Group 8 shall always be reported if Section 2 is included in a CLIMAT Report.

$y_P y_P$ – Number of missing years within the reference period from the calculation of the normals for monthly mean air pressure

$y_P y_P$ shall be encoded as the value of y_P (inclusive preceding zero, if necessary).

$y_T y_T$ – Number of missing years within the reference period from the calculation of the normal for monthly mean air temperature

$y_T y_T$ shall be encoded as the value of y_T (inclusive preceding zero, if necessary).

$y_{Tx} y_{Tx}$ – Number of missing years within the reference period from the calculation of the normal for monthly mean extreme air temperatures

$y_{Tx} y_{Tx}$ shall be encoded as the value of y_{Tx} (inclusive preceding zero, if necessary).

Example:

$y_P = 1$ ➔ $y_P y_P$ = "01"

$y_T = 0$ ➔ $y_T y_T$ = "00"

$y_{Tx} = 2$ ➔ $y_{Tx} y_{Tx}$ = "02"

The Group **8**$y_P y_P y_T y_T y_{Tx} y_{Tx}$, including the Group Identifier "8", for this example shall be coded "8010002".

2.2.3.2.10 9$y_e y_e y_R y_R y_S y_S$

Group 9 – Numbers of missing years within the reference period from the calculation of normals for monthly mean vapour pressure, total precipitation for the month and total sunshine for the month

The definitions given in 2.2.3.1 for the numbers of missing years within the reference period for the respective month from the calculation for monthly mean vapour pressure, total precipitation for the month and total sunshine for the month shall be used (Y_e, Y_R and Y_S). Group 9 shall always be reported if Section 2 is included in a CLIMAT Report.

$y_e y_e$ – Number of missing years within the reference period from the calculation of the normals for monthly mean vapour pressure

$y_e y_e$ shall be encoded as the value of y_e (inclusive preceding zero, if necessary).

y_Ry_R – Number of missing years within the reference period from the calculation of the normal for total precipitation for the month

y_Ry_R shall be encoded as the value of y_R (inclusive preceding zero, if necessary).

y_Sy_S – Number of missing years within the reference period from the calculation of the normal for total sunshine for the month

y_Sy_S shall be encoded as the value of y_S (inclusive preceding zero, if necessary).

Example:

$y_e = 1$ ➔ y_ey_e = "01"

$y_R = 2$ ➔ y_Ry_R = "02"

$y_S = 0$ ➔ y_Sy_S = "00"

The Group **9**$y_ey_ey_Ry_Ry_Sy_S$, including the Group Identifier "9", for this example shall be coded "9010200".

2.2.3.3 A coding example of Section 2

Section 2 of a CLIMAT Report containing the values of the examples given above (2.2.3.2) for the different Groups (in case of more than one example, values are obtained from the first Example), including the Section Identifier "222", shall be coded:

Example:

"222 06190 19823 29915 30005007 400820001 5012 6000000 7016 8010002 9010200"

2.2.4 Section 3: Number of days in the month with parameters beyond certain thresholds

Section 3 is optional. It contains for several parameters the numbers of days with these parameters exceeding certain thresholds for the respective month.

Section 3 consists of the Section Identifier "333" and ten Groups with Group Identifiers "0", "1", …, "9".

If there is no data available for a Group of Section 3, the respective Group shall be omitted from the CLIMAT Report.

2.2.4.1 Parameters needed

For forming Section 3 of a CLIMAT Report, daily values (of days in local time, except for precipitation, see 1.2) of the following six parameters which are regularly observed at land stations are needed for the respective month:

1. maximum air temperature $T_{max\_day\text{-}j}$ (accuracy of 0.1 ºC)

2.	minimum air temperature	$T_{min\_day\text{-}j}$	(accuracy of 0.1 ºC)
3.	total precipitation	$R_{day\text{-}j}$	(accuracy of 0.1 mm)
4.	total snow depth	$s_{day\text{-}j}$	(accuracy of 1 cm)
5.	maximum wind speed	$f_{day\text{-}j}$	(accuracy of 1 m/s or 1 knot)
6.	minimum horizontal visibility	$V_{day\text{-}j}$	(accuracy of 10 m)

The number of days in the month with certain parameters beyond specific thresholds for the respective month shall be:

T_{25}	number of days with maximum air temperature equal to or more than 25°C
T_{30}	number of days with maximum air temperature equal to or more than 30ºC
T_{35}	number of days with maximum air temperature equal to or more than 35ºC
T_{40}	number of days with maximum air temperature equal to or more than 40ºC
T_{n0}	number of days with minimum air temperature less than 0ºC
T_{x0}	number of days with maximum air temperature less than 0ºC
R_{01}	number of days with precipitation equal to or more than 1 mm
R_{05}	number of days with precipitation equal to or more than 5 mm
R_{10}	number of days with precipitation equal to or more than 10 mm
R_{50}	number of days with precipitation equal to or more than 50 mm
R_{100}	number of days with precipitation equal to or more than 100 mm
R_{150}	number of days with precipitation equal to or more than 150 mm
s_{00}	number of days with snow depth more than 0 cm
s_{01}	number of days with snow depth more than 1 cm
s_{10}	number of days with snow depth more than 10 cm
s_{50}	number of days with snow depth more than 50 cm
f_{10}	number of days with observed or recorded wind speed equal to or more than 10 m/s or 20 knots (*see note below*)
f_{20}	number of days with observed or recorded wind speed equal to or more than 20 m/s or 40 knots (*see note below*)
f_{30}	number of days with observed or recorded wind speed equal to or more than 30 m/s or 60 knots (*see note below*)
V_1	number of days with observed or recorded visibility less than 50 m, irrespective of the duration of the observational period
V_2	number of days with observed or recorded visibility less than 100 m, irrespective of the duration of the observational period
V_3	number of days with observed or recorded visibility less than 1000 m, irrespective of the duration of the observational period

Note that if continuous recording exists, the daily maximum of the mean wind speed over a 10-minute period shall be used. If continuous recording does not exist, the maximum mean wind speed over a 10-minute period, observed during the day, shall be used. In the absence of wind instruments, the wind speed shall be estimated on the basis of the Beaufort wind scale. The Beaufort number obtained by estimation is converted into metres per second or knots by the use of the wind speed equivalent columns of the Beaufort scale.

2.2.4.2 Compiling the different Groups of Section 3

Values shall be obtained through comparison of observed values for days in local time (0000 - 2359 local time), except for precipitation (see 1.2), of the listed parameters with the different thresholds.

If all respective numbers with parameters beyond certain thresholds that shall be encoded in a certain Group of Section 3 equal zero, the respective Group shall be omitted from Section 3.

2.2.4.2.1 $0T_{25}T_{25}T_{30}T_{30}$

Group 0 – Number of days in the month with maximum air temperature equal to or more than 25ºC / 30ºC

$T_{25}T_{25}$ – Number of days in the month with maximum air temperature ≥ 25ºC

$T_{25}T_{25}$ shall be encoded as the value of T_{25} (inclusive preceding zeros, if necessary).

$T_{30}T_{30}$ – Number of days in the month with maximum air temperature ≥ 30ºC

$T_{30}T_{30}$ shall be encoded as the value of T_{30} (inclusive preceding zeros, if necessary).

Example:

T_{25} = 15 ➔ $T_{25}T_{25}$ = “15”

T_{30} = 9 ➔ $T_{30}T_{30}$ = “09”

The Group **0**$T_{25}T_{25}T_{30}T_{30}$, including the Group Identifier “0”, for this example shall be coded “01509”.

$T_{25}T_{25}T_{30}T_{30}$ – Regulation for the ensemble of the Group 0 data

If both values T_{25} *and* T_{30} equal zero, Group 0 shall be omitted from Section 3 of the Report.

2.2.4.2.2 $1T_{35}T_{35}T_{40}T_{40}$

Group 1 – Number of days with maximum air temperature equal to or more than 35ºC / 40ºC

$T_{35}T_{35}$ – Number of days in the month with maximum air temperature ≥ 35ºC

$T_{35}T_{35}$ shall be encoded as the value of T_{35} (inclusive preceding zeros, if necessary).

$T_{40}T_{40}$ – Number of days in the month with maximum air temperature ≥ 40ºC

$T_{40}T_{40}$ shall be encoded as the value of T_{40} (inclusive preceding zeros, if necessary).

Example:

$T_{35} = 3$ ➔ $T_{35}T_{35}$ = "03"

$T_{40} = 0$ ➔ $T_{40}T_{40}$ = "00"

The Group **1**$T_{35}T_{35}T_{40}T_{40}$, including the Group Identifier "1", for this example shall be coded "10300".

$T_{35}T_{35}T_{40}T_{40}$ – Regulation for the ensemble of the Group 1 data

If both values T_{35} *and* T_{40} equal zero, Group 1 shall be omitted from Section 3 of the Report.

2.2.4.2.3 $2T_{n0}T_{n0}T_{x0}T_{x0}$ Group 2 – Number of days in the month with minimum / maximum air temperatures less than 0ºC

$T_{n0}T_{n0}$ – Number of days in the month with minimum air temperature < 0ºC

$T_{n0}T_{n0}$ shall be encoded as the value of T_{n0} (inclusive preceding zeros, if necessary).

$T_{x0}T_{x0}$ – Number of days in the month with maximum air temperature < 0ºC

$T_{x0}T_{x0}$ shall be encoded as the value of T_{x0} (inclusive preceding zeros, if necessary).

Example:

$T_{n0} = 14$ ➔ $T_{n0}T_{n0}$ = "14"

$T_{x0} = 3$ ➔ $T_{x0}T_{x0}$ = "03"

The Group **2**$T_{n0}T_{n0}T_{x0}T_{x0}$, including the Group Identifier "2", for this example shall be coded "21403".

$T_{n0}T_{n0}T_{x0}T_{x0}$ – Regulation for the ensemble of the Group 2 data

If both values T_{n0} *and* T_{x0} equal zero (hence, all days of the respective month had no temperatures below zero), Group 2 shall be omitted from Section 3 of the Report.

2.2.4.2.4 $3R_{01}R_{01}R_{05}R_{05}$ Group 3 – Number of days in the month with precipitation equal to or more than 1 mm / 5 mm

$R_{01}R_{01}$ – Number of days in the month with precipitation ≥ 1 mm

$R_{01}R_{01}$ shall be encoded as the value of R_{01} (inclusive preceding zeros, if necessary).

$R_{05}R_{05}$ – Number of days in the month with precipitation ≥ 1 mm

$R_{05}R_{05}$ shall be encoded as the value of R_{05} (inclusive preceding zeros, if necessary).

Example:

R_{01} = 16 ➔ $R_{01}R_{01}$ = "16"

R_{05} = 7 ➔ $R_{05}R_{05}$ = "07"

The Group **3**$R_{01}R_{01}R_{05}R_{05}$, including the Group Identifier "3", for this example shall be coded "31607".

$R_{01}R_{01}R_{05}R_{05}$ – Regulation for the ensemble of the Group 3 data

If both values R_{01} *and* R_{05} equal zero (hence, all days of the respective month had no precipitation above 1 mm), Group 3 shall be omitted from Section 3 of the Report.

2.2.4.2.5 $4R_{10}R_{10}R_{50}R_{50}$ Group 4 – Number of days in the month with precipitation equal to or more than 10 mm / 50 mm

$R_{10}R_{10}$ – Number of days in the month with precipitation ≥ 10 mm

$R_{10}R_{10}$ shall be encoded as the value of R_{10} (inclusive preceding zeros, if necessary).

$R_{50}R_{50}$ – Number of days in the month with precipitation ≥ 50 mm

$R_{50}R_{50}$ shall be encoded as the value of R_{50} (inclusive preceding zeros, if necessary).

Example:

R_{10} = 3 ➔ $R_{10}R_{10}$ = "03"

R_{50} = 3 ➔ $R_{50}R_{50}$ = "03"

The Group **4**$R_{10}R_{10}R_{50}R_{50}$, including the Group Identifier "4", for this example shall be coded "40303".

$R_{10}R_{10}R_{50}R_{50}$ – Regulation for the ensemble of the Group 4 data

If both values R_{10} *and* R_{50} equal zero (hence, all days of the respective month had no precipitation above 10 mm), Group 4 shall be omitted from Section 3 of the Report.

2.2.4.2.6 $5R_{100}R_{100}R_{150}R_{150}$

Group 5 – Number of days in the month with precipitation equal to or more than 100 mm / 150 mm

$R_{100}R_{100}$ – Number of days in the month with precipitation ≥ 100 mm

$R_{100}R_{100}$ shall be encoded as the value of R_{100} (inclusive preceding zeros, if necessary).

$R_{150}R_{150}$ – Number of days in the month with precipitation ≥ 150 mm

$R_{150}R_{150}$ shall be encoded as the value of R_{150} (inclusive preceding zeros, if necessary).

Example:

R_{100} = 1 ➔ $R_{100}R_{100}$ = "01"

R_{150} = 0 ➔ $R_{150}R_{150}$ = "00"

The Group **$5R_{100}R_{100}R_{150}R_{150}$**, including the Group Identifier "5", for this example shall be coded "50100".

$R_{100}R_{100}R_{150}R_{150}$ – Regulation for the ensemble of the Group 5 data

If both values R_{100} *and* R_{150} equal zero (hence, all days of the respective month had no precipitation above 100 mm), Group 5 shall be omitted from Section 3 of the Report.

2.2.4.2.7 $6s_{00}s_{00}s_{01}s_{01}$

Group 6 – Number of days in the month with snow depth more than 0 cm / 1 cm

$s_{00}s_{00}$ – Number of days in the month with snow depth > 0 cm

$s_{00}s_{00}$ shall be encoded as the value of s_{00} (inclusive preceding zeros, if necessary).

$s_{01}s_{01}$ – Number of days in the month with snow depth > 1 cm

$s_{01}s_{01}$ shall be encoded as the value of s_{01} (inclusive preceding zeros, if necessary).

Example:

s_{00} = 30 ➔ $s_{00}s_{00}$ = "30"

s_{01} = 29 ➔ $s_{01}s_{01}$ = "29"

The Group **$6s_{00}s_{00}s_{01}s_{01}$**, including the Group Identifier "6", for this example shall be coded "63029".

$s_{00}s_{00}s_{01}s_{01}$ – Regulation for the ensemble of the Group 6 data

If both values s_{00} *and* s_{01} equal zero (hence, all days of the respective month had no snow depth), Group 6 shall be omitted from Section 3 of the Report.

2.2.4.2.8 $7s_{10}s_{10}s_{50}s_{50}$

Group 7 – Number of days in the month with snow depth more than 10 cm / 50 cm

$s_{10}s_{10}$ – Number of days in the month with snow depth > 10 cm

$s_{10}s_{10}$ shall be encoded as the value of s_{10} (inclusive preceding zeros, if necessary).

$s_{50}s_{50}$ – Number of days in the month with snow depth > 50 cm

$s_{50}s_{50}$ shall be encoded as the value of s_{50} (inclusive preceding zeros, if necessary).

Example:

s_{10} = 12 ➔ $s_{10}s_{10}$ = "12"

s_{50} = 9 ➔ $s_{50}s_{50}$ = "09"

The Group **7$s_{10}s_{10}s_{50}s_{50}$**, including the Group Identifier "7", for this example shall be coded "71209".

$s_{10}s_{10}s_{50}s_{50}$ – Regulation for the ensemble of the Group 7 data

If both values s_{10} *and* s_{50} equal zero (hence, all days of the respective month had no snow depth above 10 cm), Group 7 shall be omitted from Section 3 of the Report.

2.2.4.2.9 $8f_{10}f_{10}f_{20}f_{20}f_{30}f_{30}$

Group 8 – Number of days in the month with observed or recorded wind speed equal to or more than 10 m/s (or 20 knots) / 20 m/s (or 40 knots) / 30 m/s (or 60 knots)

$f_{10}f_{10}$ – Number of days in the month with wind speed ≥ 10 m/s (or ≥ 20 knots)

$f_{10}f_{10}$ shall be encoded as the value of f_{10} (inclusive preceding zeros, if necessary).

$f_{20}f_{20}$ – Number of days in the month with wind speed ≥ 20 m/s (or ≥ 40 knots)

$f_{20}f_{20}$ shall be encoded as the value of f_{20} (inclusive preceding zeros, if necessary).

$f_{30}f_{30}$ – Number of days in the month with wind speed ≥ 30 m/s (or ≥ 60 knots)

$f_{30}f_{30}$ shall be encoded as the value of f_{30} (inclusive preceding zeros, if necessary).

Example:

f_{10} = 10 ➔ $f_{10}f_{10}$ = "10"

f_{20} = 4 ➔ $f_{20}f_{20}$ = "04"

f_{30} = 0 ➔ $f_{30}f_{30}$ = "00"

The Group **8$f_{10}f_{10}f_{20}f_{20}f_{30}f_{30}$**, including the Group Identifier "8", for this example shall be coded "8100400".

$f_{10}f_{10}f_{20}f_{20}f_{30}f_{30}$ – Regulation for the ensemble of the Group 8 data

If all three values f_{10} *and* f_{20} *and* f_{30} equal zero (hence, all days of the respective month had no wind speed above 10 m/s (or 20 knots)), Group 8 shall be omitted from Section 3 of the Report.

2.2.4.2.10 $9V_1V_1V_2V_2V_3V_3$

Group 9 – Number of days in the month with observed or recorded visibility less than 50 m / 100 m / 1000 m, irrespective of the duration of the observational period

V_1V_1 – Number of days in the month with visibility < 50 m

V_1V_1 shall be encoded as the value of V_1 (inclusive preceding zeros, if necessary).

V_2V_2 – Number of days in the month with visibility < 100 m

V_2V_2 shall be encoded as the value of V_2 (inclusive preceding zeros, if necessary).

V_3V_3 – Number of days in the month with visibility < 1000 m

V_3V_3 shall be encoded as the value of V_3 (inclusive preceding zeros, if necessary).

Example:

$V_1 = 1$ ➔ V_1V_1 = "01"

$V_2 = 1$ ➔ V_2V_2 = "01"

$V_3 = 19$ ➔ V_3V_3 = "19"

The Group **$9V_1V_1V_2V_2V_3V_3$**, including the Group Identifier "9", for this example would be coded "9010119".

$V_1V_1V_2V_2V_3V_3$ – Regulation for the ensemble of the Group 9 data

If all three values V_1 *and* V_2 *and* V_3 equal zero (hence, all days of the respective month had no visibility below 1000 m, Group 9 shall be omitted from Section 3 of the Report.

2.2.4.3 A coding example of Section 3

Section 3 of a CLIMAT Report containing the values of the examples given above (2.2.4.2) for the different Groups (in case of more than one example, values are obtained from the first Example), including the Section Identifier "333", shall be coded:

Example:

"333 01509 10300 21403 31607 40303 50100 63029 71209 8100400 9010119"

2.2.5 Section 4: Extreme values during the month and occurrence of thunderstorms and hail

Section 4 is optional. It contains for several parameters extreme values that were attained during the respective month.

Section 4 consists of the Section Identifier “444” and eight Groups with Group Identifiers “0”, “1”, …, “7”.

In the Groups 0 to 5 (Group Identifiers “0”, “1”, “2”, “3”, “4” and “5”), the day of the occurrence of the extreme value shall be coded as the last two digits in the respective Group if the extreme value only occurred on one day. If it occurred on more than one day, 50 shall be added to the first day of occurrence and the result shall be inserted for the respective symbolic letters.

2.2.5.1 Parameters needed

For forming Section 4 of a CLIMAT Report, daily values (of days in local time, except for precipitation, see 1.2) of the following five parameters which are regularly observed at land stations are needed for *every day* of the respective month:

1.	mean air temperature	$T_{day\text{-}j}$	(accuracy of 0.1 ºC)
2.	maximum air temperature	$T_{max\_day\text{-}j}$	(accuracy of 0.1 ºC)
3.	minimum air temperature	$T_{min\_day\text{-}j}$	(accuracy of 0.1 ºC)
4.	total precipitation for the day	$R_{day\text{-}j}$	(accuracy of 0.1 mm)
5.	highest wind speed	$f_{gust\_day\text{-}j}$	(accuracy of 0.1 m/s or 0.1 knot)

The number of days in the month with certain parameters beyond specific thresholds for the respective month shall be:

D_{ts}	number of days in the month with thunderstorm(s)
D_{gr}	number of days in the month with hail

If one or more of these daily values is missing from the respective record, the corresponding parameter(s) shall be omitted from the Report because of the high probability that the extreme phenomenon caused the missing.

The principal times (in UTC hours) of daily extreme temperature reading shall be:

G_x	principal time of daily reading in UTC (hours) of maximum temperature
G_n	principal time of daily reading in UTC (hours) of minimum temperature

G_x and G_n shall only be reported if they were changed.

2.2.5.2 Compiling the different Groups of Section 4

Values shall be obtained through identifying extreme values from the observations taken during the respective month for the listed parameters and from documentation on changes of extreme temperature reading.

2.2.5.2.1 0$s_n T_{xd} T_{xd} T_{xd} y_x y_x$

Group 0 – Highest daily mean air temperature of the month and day of event

On the basis of daily mean temperatures for the respective month, the highest daily mean air temperature T_{max} shall be calculated as

$$T_{max} = \max\{T_{day\text{-}j},\ j = 1, \ldots, N_{days}\} \quad (32)$$

$T_{day\text{-}j}$ daily mean air temperature for day j of the respective month (see 2.2.2.1)

N_{days} number of days of the respective month

$s_n T_{xd} T_{xd} T_{xd}$ – Highest daily mean air temperature of the month

s_n shall be encoded as the algebraic sign of T_{max}, according to the following regulation. s_n shall be

0 if $T_{max} \geq 0.0$ºC (for positive values and zero)

1 if $T_{max} < 0.0$ºC (for negative values)

$T_{xd} T_{xd} T_{xd}$ shall be encoded as the absolute value of T_{max}, with the following regulations. Only the tens, singles and tenths digits of T_{max} shall be encoded in $T_{xd} T_{xd} T_{xd}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{max} shall be omitted.

$y_x y_x$ – Day of highest daily mean air temperature of the month

$y_x y_x$ shall be encoded as the day of highest daily mean air temperature of the month (inclusive preceding zeros, if necessary). If T_{max} was observed on more than one day of the month, $y_x y_x$ shall be encoded as the first day of highest daily mean air temperature plus 50.

Example 1:

T_{max} = 20.5ºC ➔ s_n = "0"

➔ $T_{xd} T_{xd} T_{xd}$ = "205"

T_{max} on day 12 ➔ $y_x y_x$ = "12"

The Group **0**$s_n T_{xd} T_{xd} T_{xd} y_x y_x$, including the Group Identifier "0", for this example shall be coded "0020512".

Example 2:

T_{max} = -2.3ºC ➔ s_n = "1"

➔ $T_{xd}T_{xd}T_{xd}$ = "023"

T_{max} on day 5 and day 7 ➔ y_xy_x = "55"

The Group **0**$s_nT_{xd}T_{xd}T_{xd}y_xy_x$, including the Group Identifier "0", for this example shall be coded "0102355".

$s_nT_{xd}T_{xd}T_{xd}y_xy_x$ – Regulation for the ensemble of the Group 0 data

If T_{max} could not be defined (for example due to one or more missing values for the daily mean temperature), Group 0 shall be omitted from Section 4 of the Report.

2.2.5.2.2 1$s_nT_{nd}T_{nd}T_{nd}y_ny_n$

Group 1 – Lowest daily mean air temperature of the month and day of event

On the basis of daily mean temperatures for the respective month, the lowest daily mean air temperature T_{min} shall be calculated as

$$T_{min} = \min\{T_{day\text{-}j},\ j = 1, \ldots, N_{days}\} \quad (33)$$

$T_{day\text{-}j}$ daily mean air temperature for day j of the respective month (see 2.2.2.1)

N_{days} number of days of the respective month

$s_nT_{nd}T_{nd}T_{nd}$ – Lowest daily mean air temperature of the month

s_n shall be encoded as the algebraic sign of T_{min}, according to the following regulation. s_n shall be

0 if $T_{min} \geq 0.0$ºC (for positive values and zero)

1 if $T_{min} < 0.0$ºC (for negative values)

$T_{nd}T_{nd}T_{nd}$ shall be encoded as the absolute value of T_{min}, with the following regulations. Only the tens, singles and tenths digits of T_{min} shall be encoded in $T_{nd}T_{nd}T_{nd}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{min} shall be omitted.

y_ny_n – Day of lowest daily mean air temperature of the month

y_ny_n shall be encoded as the day of lowest daily mean air temperature of the month (inclusive preceding zeros, if necessary). If T_{min} was observed on more than one day of the month, y_ny_n shall be encoded as the first day of lowest daily mean air temperature plus 50.

Example 1:

T_{min} = 17.2ºC ➔ s_n = "0"

➔ $T_{nd}T_{nd}T_{nd}$ = "172"

T_{min} on day 24 ➔ y_ny_n = "24"

The Group **1**$s_n T_{nd} T_{nd} T_{nd} y_n y_n$, including the Group Identifier "1", for this example shall be coded "1017224".

Example 2:

T_{min} = -24.1ºC ➔ s_n = "1"

➔ $T_{nd} T_{nd} T_{nd}$ = "241"

T_{min} on day 17 and day 18 ➔ $y_n y_n$ = "67"

The Group **1**$s_n T_{nd} T_{nd} T_{nd} y_n y_n$, including the Group Identifier "1", for this example shall be coded "1124167".

$s_n T_{nd} T_{nd} T_{nd} y_n y_n$ – Regulation for the ensemble of the Group 1 data

If T_{min} could not be defined (for example due to one or more missing values for the daily mean temperature), Group 1 shall be omitted from Section 4 of the Report.

2.2.5.2.3 $2 s_n T_{ax} T_{ax} T_{ax} y_{ax} y_{ax}$ Group 2 – Highest air temperature of the month and day of event

On the basis of daily maximum temperatures $T_{max\_day\text{-}j}$ for the respective month, the highest air temperature of the month T_{high} shall be calculated as

$$T_{high} = \max\{T_{max\_day\text{-}j}, j = 1, \ldots, N_{days}\} \quad (34)$$

$T_{max\_day\text{-}j}$ daily maximum air temperature for day j of the respective month (see 2.2.2.1)

N_{days} number of days of the respective month

$s_n T_{ax} T_{ax} T_{ax}$ – Highest air temperature of the month

s_n shall be encoded as the algebraic sign of T_{high}, according to the following regulation. s_n shall be

0 if $T_{high} \geq 0.0$ºC (for positive values and zero)

1 if $T_{high} < 0.0$ºC (for negative values)

$T_{ax} T_{ax} T_{ax}$ shall be encoded as the absolute value of T_{high}, with the following regulations. Only the tens, singles and tenths digits of T_{high} shall be encoded in $T_{ax} T_{ax} T_{ax}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{high} shall be omitted.

$y_{ax} y_{ax}$ – Day of highest air temperature of the month

$y_{ax} y_{ax}$ shall be encoded as the day of the highest air temperature of the month (inclusive preceding zeros, if necessary). If T_{high} was observed on more than one day of the month, $y_{ax} y_{ax}$ shall be encoded as the first day of highest air temperature of the month plus 50.

Example 1:

T_{high} = 29.2ºC ➔ s_n = "0"

➔ $T_{ax}T_{ax}T_{ax}$ = "292"

T_{high} on day 11 ➔ $y_{ax}y_{ax}$ = "11"

The Group **2**$s_nT_{ax}T_{ax}T_{ax}y_{ax}y_{ax}$, including the Group Identifier "2", for this example shall be coded "2029211".

Example 2:

T_{high} = -0.3ºC ➔ s_n = "1"

➔ $T_{ax}T_{ax}T_{ax}$ = "003"

T_{high} on day 7 and day 14 ➔ $y_{ax}y_{ax}$ = "57"

The Group **2**$s_nT_{ax}T_{ax}T_{ax}y_{ax}y_{ax}$, including the Group Identifier "2", for this example shall be coded "2100357".

$s_nT_{ax}T_{ax}T_{ax}y_{ax}y_{ax}$ – Regulation for the ensemble of the Group 2 data

If T_{high} could not be defined (for example due to one or more missing values for the daily maximum temperature), Group 2 shall be omitted from Section 4 of the Report.

2.2.5.2.4 $3s_nT_{an}T_{an}T_{an}y_{an}y_{an}$

Group 3 – Lowest air temperature of the month and day of event

On the basis of daily minimum temperatures $T_{min\_day\text{-}j}$ for the respective month, the lowest air temperature of the month T_{low} shall be calculated as

$$T_{low} = \min\{T_{min\_day\text{-}j},\ j = 1, \ldots, N_{days}\} \quad (35)$$

$T_{min\_day\text{-}j}$ daily minimum air temperature for day j of the respective month (see 2.2.2.1)

N_{days} number of days of the respective month

$s_nT_{an}T_{an}T_{an}$ – Lowest air temperature of the month

s_n shall be encoded as the algebraic sign of T_{low}, according to the following regulation. s_n shall be

0 if $T_{low} \geq 0.0$ºC (for positive values and zero)

1 if $T_{low} < 0.0$ºC (for negative values)

$T_{an}T_{an}T_{an}$ shall be encoded as the absolute value of T_{low}, with the following regulations. Only the tens, singles and tenths digits of T_{low} shall be encoded in $T_{an}T_{an}T_{an}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{low} shall be omitted.

$y_{an}y_{an}$ – Day of lowest air temperature of the month

$y_{an}y_{an}$ shall be encoded as the day of the lowest air temperature of the month (inclusive preceding zeros, if necessary). If T_{low} was observed on more than one day of the month, $y_{an}y_{an}$ shall be encoded as the first day of lowest air temperature of the month plus 50.

Example 1:

T_{low} = 10.1ºC ➔ s_n = "0"

➔ $T_{an}T_{an}T_{an}$ = "101"

T_{low} on day 4 ➔ $y_{an}y_{an}$ = "04"

The Group **3**$s_nT_{an}T_{an}T_{an}y_{an}y_{an}$, including the Group Identifier "3", for this example shall be coded "3010104".

Example 2:

T_{low} = -37.8ºC ➔ s_n = "1"

➔ $T_{an}T_{an}T_{an}$ = "378"

T_{low} on day 21 and day 23 ➔ $y_{an}y_{an}$ = "71"

The Group **3**$s_nT_{an}T_{an}T_{an}y_{an}y_{an}$, including the Group Identifier "3", for this example shall be coded "3137871".

$s_nT_{an}T_{an}T_{an}y_{an}y_{an}$ – Regulation for the ensemble of the Group 3 data

If T_{low} could not be defined (for example due to one or more missing values for the daily minimum temperature), Group 3 shall be omitted from Section 4 of the Report.

2.2.5.2.5 $4R_xR_xR_xR_xy_ry_r$

Group 4 – Highest total precipitation for the day of the month and day of event

On the basis of daily values for total precipitation for the day $R_{day\text{-}j}$ for the respective month, the highest total precipitation for the day of the month R_{max} shall be calculated as

$$R_{max} = \max\{R_{day\text{-}j},\ j = 1, \ldots, N_{days}\} \quad (36)$$

$R_{day\text{-}j}$ total precipitation for the day for day j of the respective month (see 2.2.2.1)

N_{days} number of days of the respective month

R_{max} shall be rounded to tenths of mm (0.1 mm).

$R_xR_xR_xR_x$ shall be encoded as the value of R_{max}, with the following regulations. Only the hundreds, tens, singles and tenths digits of R_{max} shall be encoded in $R_xR_xR_xR_x$ (inclusive preceding zeros, if necessary), the decimal point of R_{max} shall be omitted.

y_ry_r – Day of highest total precipitation for the day of the month

y_ry_r shall be encoded as the day of the highest total precipitation for the day of the month (inclusive preceding zeros, if necessary). If R_{max} was observed on more than one day of the month, y_ry_r shall be encoded as the first day of highest total precipitation for the day of the month plus 50.

Example 1:

R_{max} = 19.6 mm ➔ $R_xR_xR_xR_x$ = "0196"

R_{max} on day 29 ➔ y_ry_r = "29"

The Group **4**$R_xR_xR_xR_xy_ry_r$, including the Group Identifier "4", for this example shall be coded "4019629".

Example 2:

R_{max} = 162.4 mm ➔ $R_xR_xR_xR_x$ = "1624"

R_{max} on day 9 and day 27 ➔ y_ry_r = "59"

The Group **4**$R_xR_xR_xR_xy_ry_r$, including the Group Identifier "4", for this example shall be coded "4162459".

$R_xR_xR_xR_xy_ry_r$ – Regulation for the ensemble of the Group 4 data

If R_{max} could not be defined (for example due to one or more missing values for the daily precipitation amount), Group 4 shall be omitted from Section 4 of the Report.

2.2.5.2.6 $5i_wf_xf_xf_xy_{fx}y_{fx}$

Group 5 – Indicator for source and units of wind speed, highest gust wind speed observed or recorded during the month and day of event

i_w – Indicator for source and units of wind speed

The source of the wind speed and the applied units shall be encoded in i_w according to Table 9.

Table 9: Encoding the source of wind gust speed and units in i_w.

Method of obtaining wind gust speed and units	i_w (code figure)
Wind speed estimated, m/s	0
Wind speed from anemometer, m/s	1
Wind speed estimated, knots	3
Wind speed from anemometer, knots	4

$f_xf_xf_x$ – Highest gust wind speed observed or recorded during the month

On the basis of daily highest wind speeds $f_{gust\_day\text{-}j}$ for the respective month, the highest gust wind speed of the month f_{max} shall be calculated as

$$f_{max} = \max\{f_{gust\_day\text{-}j},\ j = 1, \ldots, N_{days}\} \quad (37)$$

$f_{gust\_day\text{-}j}$	daily highest wind speed for day j of the respective month (see 2.2.5.1)
N_{days}	number of days of the respective month

f_{max} shall be rounded to tenths of meters per second or knots (0.1 m/s / 0.1 knots).

$f_xf_xf_x$ shall be encoded as the value of f_{max}, with the following regulations. Only the tens, singles and tenths digits of f_{max} shall be encoded in $f_xf_xf_x$ (inclusive preceding zeros, if necessary), the decimal point of f_{max} shall be omitted.

$y_{fx}y_{fx}$ – Day of highest gust wind speed of the month

$y_{fx}y_{fx}$ shall be encoded as the day of the highest gust wind speed of the month (inclusive preceding zeros, if necessary). If f_{max} was observed on more than one day during the month, $y_{fx}y_{fx}$ shall be encoded as the first day of the highest gust wind speed of the month plus 50.

Example 1:

Wind gust speed estimated and in m/s → i_w = "0"

f_{max} = 7.3 m/s → $f_xf_xf_x$ = "073"

f_{max} on day 20 → $y_{fx}y_{fx}$ = "20"

The Group **5**$i_wf_xf_xf_xy_{fx}y_{fx}$, including the Group Identifier "5", for this example shall be coded "5007320".

Example 2:

Wind gust speed from anemometer and in knots → i_w = "4"

f_{max} = 16.0 m/s → $f_xf_xf_x$ = "160"

f_{max} on day 17 and 18 → $y_{fx}y_{fx}$ = "67"

The Group **5**$i_wf_xf_xf_xy_{fx}y_{fx}$, including the Group Identifier "5", for this example shall be coded "5416067".

$i_wf_xf_xf_xy_{fx}y_{fx}$ – Regulation for the ensemble of the Group 4 data

If f_{max} could not be defined (for example due to one or more missing values for the daily maximum wind gust speed), Group 5 shall be omitted from Section 4 of the Report.

2.2.5.2.7 $6D_{ts}D_{ts}D_{gr}D_{gr}$

Group 6 – Number of days in the month with thunderstorm(s) / hail

$D_{ts}D_{ts}$ – Number of days in the month with thunderstorm(s)

$D_{ts}D_{ts}$ shall be encoded as the value of D_{ts} (inclusive preceding zeros, if necessary).

$D_{gr}D_{gr}$ – Number of days in the month with hail

$D_{gr}D_{gr}$ shall be encoded as the value of D_{gr} (inclusive preceding zeros, if necessary).

Example:

D_{ts} = 3 ➔ $D_{ts}D_{ts}$ = "03"

D_{gr} = 11 ➔ $D_{gr}D_{gr}$ = "11"

The Group **$6D_{ts}D_{ts}D_{gr}D_{gr}$**, including the Group Identifier "6", for this example shall be coded "60311".

$D_{ts}D_{ts}D_{gr}D_{gr}$ – Regulation for the ensemble of the Group 6 data

If both values D_{ts} and D_{gr} equal zero and there are no days for which thunderstorm and hail observations are missing, Group 6 shall be included in Section 4 of the Report (and the symbolic letters shall be encoded as zeros).

2.2.5.2.8 $7i_yG_xG_xG_nG_n$

Group 7 – Information about changes in extreme temperature observation

Group 7 shall only be included in Section 4 if a change in the extreme temperature observation practice has occurred.

i_y – Indicator to specify type of reading

The type of extreme temperature reading shall be encoded in i_y, according to Table 10.

Table 10: Encoding the type of extreme temperature reading in i_y.

Type of extreme temperature reading	i_y (code figure)
Maximum / minimum thermometers	1
Automatic weather station	2
Thermograph	3

G_xG_x – Principal time of daily reading in UTC (hours) of maximum temperature

G_xG_x shall be encoded as the value of G_x (with preceding zeros if necessary).

G_nG_n – Principal time of daily reading in UTC (hours) of minimum temperature

G_nG_n shall be encoded as the value of G_n (with preceding zeros if necessary).

Example:

Extreme temperatures from maximum / minimum thermometers
➔ i_y = "1"

G_x = 16 ➔ G_xG_x = "16"

G_n = 4 ➔ G_nG_n = "04"

The Group **7**$i_yG_xG_xG_nG_n$, including the Group Identifier "7", for this example shall be coded "711604".

2.2.5.3 A coding example of Section 4

Section 4 of a CLIMAT Report containing the values of the examples given above (2.2.5.2) for the different Groups (in case of more than one example, values are obtained from the first Example), including the Section Identifier "444", shall be coded:

Example:

"444 0020512 1017224 2029211 3010104 4019629 5007320 60311 711604"

2.2.6 An example of a full CLIMAT Report

Based on the examples given above for the Sections 0 to 4 (2.2.1.2, 2.2.2.3, 2.2.3.3, 2.2.4.3, 2.2.5.3), a full CLIMAT Report consisting of these examples shall be coded:

Example:

"CLIMAT 01004 11035
111 19823 29915 30005007 400820001 5012 60000/00 7016/// 8010021 9010200
222 06190 19823 29915 30005007 400820001 5012 6000000 7016 8010002 9010200
333 01509 10300 21403 31607 40303 50100 63029 71209 8100400 9010119
444 0020512 1017224 2029211 3010104 4019629 5007320 60311 711604="

2.2.7 Check lists for CLIMAT Reports / Bulletins

Rigorous checking of formed CLIMAT Reports is strongly recommended. Table 12 to Table 17 show check lists to simplify checking. In the "Example" and "Data Range" columns, line breaks are inserted to simplify the distinction of the descriptions of the different symbolic letters. (For example, in Table 12, in the column "Example" of the row "**MMJJJ**", the first line "01" describes the contents of "**MM**" and the second line "004" those of "**JJJ**".) The second column ("inclusion") of the tables indicates the needs of different Groups to be included in the CLIMAT Report. For an explanation of the different terms used in this column, refer to Table 11.

Table 11: Explanation of the different terms used in the "inclusion" column in the check lists.

Term	Description
Always	The Group shall always be reported.
Mandatory	The Group shall always be reported, except if all parameters of the Group are missing (the Group shall be omitted in this case).
Always*	The Group shall always be reported if the corresponding optional Section is reported.
Mandatory*	The Group shall always be reported if the corresponding optional Section is reported, except if all parameters of the Group are missing (the Group shall be omitted in this case).

Table 12: Check list for mandatory Section 0.

Group	Inclusion	Example	Data Range	Remarks
CLIMAT	Always	CLIMAT	CLIMAT	Only included in the first Report of a Bulletin
MMJJJ	Always	01 004	01 - 12 009 - 999 (year 2009 - 2999)	Only included in the first Report of a Bulletin
IIiii	Always	11035	01001 - 98998 (for land stations as of Jan 2009)	

Table 13: Check list for mandatory Section 1.

Group	Inclusion	Example	Data Range	Remarks
111	Always	111	111	
1 $\overline{P_0P_0P_0P_0}$	Mandatory	1 9823	1 0000 - 9999	Omitted if all missing (1////)
2 $\overline{PPPP}$	Mandatory	2 9915	2 0000 - 9999	Omitted if all missing (2////)
3s_n $\overline{TTT}$ $s_ts_ts_t$	Mandatory	3 0 005 007	3 0 or 1 000 - 999 000 - 999	Omitted if all missing (3///////)
4s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$	Mandatory	4 0 082 0 007	4 0 or 1 000 - 999 0 or 1 000 - 999	Omitted if all missing (4////////)
5 $\overline{eee}$	Mandatory	5 012	5 000 - 999	Omitted if all missing (5///)
6$R_1R_1R_1R_1R_dn_rn_r$	Mandatory	6 0000 / 00	6 0000 - 9999 0 - 6 00 - 31	Omitted if all missing (6///////)
7$S_1S_1S_1p_Sp_Sp_S$	Mandatory	7 016 ///	7 000 - 744 000 - 100	Omitted if all missing (7//////)
8$m_Pm_Pm_Tm_Tm_{Tx}m_{Tn}$	Always	8 01 00 2 1	8 00 - 31 00 - 31 0 - 9 0 - 9	
9$m_em_em_Rm_Rm_Sm_S$	Always	9 01 02 00	9 00 - 31 00 - 31 00 - 31	

Table 14: Check list for optional Section 2.

Group	Inclusion	Example	Data Range	Remarks
222	Always*	222	222	Omitted only if Section 2 not reported
0$Y_bY_bY_cY_c$	Always*	0 61 90	0 00 - 99 00 - 99	Omitted only if Section 2 not reported For the normal period, see WMO Technical Regulations Vol. I, Definitions
1 $\overline{P_0P_0P_0P_0}$	Mandatory*	1 9823	1 0000 - 9999	Omitted if all missing (1////)
2 $\overline{PPPP}$	Mandatory*	2 9915	2 0000 - 9999	Omitted if all missing (2////)
3s_n $\overline{TTT}$ $s_ts_ts_t$	Mandatory*	3 0 005 007	3 0 or 1 000 - 999 000 - 999	Omitted if all missing (3///////)
4s_n $\overline{T_xT_xT_x}$ s_n $\overline{T_nT_nT_n}$	Mandatory*	4 0 082 0 007	4 0 or 1 000 - 999 0 or 1 000 - 999	Omitted if all missing (4////////)
5 $\overline{eee}$	Mandatory*	5 012	5 000 - 999	Omitted if all missing (5///)
6$R_1R_1R_1R_1n_rn_r$	Mandatory*	6 0000 00	6 0000 - 9999 00 - 31	Omitted if all missing (6//////)
7$S_1S_1S_1$	Mandatory*	7 016	7 000 - 744	Omitted if all missing (7///)
8$y_Py_Py_Ty_Ty_{Tx}y_{Tx}$	Always*	8 01 00 02	8 00 - 31 00 - 31 00 - 31	Omitted only if Section 2 not reported
9$y_ey_ey_Ry_Ry_Sy_S$	Always*	9 01 02 00	9 00 - 31 00 - 31 00 - 31	Omitted only if Section 2 not reported

Table 15: Check list for optional Section 3.

Group	Inclusion	Example	Data Range	Remarks
333	Always*	333	333	Omitted only if Section 3 not reported
0$T_{25}T_{25}T_{30}T_{30}$	Mandatory*	0 15 09	0 00 - 31 00 - 31	Omitted if all missing (0////) or if 00000
1$T_{35}T_{35}T_{40}T_{40}$	Mandatory*	1 03 00	1 00 - 31 00 - 31	Omitted if all missing (1////) or if 10000
2$T_{n0}T_{n0}T_{x0}T_{x0}$	Mandatory*	2 14 03	2 00 - 31 00 - 31	Omitted if all missing (2////) or if 20000
3$R_{01}R_{01}R_{05}R_{05}$	Mandatory*	3 16 07	3 00 - 31 00 - 31	Omitted if all missing (3////) or if 30000
4$R_{10}R_{10}R_{50}R_{50}$	Mandatory*	4 03 03	4 00 - 31 00 - 31	Omitted if all missing (4////) or if 40000
5$R_{100}R_{100}R_{150}R_{150}$	Mandatory*	5 01 03	5 00 - 31 00 - 31	Omitted if all missing (5////) or if 50000
6$s_{00}s_{00}s_{01}s_{01}$	Mandatory*	6 30 29	6 00 - 31 00 - 31	Omitted if all missing (6////) or if 60000
7$s_{10}s_{10}s_{50}s_{50}$	Mandatory*	7 12 09	7 00 - 31 00 - 31	Omitted if all missing (7////) or if 70000
8$f_{10}f_{10}f_{20}f_{20}f_{30}f_{30}$	Mandatory*	8 10 04 00	8 00 - 31 00 - 31 00 - 31	Omitted if all missing (8//////) or if 8000000
9$V_1V_1V_2V_2V_3V_3$	Mandatory*	9 01 01 19	9 00 - 31 00 - 31 00 - 31	Omitted if all missing (9//////) or if 9000000

Table 16: Check list for optional Section 4.

Group	Inclusion	Example	Data Range	Remarks
444	Always*	444	444	Omitted only if Section 4 not reported
0$s_n T_{xd} T_{xd} T_{xd} y_x y_x$	Mandatory*	0 0 205 12	0 0 or 1 000 - 999 01 - 31, 51 - 80	Omitted if all missing (0//////)
1$s_n T_{nd} T_{nd} T_{nd} y_n y_n$	Mandatory*	1 0 172 24	1 0 or 1 000 - 999 01 - 31, 51 - 80	Omitted if all missing (1//////)
2$s_n T_{ax} T_{ax} T_{ax} y_{ax} y_{ax}$	Mandatory*	2 0 292 11	2 0 or 1 000 - 999 01 - 31, 51 - 80	Omitted if all missing (2//////)
3$s_n T_{an} T_{an} T_{an} y_{an} y_{an}$	Mandatory*	3 0 101 04	3 0 or 1 000 - 999 01 - 31, 51 - 80	Omitted if all missing (3//////)
4$R_x R_x R_x R_x y_r y_r$	Mandatory*	4 0196 29	4 0000 - 9999 00 - 31, 51 - 80	Omitted if all missing (4//////)
5$i_w f_x f_x f_x y_{fx} y_{fx}$	Mandatory*	5 0 073 20	5 0, 1, 3 or 4 000 - 999 00 - 31, 51 - 80	Omitted if all missing (5//////)
6$D_{ts} D_{ts} D_{gr} D_{gr}$	Mandatory*	6 03 11	6 00 - 31 00 - 31	Omitted if all missing (6////)
7$i_y G_x G_x G_n G_n$	Mandatory*	7 0 16 04	7 1 - 3 00 - 23 00 - 23	Omitted if all missing (7/////)
8$y_P y_P y_T y_T y_{Tx} y_{Tx}$	Always*	8 01 00 02	8 00 - 31 00 - 31 00 - 31	Omitted only if Section 2 not reported
9$y_e y_e y_R y_R y_S y_S$	Always*	9 01 02 00	9 00 - 31 00 - 31 00 - 31	Omitted only if Section 2 not reported

Table 17: Check list for mandatory End Identifier.

Group	Inclusion	Example	Data Range	Remarks
=	Always	=	=	Attached to last Group of Report without a space

3 FM 72–XII CLIMAT SHIP: Report of monthly values from an ocean weather station

CLIMAT SHIP is the name of the code for reporting monthly values from an ocean weather station. Its index number in WMO Classification is “FM 72–XII”, where “72” is the sequential number of the code in the WMO code numeration and “XII” is the number of the respective session of the WMO Commission for Basic Systems (CBS) that adopted major amendments to the code.

Ocean weather stations should provide essential and detailed meteorological data from critical locations or sea areas. Hence, these stations are an integral part of regional and national networks. Each station should be located so as to provide data which are representative for the surrounding marine area. The observations made should contain as many elements of a full synoptic report as possible.

The main standard times for synoptic observations shall be 0000, 0600, 1200 and 1800 UTC. The intermediate standard times shall be 0300, 0900, 1500 and 2100 UTC. Observations should be made and reported at both the main and intermediate standard times. If this is not feasible, observations shall be taken at least at the main standard times. If operational difficulties on board a ship make observations at a standard time impracticable, the actual time of observation should be as close to the standard time as possible.

3.1 CLIMAT SHIP: Structure, code form, and general regulations

3.1.1 CLIMAT SHIP Report structure

The overall CLIMAT SHIP Report structure and a description of the contents related to each Section are shown in Table 18. Note that the so-called ‘End Identifier’ is not a Section like the other Sections but shall always be added after the last Section.

Table 18: Section-based structure and description of respective contents of a CLIMAT Report.

Section number	Section Identifier	Contents
1	**CLIMAT SHIP**	Code name (CLIMAT SHIP) and location of observation point in time (month and year) and space (station latitude and longitude), and monthly averaged meteorological values (pressure, air temperature, sea surface temperature, vapour pressure and, if available, precipitation amount). *This Section is mandatory.*
2	**NORMAL**	Normal climatological values, averaged for the respective month over a defined reference period (usually 30 years), including number of years with missing data for the respective month and value. *This Section is optional and shall only be reported if the reference period was changed, for the twelve months following that change.*
		End Identifier “=” to indicate end of the Report, placed after the last Section of the Report without a space. *The End Identifier is mandatory.*

3.1.2 The FM 72–XII CLIMAT SHIP code form

Table 19 shows the 2 different Sections of a CLIMAT SHIP Report and the relating coding material composed by the respective Section Identifier and contents that follow the Section Identifiers. Note that for the contents of both Sections, two possibilities exist (indicated by the "*or*" in the Contents column) of which one has to be chosen, depending on the availability of the (normal) total precipitation for the month (see 3.2.1.2.7 for more details).

Table 19: CLIMAT SHIP code form. Note that columns "Section Identifier" and "Contents" refer to actual coding material whereas column "Section number" is for easier understanding of the table. Column "Remarks" indicates different coding options depending on the availability of (normal) total precipitation for the month.

Section number	Section Identifier	Contents	Remarks
1	**CLIMAT SHIP**	**MMJJJ 99$L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $\overline{PPPP}$**	
		s_n $\overline{TTT}$	
		9s_n $\overline{T_wT_wT_w}$ $\overline{eee}$ n_rn_r $R_1R_1R_1R_1R_d$	If total precipitation for the month *available*
		or	
		8s_n $\overline{T_wT_wT_w}$ $\overline{eee}$ //	If total precipitation for the month *not available*
2	**NORMAL**	$\overline{PPPP}$ s_n $\overline{TTT}$	
		9s_n $\overline{T_wT_wT_w}$ $\overline{eee}$ n_rn_r $R_1R_1R_1R_1$/	If normal total precipitation for the month available
		or	
		8s_n $\overline{T_wT_wT_w}$ $\overline{eee}$ //	If normal total precipitation for the month not availab.
		=	

3.1.3 General regulations for the FM 71–XII CLIMAT code form

1. CLIMAT SHIP Reports of several stations may be combined in a CLIMAT SHIP Bulletin. In this case, the Groups **CLIMAT SHIP** and **MMJJJ** shall only be included in the first Report of the Bulletin and shall not be repeated for each (or any) Report that follows. These following Reports shall begin with Group **99$L_aL_aL_a$**.
2. In the case of a combination of CLIMAT SHIP Reports of several stations in a Bulletin, the Reports shall all be for the same specific month only.
3. Monthly means shall be calculated on the base of daily means.
4. Section 1 is mandatory and shall always be reported.
5. Section 2 is optional and shall usually be included in the CLIMAT SHIP Report according to National Meteorological Service rules and regulations.
6. The Section Identifier "NORMAL" for Section 2 has to be included in the CLIMAT SHIP Report if it contains any of the Groups from Section 2.

7. If one or several parameters of a Group are missing, the fields for the missing parameters shall be encoded with the appropriate number of slashes (“/”). If all parameters of a Group are missing, the Group shall be omitted from the Report.
8. If all parameters of Section 2 are missing, Section 2 shall be omitted.
9. If all Groups of Section 1 are missing, except time and location information, time and location information shall be followed by a space (“ ”) and the word “NIL” (Section 2 shall not be included in this case).
10. It is common practice at many National Meteorological Services (USA, Russia, …) to define three days as an acceptable limit of missing days from the record for a parameter during a month for the majority of the CLIMAT SHIP Report parameters, and zero days for parameters such as R_1 (total precipitation or snow water equivalent for the month) to avoid possible significant observational errors for monthly values.
11. If any parameters of time and location information are missing, the CLIMAT Report shall not be transmitted.
12. The different Groups in the Report have to be separated from each other by a space (“ ”). No spaces shall be included within any Group (except the code and Section 1 Identifier “CLIMAT SHIP”).
13. The End Identifier is an equal sign (“=”) and has to be placed after the final Section of the Report without a space.
14. The WMO Technical Regulations provide that CLIMAT SHIP Reports shall be transmitted not later than the fifth day of the month following the month to which the data refer.
15. The monthly data shall be encoded in the code form which was in force during the month to which the data refer (e.g. if a CLIMAT SHIP code change came into effect on 1 November, the CLIMAT SHIP data for October, transmitted in November, will be in the old code form; the first CLIMAT SHIP Report in the new code form will be for November data, transmitted in December).

3.2 Recommended algorithm for CLIMAT SHIP Report forming

3.2.1 Section 1: Report Header and monthly data

Section 1 is mandatory for any CLIMAT SHIP Report and shall always be reported (except when it is impossible to form a CLIMAT SHIP Report and only the Report Header (inclusive time and location information) and the word “NIL” are coded for Section 1, and the rest of Section 1 and Section 2 are omitted). It consists of the Section Identifier “CLIMAT SHIP” that also is the code Identifier, information on the month and year of data collection for the Report, the geographical position, and associated meteorological data, contained in either seven or eight Groups (see 3.2.1.2.7). For every ocean weather station, geographical coordinates shall be defined (north/south latitudes and east/west longitudes). Generally, the calculation of the monthly values is based on daily observational values. Hence, for inserting data into the Groups of Section 1 and compiling Section 1, certain parameters have to be available and some calculations have to be conducted.

3.2.1.1 Parameters needed

For forming Section 1 of a CLIMAT SHIP Report for the respective month, daily values (of days in local time, except for total precipitation, see 1.2 and 3.2.1.1.1) of the following five parameters which are regularly observed at ocean weather stations are needed:

1. mean pressure at sea level (equates mean pressure at station level) $P_{day\text{-}j}$ (accuracy of 0.1 hPa)
2. mean air temperature $T_{day\text{-}j}$ (accuracy of 0.1 ºC)
3. mean sea-surface temperature $T_{w\_day\text{-}j}$ (accuracy of 0.1 ºC)
4. mean vapour pressure $e_{day\text{-}j}$ (accuracy of 0.1 hPa)
5. total precipitation $R_{day\text{-}j}$ (accuracy of 0.1 mm)

For calculation advice for these parameters, see below (3.2.1.1.1 - 3.2.1.1.2).

The main standard times for surface synoptic observations are 0000, 0600, 1200 and 1800 UTC. The intermediate standard times for surface synoptic observations are 0300, 0900, 1500 and 2100 UTC. Mean daily values shall be calculated on the basis of observations either at the UTC main standard times for surface synoptic observations or at both the UTC main and intermediate standard times for surface synoptic observations for each day in local time (0000 - 2359).

As an exception, observational days for precipitation are defined from 0601 UTC to 0600 UTC of the following day (hence, six hours of the following UTC day shall be considered as belonging to the preceding UTC day). Local time for stations in the eastern hemisphere has a positive offset with respect to UTC, and for stations in the western hemisphere a negative one. That means, that for the calculation of daily values in local time from stations in the eastern hemisphere some observations from the preceding UTC day are required, whereas for stations in the western hemisphere some observations from the following UTC day; see also 1.2.

Table 1 (p. 3) may be used to convert UTC to the respective local time.

3.2.1.1.1 Daily means for pressure, air temperature, and vapour pressure at station level and sea-surface temperature

The daily mean pressure at station level $P_{0\_day\text{-}j}$ is the arithmetic mean of all four or eight pressure values observed during a day j.

The daily mean air temperature at station level $T_{day\text{-}j}$ is the arithmetic mean of all four or eight air temperature values observed during a day j.

The daily mean vapour pressure $e_{day\text{-}j}$ is the arithmetic mean of all four or eight vapour pressure values observed during a day j.

The daily mean sea-surface temperature $T_{w\_day\text{-}j}$ is the arithmetic mean of all four or eight sea-surface temperature values observed during a day j.

Mean daily values shall be calculated as an average of observation values at the UTC standard times for surface synoptic observations which correspond to a given day j in local time (0000 - 2359 local time) for all days of the respective month. All four or eight observations shall be used for daily averaging.

If any value necessary for the calculation of a mean daily value is missing, the missing value, if possible, should be taken from appropriate autographic records. If this cannot be done, and if it was intended to calculate the mean daily value on the base of eight standard times for surface synoptic observations, then only the four main or intermediate standard times for surface synoptic observations shall be used for calculation. If this cannot be done, the respective daily mean value shall be marked as missing. It is not allowable to use less than four either main or intermediate standard times for surface synoptic observations for the calculation of a mean daily value.

A mean daily value $F_{day\text{-}j}$ for a day j of the respective month for a parameter F (as a placeholder for the parameters pressure, air temperature and vapour pressure) shall be calculated as

$$F_{day-j} = \left(\frac{\sum_{i=1}^{x} f_i}{x} \right) \tag{38}$$

f_i observed value for the respective parameter at observation i

x number of observations on the respective day (4 or 8)

The number of missing values for daily mean pressure, air temperature and vapour pressure shall be defined as:

m_P number of days missing from the record for daily mean pressure at station level for the respective month

m_T number of days missing from the record for daily mean air temperature at station level for the respective month

m_{Tw} number of days missing from the record for daily mean sea-surface temperature for the respective month

m_e number of days missing from the record for daily mean vapour pressure at station level for the respective month

3.2.1.1.2 Total precipitation for the day

The total precipitation for the day $R_{day\text{-}j}$ is the accumulated precipitation of a specific day j from 0601 - 0600 UTC (hence, six hours of the following UTC day shall be considered as belonging to the preceding UTC day, see also 1.2). For non-automatic precipitation gauges, $R_{day\text{-}j}$ shall be calculated as

$$R_{day-j} = \sum_{i=1}^{x} R_i \tag{39}$$

R_i observed precipitation amount between observations i-1 and i

x number of observations on the respective day (4 or 8)

If there were no observations of precipitation over a day j or a part of a day j, $R_{day\text{-}j}$ shall be considered as missing.

3.2.1.2 Compiling the different Groups of Section 1

Monthly mean values shall be calculated on the basis of daily mean values (for the day in local time) and monthly accumulated values shall be calculated as sums of the daily accumulations, as obtained during the respective month (in local time). The monthly values shall be encoded, according to the regulations listed and described below, into the Groups that make up Section 1.

N refers to the number of days of the respective month.

A coding example of Section 1, based on examples given within the descriptions of the Groups, is given in 3.2.1.3.

3.2.1.2.1 CLIMAT SHIP
Section and Code identifier

The invariant Group “CLIMAT SHIP” shall be used as the first Group of a single CLIMAT SHIP Report or as the first Group of the first CLIMAT SHIP Report in a CLIMAT SHIP Bulletin (see 5, pp. 105 for more information on Bulletins).

3.2.1.2.2 MMJJJ
Month and year of data collection

MM – Month of data collection

MM shall be encoded as the number of the respective month (UTC) (inclusive preceding zero, if necessary) of the year.

JJJ – Year of data collection

JJJ shall be encoded as the respective year (UTC). Only the hundreds, tens and single digits (hence, the last three digits of the year) of the year shall be encoded in **JJJ** (inclusive preceding zeros, if necessary).

Example 1:

January ➔ **MM** = “01”

1977 ➔ **JJJ** = “977”

The whole Group **MMJJJ** for this example shall be coded “01977”.

Example 2:

November ➔ **MM** = “11”

2004 ➔ **JJJ** = “004”

The whole Group **MMJJJ** for this example shall be coded “11004”.

3.2.1.2.3 $99L_aL_aL_a$

Latitude of the ocean weather station

99 shall be used as an invariant Group Identifier.

$L_aL_aL_a$ shall be encoded as the latitude of the ocean weather station in tenths of a degree, with the following regulations. The tens, singles and tenths digits of the latitude shall be encoded in $L_aL_aL_a$ (inclusive preceding zeros, if necessary), the decimal point of the latitude shall be omitted. The north/south suffix or possible minus signs of the latitude shall be omitted (information on the hemisphere is included in the quadrant Q_c of Group $Q_cL_oL_oL_oL_o$). If the latitude is in degrees and minutes, the minutes shall be divided by 6, disregarding the remainder, and added to the degrees as the tenths digit, to fulfil the requirement of an accuracy of 0.1 degrees.

Example 1:

Latitude = 47º50' N ≈ 47.8º N ➔ $L_aL_aL_a$ = "478"

The whole Group **99**$L_aL_aL_a$, including the Group identifier "99", for this example shall be coded "99478".

Example 2:

Latitude = 21º15' S ≈ 21.2º S ➔ $L_aL_aL_a$ = "212"

The whole Group **99**$L_aL_aL_a$, including the Group identifier "99", for this example shall be coded "99212".

Two full examples for geographical positions are given at the end of 3.2.1.2.4 $Q_cL_oL_oL_oL_o$.

3.2.1.2.4 $Q_cL_oL_oL_oL_o$

Quadrant and longitude of the ocean weather station

Q_c – quadrant of the globe

Q_c shall be encoded as the quadrant of the globe in which the ocean weather station is located, based on Table 20 and Figure 1. If the ocean weather station is located on Greenwich Meridian (longitude = 0º) or the 180th meridian (longitude = 180º), Q_c may be chosen to be either 1 or 7 (for positions in the northern hemisphere), and either 3 or 5 (for positions in the southern hemisphere), respectively. If the ocean weather station is located on the Equator (latitude = 0º), Q_c may be chosen to be 1 or 3 (for positions in the eastern hemisphere), and 5 or 7 (for positions in the western hemisphere), respectively.

Table 20: Encoding the quadrant in Q_c.

Latitude	Longitude	Q_c (code figure)
North	East	1
South	East	3
South	West	5
North	West	7

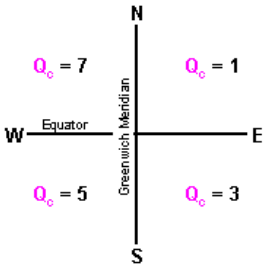

Figure 1: Encoding the quadrant in Q_c.

$L_oL_oL_oL_o$ – longitude of the ocean weather station

$L_oL_oL_oL_o$ shall be encoded as the longitude of the ocean weather station in tenths of a degree, with the following regulations. The hundreds, tens, singles and tenths digits of the longitude shall be encoded in $L_oL_oL_oL_o$ (inclusive preceding zeros, if necessary), the decimal point of the longitude shall be omitted. The east/west suffix or possible minus signs shall be omitted (this information is included in the quadrant Q_c). If the longitude is in degrees and minutes, the minutes shall be divided by 6, disregarding the remainder, and added to the degrees as the tenths digit, to fulfil the requirement of an accuracy of 0.1 degrees.

Example 1:

Longitude = 27º13' E ≈ 27.2º E ➔ $L_oL_oL_oL_o$ = "0272"

Example 2:

Longitude = 167º20' W ≈ 167.3º W

➔ $L_oL_oL_oL_o$ = "1673"

Examples obtained from the separate examples in 3.2.1.2.3 and above:

Example 1 for both Groups 99$L_aL_aL_a$ and $Q_cL_oL_oL_oL_o$:

The full geographical information included in Example 1 of Group **99**$L_aL_aL_a$ and Example 1 of $L_oL_oL_oL_o$, including the corresponding quadrant Q_c, shall be coded "99478 10272".

Example 2 for both Groups 99$L_aL_aL_a$ and $Q_cL_oL_oL_oL_o$:

The full geographical information included in Example 2 of Group **99**$L_aL_aL_a$ and Example 2 of $L_oL_oL_oL_o$, including the corresponding quadrant Q_c, shall be coded "99212 51673".

3.2.1.2.5 $\overline{PPPP}$

Mean monthly pressure at sea level

The mean monthly pressure at sea level P shall be calculated as

$$P = \frac{\sum_{j=1}^{N-m_P} P_{day-j}}{N - m_P} \qquad (40)$$

$P_{day\text{-}j}$ daily mean pressure at sea level for day j of the respective month

$N\text{-}m_P$ number of available values for $P_{day\text{-}j}$

P shall be rounded to tenths of a hectopascal (0.1 hPa).

$\overline{PPPP}$ shall be encoded as the value of P, with the following regulations. Only the hundreds, tens, singles and tenths digits shall be encoded in $\overline{PPPP}$ (inclusive preceding zeros, if necessary), the thousands digit of P shall be omitted in case P is greater than 999.9 hPa (P ≥ 1000.0 hPa). The decimal point of P shall be omitted.

Examples:

P = 991.5 hPa ➔ $\overline{PPPP}$ = "9915"

P = 1014.1 hPa ➔ $\overline{PPPP}$ = "0141"

The Group $\overline{PPPP}$ for these examples shall be coded "9915" and "0141", respectively.

3.2.1.2.6 $s_n\,\overline{TTT}$

Monthly mean air temperature

The monthly mean air temperature T shall be calculated as

$$T = \frac{\sum_{j=1}^{N-m_T} T_{day-j}}{N - m_T} \qquad (41)$$

$T_{day\text{-}j}$ daily mean air temperature for day j of the respective month

$N\text{-}m_T$ number of available values for $T_{day\text{-}j}$

T shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T, according to the following regulation. s_n shall be

0 if T ≥ 0.0ºC (for positive values and zero)

1 if T < 0.0ºC (for negative values)

$\overline{TTT}$ shall be encoded as the absolute value of T, with the following regulations. Only the tens, singles and tenths digits of T shall be encoded in $\overline{TTT}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T shall be omitted.

Example 1:

T = 0.5 ºC ➔ s_n = "0"

➔ $\overline{TTT}$ = "005"

The Group $s_n \overline{TTT}$ for this example shall be coded "0005".

Example 2:

T = -21.3 ºC ➔ s_n = "1"

➔ $\overline{TTT}$ = "213"

The Group $s_n \overline{TTT}$ for this example shall be coded "1213".

3.2.1.2.7 Regulation depending on the availability of the total precipitation for the month

Depending on the availability of the total precipitation for the month $R_1R_1R_1R_1$ (see 3.2.1.2.10), the Group Identifier of the Group $s_n \overline{T_wT_wT_w}$ shall be either "9" (if the total precipitation for the month is available) or "8" (if the total precipitation for the month is *not* available), see 3.2.1.2.8.

3.2.1.2.8 $9s_n \overline{T_wT_wT_w}$ *or* $8s_n \overline{T_wT_wT_w}$

Monthly mean sea-surface temperature

Note that the figure of the Group Identifier (either "9" or "8") depends on the availability of the total precipitation for the month (see 3.2.1.2.7).

The monthly mean sea-surface temperature T_w shall be calculated as

$$T_w = \frac{\sum_{j=1}^{N-m_{Tw}} T_{w\_day-j}}{N - m_{Tw}} \qquad (42)$$

T_{w_day-j} daily mean sea-surface temperature for day j of the respective month

$N\text{-}m_{Tw}$ number of available values for $T_{w\_day\text{-}j}$

T_w shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T_w, according to the following regulation. s_n shall be

0 if $T_w \geq 0.0$ºC (for positive values and zero)

1 if $T_w < 0.0$ºC (for negative values)

$\overline{T_wT_wT_w}$ shall be encoded as the absolute value of T_w, with the following regulations. Only the tens, singles and tenths digits of T_w shall be encoded in $\overline{T_wT_wT_w}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_w shall be omitted.

Example 1:

$T_w = 0.5$ ºC ➔ s_n = "0"

➔ $\overline{T_wT_wT_w}$ = "005"

The Group $s_n \overline{T_wT_wT_w}$, including the Group Identifier "9" or "8", for this example shall be coded "90005" or "80005", respectively.

Example 2:

$T_w = -0.3$ ºC ➔ s_n = "1"

➔ $\overline{T_wT_wT_w}$ = "003"

The Group $s_n \overline{T_wT_wT_w}$, including the Group Identifier "9" or "8", for this example shall be coded "91003" or "81003", respectively.

3.2.1.2.9 $\overline{eee}\ n_rn_r$

Monthly mean vapour pressure and number of days in the month with precipitation equal to or greater than 1 millimetre

$\overline{eee}$ – monthly mean vapour pressure

The monthly mean vapour pressure e shall be calculated as

$$e = \frac{\sum_{j=1}^{N-m_e} e_{day-j}}{N - m_e} \qquad (43)$$

e_{day-j} daily mean vapour pressure for day j of the respective month

$N\text{-}m_e$ number of available values for e_{day-j}

e shall be rounded to tenths of a hectopascal.

$\overline{eee}$ shall be encoded as the value of e, with the following regulations. The tens, singles and tenths digits of e shall be encoded in $\overline{eee}$ (inclusive preceding zeros, if necessary), the decimal point of e shall be omitted.

n_rn_r – Number of days in the month with precipitation equal to or greater than 1 millimetre

n_r shall be the number of days in the month with precipitation ≥ 1 mm.

n_rn_r shall be encoded as the value of n_r (inclusive preceding zeros, if necessary).

Example 1:

e = 1.2 hPa ➔ $\overline{eee}$ = "012"

$n_r = 0$ ➔ n_rn_r = "00"

The Group $\overline{eee}$ n_rn_r for this example shall be coded "01200".

Example 2:

e = 18.1 hPa ➔ $\overline{eee}$ = "181"

$n_r = 17$ ➔ n_rn_r = "17"

The Group $\overline{eee}$ n_rn_r for this example shall be coded "18117".

$\overline{eee}$ n_rn_r – Regulation for the ensemble of the Group 4 data

If the total monthly precipitation is not available for the respective month, n_rn_r shall be encoded "//". In this case, the examples above shall be encoded "012//" and "181//", respectively.

3.2.1.2.10 $R_1R_1R_1R_1R_d$ Monthly precipitation characteristics

$R_1R_1R_1R_1$ – Total precipitation for the month

The total precipitation for the month R_1 shall be calculated as

$$R_1 = \sum_{j=1}^{N} R_{day-j} \qquad (44)$$

R_{day-j} total precipitation for the day for day j of the respective month

N number of days of the respective month

R_1 shall be rounded to millimetres (1 mm), except if R_1 is greater than 0 mm and less than 1 mm (see Table 21).

$R_1R_1R_1R_1$ shall be encoded as the value of R_1, according to the regulations given in Table 21.

Table 21: Encoding R_1 in $R_1R_1R_1R_1$.

R_1 (calculated value)	$R_1R_1R_1R_1$ (code figure)
0 mm (or no measurable water equivalent of snow cover on the ground)	0000
1 mm	0001
2 mm	0002
…	…
8898 mm	8898
≥ 8899 mm	8899
0 mm < R_1 < 1 mm	9999

R_d – Frequency group in which $R_1R_1R_1R_1$ falls

If the 30-year normal precipitation R_{1_norm} is known (see 3.2.2.2.6, p. 81), as well as all yearly precipitations $R_{1\_year\text{-}k}$ (k = 1,…,30) and the probability distribution of the precipitation for the respective station, R_d shall be derived by assigning the appropriate frequency group (probability distribution quintile) to the calculated value R_1 (see Table 22). These quintiles shall be defined by appropriate tables of the probability distribution (see Table 23 for examples), based on the following regulations:

- The total precipitation for the month for the respective month shall be observed over 30 years.
- These 30 observational values shall be put in ascending order and grouped into five quintiles (hence, six observational values per quintile) of which the first quintile contains the lowest six values and the fifth quintile contains the highest six values.
- The upper and lower limits of the five quintiles shall be determined. Between two quintiles, the boundary is set half-way between the top value of the lower quintile and the first value of the upper quintile.
- For stations where the monthly precipitation during the reference period was zero more than six times and hence, more than one quintile contain the value zero, only the highest of the quintiles that contain the value zero shall be used. (See Table 23, example 2.)

If the 30-year normal total precipitation for the month R_{1_norm} is not available, R_d shall be "/".

Table 22: Assigning the calculated value R_1 to the appropriate frequency group and encoding it into R_d.

R_1 (calculated value) is	R_d (code figure)
smaller than any value in the 30-year period	0
in the 1st quintile	1
in the 2nd quintile	2
in the 3rd quintile	3
In the 4th quintile	4
In the 5th quintile	5
greater than any value in the 30-year period	6

Table 23: Two examples on how to assign the appropriate frequency groups to R_d.

Example 1				**Example 2**			
Precipitation [mm]	Quintile	Quintile limits [mm]	R_d	Precipitation [mm]	Quintile	Quintile limits [mm]	R_d
		0 - 4.9	R_d = 0				
5		5.0		0		0	
18				0			
38	1st	-	R_d = 1	0	1st		
48	Quintile			0	Quintile		
56				0			
61		62.5		0			R_d = 0 - 2
64		62.6		0		0	shall
69				0			not be used
86	2nd	-	R_d = 2	0	2nd		
104	Quintile			0	Quintile		
105				0			
119		121.5		0			
124		121.6		0		0	
155				0			
163	3rd	-	R_d = 3	0	3rd	-	R_d = 3
164	Quintile			2	Quintile		
175				3			
203		213.5		3		4.0	
224		213.6		5		4.1	
236				5			
236	4th	-	R_d = 4	6	4th	-	R_d = 4
239	Quintile			8	Quintile		
249				8			
254		255.5		9		9.0	
257		255.6		9		9.1	
293				14			
335	5th	-	R_d = 5	19	5th	-	R_d = 5
344	Quintile			20	Quintile		
349				21			
411		411.0		28		28.0	
		>411.0	R_d = 6			>28.0	R_d = 6

Example 1:

R_1 = 0 mm ➔ $R_1R_1R_1R_1$ = "0000"

R_{1_norm} unavailable ➔ R_d = "/"

The Group $R_1R_1R_1R_1R_d$ for this example shall be coded "0000/".

Example 2:

R_1 = 671 mm ➔ **$R_1R_1R_1R_1$** = "0671"

R_{1_norm} unavailable ➔ **R_d** = "/"

The Group **$R_1R_1R_1R_1R_d$** for this example shall be coded "0671/".

3.2.1.3 A coding example of Section 1

Section 1 of CLIMAT SHIP Reports containing the values of the examples given above (3.2.1.2) for the different Groups, including the Section and Code Identifier "CLIMAT SHIP", shall be coded (Example 1 contains all of the first examples given for the Groups, Example 2 contains all of the second examples):

Example 1:

"CLIMAT SHIP 01977 99478 10272 9915 0005 90005 01200 0000/" or

"CLIMAT SHIP 01977 99478 10272 9915 0005 80005 012//" (if the total precipitation for the month is *not* available)

Example 2:

"CLIMAT SHIP 11004 99212 51673 0141 1213 91003 18117 0671/" or

"CLIMAT SHIP 11004 99212 51673 0141 1213 81003 181//" (if the total precipitation for the month is *not* available)

3.2.2 Section 2: Normals for monthly values

Section 2 is optional (see below). It contains normals for monthly values of the parameters observed at the respective station for the respective month (the month specified in **MM** of Section 1 of the CLIMAT SHIP Report). These normals shall be obtained by averaging the monthly values of all years of a reference period (usually 30 years, defined by WMO Technical Regulations) for the respective month. Section 2 shall only be included in the CLIMAT SHIP Report for a station if either no normals for monthly values have been submitted to the Secretariat by the time or changes in the normals for monthly values occur (e.g. because of a change in the definition of the reference period or because Meteorological Services consider it necessary to make amendments to previously published normals). If Section 2 is to be reported, it shall be included in the CLIMAT SHIP Reports for all twelve months in a row so that normal data for all twelve months be available for the respective station.

See 1.2.3 for general information on normals.

It consists of the Section Identifier "NORMAL" and either four or five Groups (see 3.2.2.2.3).

3.2.2.1 Parameters needed

Monthly values of the required parameters shall be calculated on the basis of daily values, with the algorithms given in 3.2.1 and its sub- and sub-subsections. Data should be available for every month of every year of the reference period.

For forming Section 2 of a CLIMAT SHIP Report, monthly values of the following ten parameters which are regularly observed at ocean weather stations are needed for the respective month of every year (year k) of the reference period:

1.	mean pressure at sea level (equates mean pressure at station level)	$P_{year\text{-}k}$	(accuracy of 0.1 hPa)
2.	mean air temperature	$T_{year\text{-}k}$	(accuracy of 0.1 ºC)
3.	mean sea-surface temperature	$T_{w\_year\text{-}k}$	(accuracy of 0.1 ºC)
4.	mean vapour pressure	$e_{year\text{-}k}$	(accuracy of 0.1 hPa)
5.	total precipitation of precipitation	$R_{1\_year\text{-}k}$	(accuracy of 0.1 mm)
6.	number of days with precipitation ≥ 1 mm	$n_{r\_year\text{-}k}$	

Note that the indexes of the parameters include “year” but refer to values for the respective *month of that year*.

The same reference period shall be used for all parameters.

The numbers of missing years within the reference period from the calculation of the normal of the respective parameter shall be defined as:

y_P	number of missing years within the reference period from the calculation of the normal for monthly mean pressure at sea level
y_T	number of missing years within the reference period from the calculation of the normal for monthly mean air temperature
y_{Tw}	number of missing years within the reference period from the calculation of the normal for monthly mean sea-surface temperature
y_e	number of missing years within the reference period from the calculation of the normal for monthly mean vapour pressure
y_R	number of missing years within the reference period from the calculation of the normal for total precipitation for the month

3.2.2.2 Compiling the different Groups of Section 2

Normals of monthly values shall be calculated on the basis of monthly values for the *respective* month over the indicated period of years.

Note that most of the Groups of Section 2 may look similar to Groups included in Section 1 but differences exist and calculations shall be conducted very attentively on the basis of the instructions and regulations given below.

N_{years} refers to the number of years of the reference period.

A coding example of Section 2, based on examples given within the descriptions of the Groups, is given in 3.2.2.3.

3.2.2.2.1 $\overline{PPPP}$

Normal for monthly mean pressure at sea level

The normal for monthly mean pressure at sea level P_{norm} shall be calculated as

$$P_{norm} = \frac{\sum_{k=1}^{N_{years}-y_P} P_{year-k}}{N_{years} - y_P} \quad (45)$$

P_{year-k} mean pressure at sea level for the respective month of year k

N_{years}-y_P number of available values for P_{year-k}

P_{norm} shall be rounded to tenths of a hectopascal.

$\overline{PPPP}$ shall be encoded as the value of P_{norm}, with the following regulations. Only the hundreds, tens, singles and tenths digits shall be encoded in $\overline{PPPP}$ (inclusive preceding zeros, if necessary), the thousands digit of P_{norm} shall be omitted in case P_{norm} is greater than 999.9 hPa ($P_{norm} \geq 1000.0$ hPa). The decimal point of P_{norm} shall be omitted.

Examples:

P_{norm} = 991.5 hPa ➔ $\overline{PPPP}$ = "9915"

P_{norm} = 1014.1 hPa ➔ $\overline{PPPP}$ = "0141"

The Group $\overline{PPPP}$ for these examples shall be coded "9915" and "0141", respectively.

3.2.2.2.2 $s_n\overline{TTT}$

Normal for monthly mean air temperature

The normal for monthly mean air temperature T_{norm} shall be calculated as

$$T_{norm} = \frac{\sum_{k=1}^{N_{years}-y_T} T_{year-k}}{N_{years} - y_T} \quad (46)$$

T_{year-k} mean air temperature for the respective month of year k

N_{years}-y_T number of available values for T_{year-k}

T_{norm} shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T_{norm}, according to the following regulation. s_n shall be

0 if $T_{norm} \geq 0.0$ºC (for positive values and zero)

1 if $T_{norm} < 0.0$ºC (for negative values)

$\overline{TTT}$ shall be encoded as the absolute value of T_{norm}, with the following regulations. Only the tens, singles and tenths digits of T_{norm} shall be encoded in $\overline{TTT}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{norm} shall be omitted.

Example 1:

T_{norm} = 0.5 ºC ➔ s_n = "0"

➔ $\overline{TTT}$ = "005"

The Group $s_n \overline{TTT}$ for this example shall be coded "0005".

Example 2:

T_{norm} = -21.3 ºC ➔ s_n = "1"

➔ $\overline{TTT}$ = "213"

The Group $s_n \overline{TTT}$ for this example shall be coded "1213".

3.2.2.2.3 Regulation depending on the availability of the normal for the total precipitation for the month

Depending on the availability of the normal for total precipitation for the month $R_1R_1R_1R_1$ (see 3.2.2.2.6), the Group Identifier of the Group $s_n \overline{T_wT_wT_w}$ shall be either "9" (if the normal monthly precipitation is available) or "8" (if the normal monthly precipitation is *not* available) see 3.2.2.2.4.

3.2.2.2.4 $9s_n\overline{T_wT_wT_w}$ *or* $8s_n\overline{T_wT_wT_w}$ Normal for monthly sea-surface temperature

Note that the figure of the Group Identifier (either "9" or "8") depends on the availability of the normal for total precipitation for the month (see 3.2.2.2.3).

The normal for monthly sea-surface temperature T_{w_norm} shall be calculated as

$$T_{w\_norm} = \frac{\sum_{k=1}^{N_{years}-y_{Tw}} T_{w\_year-k}}{N_{years} - y_{Tw}} \qquad (47)$$

T_{w_year-k} monthly mean sea-surface temperature for the respective month of year k

N_{years}-y_{Tw} number of available values for T_{w_year-k}

T_{w_norm} shall be rounded to tenths of a degree Celsius (0.1ºC).

s_n shall be encoded as the algebraic sign of T_{w_norm}, according to the following regulation. s_n shall be

0 if $T_{w_norm} \geq 0.0$ºC (for positive values and zero)

1 if $T_{w_norm} < 0.0$ºC (for negative values)

$\overline{T_wT_wT_w}$ shall be encoded as the absolute value of T_{w_norm}, with the following regulations. Only the tens, singles and tenths digits of T_{w_norm} shall be encoded in $\overline{T_wT_wT_w}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted (the information of the algebraic sign is included in s_n). The decimal point of T_{w_norm} shall be omitted.

Example 1:

T_{w_norm} = 2.5 ºC ➔ s_n = "0"

➔ $\overline{T_wT_wT_w}$ = "025"

The Group s_n $\overline{T_wT_wT_w}$, including the Group Identifier "9" or "8", for this example shall be coded "90025" or "80025", respectively.

Example 2:

T_{w_norm} = 20.1 ºC ➔ s_n = "0"

➔ $\overline{T_wT_wT_w}$ = "201"

The Group s_n $\overline{T_wT_wT_w}$, including the Group Identifier "9" or "8", for this example shall be coded "90201" or "80201", respectively.

3.2.2.2.5 $\overline{eee}$ n_rn_r

Normal for monthly mean vapour pressure and normal for number of days with precipitation equal to or greater than 1 millimetre

$\overline{eee}$ – normal for monthly mean vapour pressure

The normal for monthly mean vapour pressure e_{norm} shall be calculated as

$$e_{norm} = \frac{\sum_{k=1}^{N_{years}-y_e} e_{year-k}}{N_{years} - y_e} \quad (48)$$

e_{year-k} monthly mean vapour pressure for the respective month of year k

N_{years}-y_e number of available values for e_{year-k}

e_{norm} shall be rounded to tenths of a hectopascal (0.1 hPa).

$\overline{eee}$ shall be encoded as the value of e_{norm}, with the following regulations. The tens, singles and tenths digits of e_{norm} shall be encoded in $\overline{eee}$ (inclusive preceding zeros, if necessary), the decimal point of e_{norm} shall be omitted.

n_rn_r – Normal for number of days in the month with precipitation equal to or greater than 1 millimetre

The normal for number of days in the month with precipitation ≥ 1 mm n_{r_norm} shall be calculated as

$$n_{r\_norm} = \frac{\sum_{k=1}^{N_{years}-y_R} n_{r\_year-k}}{N_{years} - y_R} \quad (49)$$

n_{r_year-k} number of days in the month with precipitation ≥ 1 mm for the respective month of year k

N_{years}-y_R number of available values for n_{r_year-k}

n_rn_r shall be encoded as the value of n_{r_norm} (inclusive preceding zeros, if necessary).

Example 1:

e_{norm} = 1.2 hPa ➔ $\overline{eee}$ = “012”

n_{r_norm} = 0 ➔ n_rn_r = “00”

The Group $\overline{eee}$ n_rn_r for this example would be coded “01200”.

Example 2:

e_{norm} = 18.1 hPa ➔ $\overline{eee}$ = “181”

n_{r_norm} = 17 ➔ n_rn_r = “17”

The Group $\overline{eee}$ n_rn_r for this example would be coded “18117”.

$\overline{eee}$ n_rn_r – Regulation for the ensemble of the Group 4 data

If the normal for total precipitation for the month is not available for the respective month, n_rn_r shall be encoded “//”. In this case, the examples above shall be encoded “012//” and “181//”, respectively.

3.2.2.2.6 $R_1R_1R_1R_1$/ Normal for total precipitation for the month

Note that this Group does not include the frequency group classification analogue the total precipitation for the month (compare 3.2.1.2.10), and therefore the fifth digit shall always be encoded as a slash ("/").

The normal for total precipitation for the month R_{1_norm} shall be calculated as

$$R_{1\_norm} = \frac{\sum_{k=1}^{N_{years}} R_{1\_year-k}}{N_{years} - y_R} \quad (50)$$

R_{1_year-k} total precipitation for the month for the respective month of year k

N_{years}-y_R number of available values for R_{1_year-k}

R_{1_norm} shall be rounded to millimetres (1 mm), except if R_{1_norm} is greater than 0 mm and less than 1 mm (see Table 24).

$R_1R_1R_1R_1$/ shall be encoded as the value of R_{1_norm}, according to the regulations given in Table 24.

Table 24: Encoding R_{1_norm} in $R_1R_1R_1R_1$/.

R_{1_norm} (calculated value)	$R_1R_1R_1R_1$/ (code figure)
0 mm (or no measurable water equivalent of snow cover on the ground)	0000/
1 mm	0001/
2 mm	0002/
…	…
8898 mm	8898/
≥ 8899 mm	8899/
0 mm < R_{1_norm} < 1 mm	9999/

Examples:

R_{1_norm} = 0 mm ➔ $R_1R_1R_1R_1$ = "0000/"

R_{1_norm} = 671 mm ➔ $R_1R_1R_1R_1$ = "0671/"

The Group $R_1R_1R_1R_1$/ for these examples shall be coded "0000/" and "0671/", respectively.

3.2.2.3 A coding example of Section 2

Section 2 of CLIMAT SHIP Reports containing the values of the examples given above (3.2.2.2) for the different Groups, including the Section Identifier "NORMAL", shall be coded (Example 1 contains all of the first examples given for the Groups, Example 2 contains all of the second examples):

Example 1:

“NORMAL 9915 0005 90025 01200 0000/” or

“NORMAL 9915 0005 80025 012//” (if the normal for total precipitation for the month is *not* available)

Example 2:

“NORMAL 0141 1213 90201 18117 0671/” or

“NORMAL 0141 1213 80201 181//” (if the normal for total precipitation for the month is *not* available)

3.2.3 An example of a full CLIMAT SHIP Report

Based on the examples given above for the Sections 1 and 2, and supposed that the total precipitation for the month and the normal for total precipitation for the month are available, full CLIMAT SHIP Reports consisting of these examples shall be coded (Example 1 contains the first examples given for Sections 1 and 2, Example 2 contains the second examples):

Example 1:

“CLIMAT SHIP 01977 99478 10272 9915 0005 90025 01200 0000/
NORMAL 9915 0005 90025 01200 0000/=”

Example 2:

“CLIMAT SHIP 11004 99212 51673 0141 1213 91003 01200 0000/
NORMAL 0141 1213 90201 18117 0671/=”

3.2.4 Check lists for CLIMAT SHIP Reports / Bulletins

Rigorous checking of formed CLIMAT SHIP Reports is strongly recommended. Table 26 to Table 28 show check lists to simplify checking. In the “Example” and “Data Range” columns, line breaks are inserted to simplify the distinction of the descriptions of the different symbolic letters. (For example, in Table 26, in the column “Example” of the row “**MMJJJ**”, the first line “01” describes the contents of “**MM**” and the second line “977” those of “**JJJ**”.) The second column (“inclusion”) of the tables indicates the needs of different Groups to be included in the CLIMAT SHIP Report. For an explanation of the different terms used in this column, refer to Table 25.

Table 25: Explanation of the different terms used in the “inclusion” column in the check lists.

Term	Description
Always	The Group shall always be reported.
Always*	The Group shall always be reported if the corresponding Set or optional Section is reported.

Table 26: Check list for mandatory Section 1.

Group		Inclusion	Example	Data Range	Remarks
CLIMAT SHIP		Always	CLIMAT SHIP	CLIMAT SHIP	Only included in the first Report of any Bulletin
MMJJ		Always	01 977	01 - 12 009 - 999 (year 2009 - 2999)	Only included in the first Report of any Bulletin
99$L_aL_aL_a$		Always	99 478	99 000 - 900	
$Q_cL_oL_oL_oL_o$		Always	1 0272	1, 3, 5, 7 0000 - 1800	
$\overline{PPPP}$		Always	9915	0000 - 9999	If all missing, encode "////"
$s_n\ \overline{TTT}$		Always	0 005	0 or 1 000 - 999	If all missing, encode "////"
SET 1	**9$s_n\ \overline{T_wT_wT_w}$**	Always*	9 0 025	9 0 or 1 000 - 999	Use SET 1 if the monthly precipitation R_1 is *available*
	$\overline{eee}\ n_rn_r$	Always*	012 00	000 - 999 00 - 31	
	$R_1R_1R_1R_1R_d$	Always*	0000 /	0000 - 9999 0 - 6	
SET 2	**8$s_n\ \overline{T_wT_wT_w}$**	Always*	8 0 025	8 0 or 1 000 - 999	Use SET 2 if the monthly precipitation R_1 is *not available*
	$\overline{eee}$ //	Always*	012 //	000 - 999 //	

Table 27: Check list for optional Section 2.

Group		Inclusion	Example	Data Range	Remarks
NORMAL		Always	NORMAL	NORMAL	
$\overline{PPPP}$		Always	9915	0000 - 9999	If all missing, include "////"
$s_n\ \overline{TTT}$		Always	0 005	0 or 1 000 - 999	If all missing, include "////"
SET 1	**9$s_n\ \overline{T_wT_wT_w}$**	Always*	9 0 025	9 0 or 1 000 - 999	Use SET 1 if the normal precipitation R_{1_norm} is *available*
	$\overline{eee}\ n_rn_r$	Always*	012 00	000 - 999 00 - 31	
	$R_1R_1R_1R_1$/	Always*	0000 /	0000 - 9999 /	
SET 2	**8$s_n\ \overline{T_wT_wT_w}$**	Always*	8 0 025	8 0 or 1 000 - 999	Use SET 2 if the normal precipitation R_{1_norm} is *not available*
	$\overline{eee}$ //	Always*	012 //	000 - 999 //	

Table 28: Check list for mandatory End Identifier.

Group	Inclusion	Example	Data Range	Remarks
=	Always	=	=	Attached to last Group of Report without a space

4 FM 75–XII Ext. CLIMAT TEMP and FM-76-XII Ext. CLIMAT TEMP SHIP: Reports of monthly values from aerological land and ocean weather stations

CLIMAT TEMP is the name of the code for reporting monthly aerological mean values from a land station. Its index number in WMO Classification is “FM 75–XII Ext.”, where “75” is the sequential number of the code in the WMO code numeration and “XII Ext.” is the number of the respective session of the WMO Commission for Basic Systems (CBS) that adopted major amendments to the code.

CLIMAT TEMP SHIP is the name of the code for reporting monthly aerological mean values from an ocean weather station. Its index number in WMO Classification is “FM 76–XII Ext.”, where “76” is the sequential number of the code in the WMO code numeration and “XII Ext.” is the number of the respective session of the WMO Commission for Basic Systems (CBS) that adopted major amendments to the code.

Each station for aerological observations should be located so as to provide data which are representative for the surrounding area.

The main standard times for aerological observations shall be 0000, 0600, 1200 and 1800 UTC. CLIMAT TEMP (SHIP) Reports should at least be based on observations made at 0000 UTC and 1200 UTC.

Due to the time duration of the radiosonde ascent, the time of the radiosonde release shall be 45 - 30 minutes before the respective standard time for aerological observations.

Aerological observations should cover one or more of the following parameters:

- Pressure
- Air temperature
- Humidity
- Wind speed and direction

The CLIMAT TEMP SHIP code is largely identical to the CLIMAT TEMP code, with two exceptions:

1. In CLIMAT TEMP SHIP Reports, the Group **CLIMAT TEMP SHIP** shall replace the Group **CLIMAT TEMP** of CLIMAT TEMP Reports.
2. In CLIMAT TEMP SHIP Reports, the Groups **99**$L_aL_aL_a$ and $Q_cL_oL_oL_oL_o$ shall replace the Group **IIiii** of CLIMAT TEMP Reports.

4.1 CLIMAT TEMP (SHIP): Structure, code form, and general regulations

4.1.1 CLIMAT TEMP (SHIP) Report structure

A CLIMAT TEMP (SHIP) Report consists of a single Section with some Report Header Groups and some monthly data Groups.

4.1.2 The FM 75-XII Ext. CLIMAT TEMP and FM 76-XII Ext. CLIMAT TEMP SHIP code forms

Table 29 shows a CLIMAT TMEP (SHIP) Report. Note that some differences exist between CLIMAT TEMP and CLIMAT TEMP SHIP Reports (indicated by the "*or*" and the "Remarks" column).

Table 29: CLIMAT TEMP (SHIP) code form. Note that only column "Contents" refers to actual coding material. Column "Remarks" indicates differences between the CLIMAT TEMP and CLIMAT TEMP SHIP code forms.

Contents	Remarks
CLIMAT TEMP MMJJJ Iliii *or* **CLIMAT TEMP SHIP** MMJJJ **99**$L_aL_aL_a$ $Q_cL_oL_oL_o$	CLIMAT TEMP Reports *only* CLIMAT TEMP SHIP Reports *only*
g $\overline{P_0P_0P_0}$ $\overline{T_0T_0T_0}$ $\overline{D_0D_0D_0}$ $\overline{H_1H_1H_1H_1}$ n_{T1} n_{T1} $\overline{T_1T_1T_1}$ $\overline{D_1D_1D_1}$ $n_{v1}r_{f1}r_{f1}$ $\overline{d_{V1}d_{V1}d_{V1}}$ $\overline{f_{V1}f_{V1}}$ $\overline{H_2H_2H_2H_2}$ n_{T2} n_{T2} $\overline{T_2T_2T_2}$ $\overline{D_2D_2D_2}$ $n_{v2}r_{f2}r_{f2}$ $\overline{d_{V2}d_{V2}d_{V2}}$ $\overline{f_{V2}f_{V2}}$ ... $\overline{H_9H_9H_9H_9}$ n_{T9} n_{T9} $\overline{T_9T_9T_9}$ $\overline{D_9D_9D_9}$ $n_{v9}r_{f9}r_{f9}$ $\overline{d_{V9}d_{V9}d_{V9}}$ $\overline{f_{V9}f_{V9}}$	
=	

4.1.3 General regulations for the FM 75-XII Ext. CLIMAT TEMP and FM 76-XII Ext. CLIMAT TEMP SHIP code forms

1. CLIMAT TEMP (SHIP) Reports of several stations may be combined in a CLIMAT TEMP (SHIP) Bulletin. In this case, the Groups **CLIMAT TEMP** (**SHIP**) and MMJJJ shall only be included in the first Report of the Bulletin and shall not be repeated for each (or any) Report that follows. These following Reports shall begin with Group Iliii (for CLIMAT TEMP Reports) Group **99**$L_aL_aL_a$ (for CLIMAT TEMP SHIP Reports).
2. In the case of a combination of CLIMAT TEMP (SHIP) Reports of several stations in a Bulletin, the Reports shall all be for the same specific month only.
3. Monthly means shall be calculated on the base of daily means.
4. MM, the identification of the respective month in the Group MMJJJ, in addition shall be used to identify the unit of the wind speed. For wind speeds given in m/s, the value of MM shall not be altered; for wind speeds given in knots, 50 shall be added when encoding MM.
5. The monthly mean values for the parameters included in a CLIMAT TEMP (SHIP) Report shall be provided for station level and for the specified pressure surfaces of 850, 700, 500, 300, 200, 150, 100, 50 and 30 hPa, respectively.
6. The mean values at station level for pressure, temperature and dew-point depression shall be calculated for the times of the radiosonde releases.

7. For geopotentials of specified pressure surfaces above 9999 geopotential meters, the tens of thousands digit shall be omitted.
8. If one or several parameters of a Group are missing, the fields for the missing parameters shall be encoded with the appropriate number of slashes (“/”). If all parameters of a Group are missing, the Group shall *not* be omitted from the Report.
9. If any parameters of time (Group **MMJJJ**) and location (CLIMAT TEMP: Group **Iliii**, CLIMAT TEMP SHIP: Groups **99**$L_aL_aL_a$ and $Q_cL_oL_oL_oL_o$) information are missing, the CLIMAT TEMP (SHIP) Report shall not be transmitted.
10. The different Groups in the Report have to be separated from each other by a space (“ ”). No spaces shall be included within any Group (except the code Identifiers **CLIMAT TEMP** and **CLIMAT TEMP SHIP**).
11. The End Identifier is an equal sign (“=”) and has to be placed after the final Section of the Report without a space.
12. The WMO Technical Regulations provide that CLIMAT SHIP Reports shall be transmitted not later than the fifth day of the month following the month to which the data refer.
13. The monthly data shall be encoded in the code form which was in force during the month to which the data refer (e.g. if a CLIMAT SHIP code change came into effect on 1 November, the CLIMAT SHIP data for October, transmitted in November, will be in the old code form; the first CLIMAT SHIP Report in the new code form will be for November data, transmitted in December).

4.2 Recommended algorithm for CLIMAT TEMP and CLIMAT TEMP SHIP Report forming

For the sake of clearness, this section on CLIMAT TEMP (SHIP) Report forming is divided into two parts (as feasible due to the Report structure, see 4.1.1), a description for forming the heading part of CLIMAT TEMP (SHIP) Reports that provides information on locations in time and space of data collection (4.2.1 Report Header), and a description for forming the data part of CLIMAT TEMP (SHIP) Reports that contains the observational data (4.2.2 Monthly data).

4.2.1 Report Header

The Report Header is mandatory for any CLIMAT TEMP (SHIP) Report and shall always be included. It consists of the Report Identifier and information on location in time and in space of data collection. For every ocean weather station, geographical coordinates shall be defined (north/south latitudes and east/west longitudes).

4.2.1.1 Compiling the Report Header Groups

4.2.1.1.1 CLIMAT TEMP / CLIMAT TEMP SHIP Code identifier

The invariant Group **CLIMAT TEMP** shall be used as the first Group of a single CLIMAT TEMP Report or as the first Group of the first CLIMAT TEMP Report in a CLIMAT TEMP Bulletin (see chapter 5 for more information on Bulletins).

The invariant Group **CLIMAT TEMP SHIP** shall be used as the first Group of a single CLIMAT TEMP SHIP Report or as the first Group of the first CLIMAT TEMP SHIP Report in a CLIMAT TEMP SHIP Bulletin (see chapter 5 for more information on Bulletins).

4.2.1.1.2 MMJJJ Month and year of data collection *and* unit of wind speed identification

MM – Month of data collection *and* unit of wind speed identification

MM shall be encoded as the number of the respective month (UTC) (inclusive preceding zero, if necessary) of the year. In addition, **MM** shall be increased by 50 if the unit of wind speed measurements was knots (it shall not be increased if the unit of the wind speed measurements was m/s).

JJJ – Year of data collection

JJJ shall be encoded as the respective year (UTC). Only the hundreds, tens and single digits (hence, the last three digits of the year) of the year shall be encoded in **JJJ** (inclusive preceding zeros, if necessary).

Example 1:

January *and*

wind speed in m/s ➔ **MM** = "01"

1977 ➔ **JJJ** = "977"

The whole Group **MMJJJ** for this example shall be coded "01977".

Example 2:

November *and*

wind speed in knots ➔ **MM** = "51"

2004 ➔ **JJJ** = "004"

The whole Group **MMJJJ** for this example shall be coded "51004".

4.2.1.1.3 IIiii

Block number and station number *(CLIMAT TEMP only)*

II – Block number.

II shall be encoded as the block number that defines the area in which the reporting station is positioned. The block number is allocated to one country or a part of it or more countries in the same Region. The list of block numbers for all countries is given in *Weather Reporting* (WMO-No. 9) [10], *Volume A – Observing Stations*.

iii – Station number.

iii shall be encoded as the station number that has been assigned to the reporting station following national and WMO regulations.

Examples:

The whole Group shall be coded as "11035" for the station Vienna (Austria) and "11010" for the station Linz (Austria).

4.2.1.1.4 99$L_aL_aL_a$

Latitude of the ocean weather station *(CLIMAT TEMP SHIP only)*

99 shall be used as an invariant Group Identifier.

$L_aL_aL_a$ shall be encoded as the latitude of the ocean weather station in tenths of a degree, with the following regulations. The tens, singles and tenths digits of the latitude shall be encoded in $L_aL_aL_a$ (inclusive preceding zeros, if necessary), the decimal point of the latitude shall be omitted. The north/south suffix or possible minus signs of the latitude shall be omitted (information on the hemisphere is included in the quadrant Q_c of Group $Q_cL_oL_oL_oL_o$). If the latitude is in degrees and minutes, the minutes shall be divided by 6, disregarding the remainder, and added to the degrees as the tenths digit, to fulfil the requirement of an accuracy of 0.1 degrees.

Example 1:

Latitude = 47°50' N ≈ 47.8° N ➔ $L_aL_aL_a$ = "478"

The whole Group **99**$L_aL_aL_a$, including the Group identifier "99", for this example shall be coded "99478".

Example 2:

Latitude = 21°15' S ≈ 21.2° S ➔ $L_aL_aL_a$ = "212"

The whole Group **99**$L_aL_aL_a$, including the Group identifier "99", for this example shall be coded "99212".

Two full examples for geographical positions are given at the end of 4.2.1.1.5 $Q_cL_oL_oL_oL_o$.

4.2.1.1.5 $Q_cL_oL_oL_oL_o$

Quadrant and longitude of the ocean weather station *(CLIMAT TEMP SHIP only)*

Q_c – quadrant of the globe

Q_c shall be encoded as the quadrant of the globe in which the ocean weather station is located, based on Table 30 and Figure 2. If the ocean weather station is located on Greenwich Meridian (longitude = 0º) or the 180th meridian (longitude = 180º), Q_c may be chosen to be either 1 or 7 (for positions in the northern hemisphere), and either 3 or 5 (for positions in the southern hemisphere), respectively. If the ocean weather station is located on the Equator (latitude = 0º), Q_c may be chosen to be 1 or 3 (for positions in the eastern hemisphere), and 5 or 7 (for positions in the western hemisphere), respectively.

Table 30: Encoding the quadrant in Q_c.

Latitude	Longitude	Q_c (code figure)
North	East	1
South	East	3
South	West	5
North	West	7

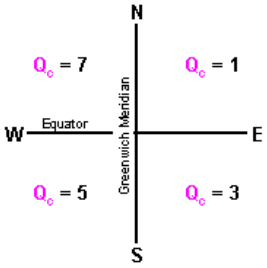

Figure 2: Encoding the quadrant in Q_c.

$L_oL_oL_oL_o$ – longitude of the ocean weather station

$L_oL_oL_oL_o$ shall be encoded as the longitude of the ocean weather station in tenths of a degree, with the following regulations. The hundreds, tens, singles and tenths digits of the longitude shall be encoded in $L_oL_oL_oL_o$ (inclusive preceding zeros, if necessary), the decimal point of the longitude shall be omitted. The east/west suffix or possible minus signs shall be omitted (this information is included in the quadrant Q_c). If the longitude is in degrees and minutes, the minutes shall be divided by 6, disregarding the remainder, and added to the degrees as the tenths digit, to fulfil the requirement of an accuracy of 0.1 degrees.

Example 1:

Longitude = 27º13’ E ≈ 27.2º E ➔ $L_oL_oL_oL_o$ = “0272”

Example 2:

Longitude = 167º20' W ≈ 167.3º W

➔ $L_oL_oL_oL_o$ = "1673"

Examples obtained from the separate examples in 4.2.1.1.4 and above:

Example 1 for both Groups 99$L_aL_aL_a$ and $Q_cL_oL_oL_oL_o$:

The full geographical information included in Example 1 of Group **99**$L_aL_aL_a$ and Example 1 of $L_oL_oL_oL_o$, including the corresponding quadrant Q_c, shall be coded "99478 10272".

Example 2 for both Groups 99$L_aL_aL_a$ and $Q_cL_oL_oL_oL_o$:

The full geographical information included in Example 2 of Group **99**$L_aL_aL_a$ and Example 2 of $L_oL_oL_oL_o$, including the corresponding quadrant Q_c, shall be coded "99212 51673".

4.2.1.2 Coding Example: CLIMAT TEMP Report Header

The Report Header of a CLIMAT TEMP Report containing the values of the examples given above (4.2.1.1) for the different Groups, including the Code Identifier "CLIMAT TEMP", shall be coded (Example 1 contains all of the first examples given for the Groups, Example 2 contains all of the second examples):

Example 1:

"CLIMAT TEMP 01977 11035"

Example 2:

"CLIMAT TEMP 51004 11010"

4.2.1.3 Coding Example: CLIMAT TEMP SHIP Report Header

The Report Header of a CLIMAT TEMP SHIP Report containing the values of the examples given above (4.2.1.1) for the different Groups, including the Code Identifier "CLIMAT TEMP SHIP", shall be coded (Example 1 contains all of the first examples given for the Groups, Example 2 contains all of the second examples):

Example 1:

"CLIMAT TEMP SHIP 01977 99478 10272"

Example 2:

"CLIMAT TEMP SHIP 51004 99212 51673"

4.2.2 Monthly data

The part containing the monthly data of a CLIMAT TEMP (SHIP) Report consists of Groups containing monthly values of several parameters. Generally, the calculation of these monthly values is based on daily (UTC) observational values. Hence, for inserting data into the monthly data, certain parameters have to be available and some calculations have to be conducted.

4.2.2.1 Parameters needed

For forming the part containing the monthly data of a CLIMAT TEMP (SHIP) Report for the respective month, daily values at station level (of UTC days) of the following three parameters which are regularly observed at aerological stations are needed:

1.	mean pressure	$P_{0\_day\text{-}j}$	(accuracy of 0.1 hPa)
2.	mean air temperature	$T_{0\_day\text{-}j}$	(accuracy of 0.1 ºC)
3.	mean dew-point depression	$D_{0\_day\text{-}j}$	(accuracy of 0.1 ºC)

Furthermore, daily values (of UTC days) at the nine mandatory specified pressure surfaces (m = 1, …, 9) of 850, 700, 500, 300, 200, 150, 100, 50, 30 hPa, respectively, of the following six parameters which are regularly observed at aerological stations are needed:

4.	mean geopotential	$H_{m\_day\text{-}j}$	(accuracy of 1 gpm)
5.	mean air temperature	$T_{m\_day\text{-}j}$	(accuracy of 0.1 ºC)
6.	mean dew-point depression	$D_{m\_day\text{-}j}$	(accuracy of 0.1 ºC)
7.	zonal wind speed	$U_{m\_day\text{-}j}$	(accuracy of 0.1 m/s or 0.1 knots)
8.	meridional wind speed	$V_{m\_day\text{-}j}$	(accuracy of 0.1 m/s or 0.1 knots)
9.	scalar wind speed (wind direction disregarded)	$S_{m\_day\text{-}j}$	(accuracy of 0.1 m/s or 0.1 knots)

For calculation algorithms for these parameters, see below (4.2.2.1.1).

4.2.2.1.1 Daily means

The main standard times for aerological observations are 0000, 0600, 1200 and 1800 UTC. The observation time for the three parameters at station level (pressure, air temperature and dew point depression) shall be the release of the radiosonde for the aerological observations. Mean daily values shall be calculated on the basis of available observations at the main standard UTC times for each day in UTC, 0000 - 2359 UTC.

Table 1 (p. 3) may be used to convert UTC to your local time zone.

Mean daily values shall be calculated as an average of observation values at the standard UTC observational times which correspond to the respective UTC day (0000 - 2359 UTC) for all days of the

respective month. All available observations (see to 4.2.2.2.1, Table 31) shall be used for daily averaging.

A mean daily value $F_{day\text{-}j}$ for a day j of the respective month for a parameter F (as a placeholder for the parameters pressure, air temperature, dew-point depression, geopotential, and zonal, meridional, scalar wind speeds) shall be calculated as

$$F_{day-j} = \left(\frac{\sum_{i=1}^{x} f_i}{x} \right) \quad (51)$$

f_i observed value at observation time i

x number of observations on the respective day

The number of days missing from the records shall be defined as:

m_{0P} number of days missing from the record for pressure at station level

m_{0T} number of days missing from the record for air temperature at station level

m_{0D} number of days missing from the record for dew point depression at station level

m_{mH} number of days missing from the record for geopotential at specified pressure surface m

m_{mT} number of days missing from the record for air temperature at specified pressure surface m

m_{mD} number of days missing from the record for dew point depression at specified pressure surface m

m_{mf} number of days missing from the record for zonal, meridional and scalar wind speed (shall be equal for the three parameters) at specified pressure surface m

4.2.2.2 Compiling the monthly data Groups

Monthly averaged values shall be calculated on the basis of mean daily values obtained during the respective month. All observations made during the calendar month (in UTC) are relevant for the compilation of the CLIMAT TEMP (SHIP) report for the respective month. The monthly values shall be encoded, according to the regulations listed and described below, into the monthly data Groups.

N refers to the number of days of the respective month.

Coding examples of the respective monthly data Groups are included at the end of 4.2.2.2.1 and 4.2.2.2.2.

4.2.2.2.1 g $\overline{P_0P_0P_0}$ $\overline{T_0T_0T_0}$ $\overline{D_0D_0D_0}$

Time of the observations and monthly mean pressure, air temperature and dew point depression at station level

g – Time of the observations used to compute the reported mean values

The main standard observation times of the aerological observations made at the respective station shall be encoded in g according to Table 31.

Table 31: Encoding the main standard observation times in g.

Observation times in UTC	g (code figure)
0000	1
1200	2
0000 and 1200	3
0600	4
1800	5
0600 and 1800	6
0000, 1200 and either 0600 or 1800	7
0600, 1800 and either 0000 or 1200	8
0000, 0600, 1200 and 1800	9
Other times	/

$\overline{P_0P_0P_0}$ – Monthly mean pressure at station level

The monthly mean pressure at station level P_0 shall be calculated as

$$P_0 = \frac{\sum_{j=1}^{N-m_{0P}} P_{0\_day-j}}{N - m_{0P}} \quad (52)$$

P_{0_day-j} daily mean pressure at station level for day j of the respective month

$N\text{-}m_{0P}$ number of available values for P_{0_day-j}

P_0 shall be rounded to hectopascals (1 hPa).

$\overline{P_0P_0P_0}$ shall be encoded as the value of P_0, with the following regulations. Only the hundreds, tens and singles digits shall be encoded in $\overline{P_0P_0P_0}$ (inclusive preceding zeros, if necessary), the thousands digit of P_0 shall be omitted in case P_0 is greater than 999 hPa ($P_0 \geq 1000$ hPa).

$\overline{T_0T_0T_0}$ – Monthly mean air temperature at station level

The monthly mean air temperature at station level T_0 shall be calculated as

$$T_0 = \frac{\sum_{j=1}^{N-m_{0T}} T_{0\_day-j}}{N - m_{0T}} \quad (53)$$

T_{0_day-j}	daily mean air temperature at station level for day j of the respective month
$N-m_{0T}$	number of available values for T_{0_day-j}

T_0 shall be rounded to tenths of a degree Celsius (0.1ºC).

$\overline{T_0\,T_0T_0}$ shall be encoded as the absolute value of T_0, with the following regulations. Only the tens, singles and tenths digits of T_0 shall be encoded in $\overline{T_0\,T_0T_0}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted. For negative values of T_0 ($T_0 < 0.0$ºC), 50.0 shall be added to the absolute value of T_0 before encoding it in $\overline{T_0\,T_0T_0}$, for values of T_0 below -49.9ºC ($T_0 \leq -50.0$ºC), the resulting hundreds digit of this addition shall be omitted (this does not lead to a possible confusion of temperatures below -50.0ºC with temperatures above 0ºC because fluctuations of the average monthly temperature remain far below 50ºC). The decimal point of T_0 shall be omitted. Between the first and the second digit of $\overline{T_0\,T_0T_0}$, there shall be a space because $\overline{T_0\,T_0T_0}$ is split between two Groups: The symbolic letter for the first digit is part of the Group $\mathbf{g}\,\overline{P_0P_0P_0}\;\overline{T_0}$ and the symbolic letters for the second and third digits are part of the Group $\overline{T_0T_0}\;\overline{D_0D_0D_0}$.

$\overline{D_0D_0D_0}$ – Monthly mean dew-point depression at station level

The monthly mean dew-point depression at station level D_0 shall be calculated as

$$D_0 = \frac{\sum_{j=1}^{N-m_{0D}} D_{0\_day-j}}{N - m_{0D}} \quad (54)$$

D_{0_day-j}	daily mean dew-point depression at station level for day j of the respective month
$N-m_{0D}$	number of available values for D_{0_day-j}

D_0 shall be rounded to tenths of a degree Celsius (0.1ºC).

$\overline{D_0D_0D_0}$ shall be encoded as the absolute value of D_0, with the following regulations. Only the tens, singles and tenths digits of D_0 shall be encoded in $\overline{D_0D_0D_0}$ (inclusive preceding zeros, if necessary), the decimal point of D_0 shall be omitted.

Example 1:

observations at 0000 and 1200 UTC

➔ **g** = “3”

P_0 = 982 hPa ➔ $\overline{P_0P_0P_0}$ = “982”

T_0 = 21.5 ºC ➔ $\overline{T_0\,T_0T_0}$ = “2 15”

D_0 = 1.5 ºC ➔ $\overline{D_0D_0D_0}$ = “015”

The Groups **g** $\overline{P_0P_0P_0}$ $\overline{T_0\,T_0T_0}$ $\overline{D_0D_0D_0}$, including the space “ ” between the two Groups, for this example shall be coded “39822 15015”.

Example 2:

observations at 0000, 0600, 1200 and 1800 UTC

➔ **g** = “9”

P_0 = 1014 hPa ➔ $\overline{P_0P_0P_0}$ = “014”

T_0 = -16.8 ºC ➔ $\overline{T_0\,T_0T_0}$ = “6 68”

D_0 = 12.0 ºC ➔ $\overline{D_0D_0D_0}$ = “120”

The Groups **g** $\overline{P_0P_0P_0}$ $\overline{T_0\,T_0T_0}$ $\overline{D_0D_0D_0}$, including the space “ ” between the two Groups, for this example shall be coded “90146 68120”.

4.2.2.2.2 $\overline{H_mH_mH_mH_m}$ n_{Tm} n_{Tm} $\overline{T_mT_mT_m}$ $\overline{D_m\,D_mD_m}$ $n_{vm}r_{fm}r_{fm}$ $\overline{d_{vm}d_{vm}d_{vm}}$ $\overline{f_{vm}f_{vm}}$

Monthly mean geopotential, air temperature characteristics, monthly mean dew-point depression and wind characteristics at specified pressure surface m

In 4.2.2.2.2, $_m$ is a placeholder for the numbers “1”, “2”, …, “9”, to be used for the respective of the nine specified pressure surface (compare also 4.2.2.1).

$\overline{H_mH_mH_mH_m}$ – Monthly mean geopotential at specified pressure surface m

The monthly mean geopotential at specified pressure surface m H_m shall be calculated as

$$H_m = \frac{\sum_{j=1}^{N-m_{mH}} H_{m\_day-j}}{N - m_{mH}} \qquad (55)$$

H_{m_day-j} daily mean geopotential at specified pressure surface m for day j of the respective month

$N\text{-}m_{mH}$ number of available values for H_{m_day-j}

H_m shall be rounded to gpm (1 gpm).

$\overline{H_mH_mH_mH_m}$ shall be encoded as the value of H_m, with the following regulations. Only the thousands, hundreds, tens and singles digits shall be encoded in $\overline{H_mH_mH_mH_m}$ (inclusive preceding zeros, if necessary), the tens of thousands digit of H_m shall be omitted in case H_m is greater than 9999 gpm ($H_m \geq 10000$ gpm) (this does not lead to a loss of information because all observations are chronologically arranged in the CLIMAT TEMP (SHIP) Report and therefore, the tens of thousands digit of the geopotential can be reconstructed).

$n_{Tm}\,n_{Tm}$ – Number of days missing from the record for air temperature at specified pressure surface m

$n_{Tm}\,n_{Tm}$ shall be encoded as the value of m_{mT}, with the following regulations (inclusive preceding zeros, if necessary). Between the first and second digit of $n_{Tm}\,n_{Tm}$, there shall be a space because $n_{Tm}\,n_{Tm}$ is split between two Groups: The symbolic letter for the first digit is part of the Group $\overline{H_mH_mH_mH_m}\;n_{Tm}$ and the symbolic letter for the second digit is part of the Group $n_{Tm}\;\overline{T_mT_mT_m}\;\overline{D_m}$.

$\overline{T_mT_mT_m}$ – Monthly mean air temperature at specified pressure surface m

The monthly mean air temperature at specified pressure surface m T_m shall be calculated as

$$T_m = \frac{\sum_{j=1}^{N-m_{mT}} T_{m\_day-j}}{N - m_{mT}} \qquad (56)$$

T_{m_day-j} daily mean air temperature at specified pressure surface m for day j of the respective month

$N\text{-}m_{mT}$ number of available values for T_{m_day-j}

T_m shall be rounded to tenths of a degree Celsius (0.1ºC).

$\overline{T_mT_mT_m}$ shall be encoded as the absolute value of T_m, with the following regulations. Only the tens, singles and tenths digits of T_m shall be encoded in $\overline{T_mT_mT_m}$ (inclusive preceding zeros, if necessary), the algebraic sign shall be omitted. For negative values of T_m ($T_m < 0.0$ºC), 50.0 shall be added to the absolute value of T_m before encoding it in $\overline{T_mT_mT_m}$, for values of T_m below -49.9ºC ($T_m \leq -50.0$ºC), the resulting hundreds digit of this addition shall be omitted (this does not lead to a possible confusion of temperatures below -50.0ºC with temperatures above 0ºC because fluctuations of the average monthly temperature remain far below 50ºC and temperatures of one height have to fit in the temperature trend of the other heights). The decimal point of T_m shall be omitted.

$\overline{D_m\,D_mD_m}$ – Monthly mean dew-point depression at specified pressure surface m

The monthly mean dew-point depression at specified pressure surface m D_m shall be calculated as

$$D_m = \frac{\sum_{j=1}^{N-m_{mD}} D_{m\_day-j}}{N - m_{mD}} \qquad (57)$$

D_{m_day-j} daily mean dew-point depression at specified pressure surface m for day j of the respective month

$N\text{-}m_{mD}$ number of available values for D_{m_day-j}

D_m shall be rounded to tenths of a degree Celsius (0.1ºC).

$\overline{D_m\,D_mD_m}$ shall be encoded as the absolute value of D_m, with the following regulations. Only the tens, singles and tenths digits of D_m shall be encoded in $\overline{D_m\,D_mD_m}$ (inclusive preceding zeros, if necessary), the decimal point of D_m shall be omitted. Between the first and second digit of $\overline{D_m\,D_mD_m}$, there shall be a space because $\overline{D_m\,D_mD_m}$ is split between two Groups: The symbolic letter for the first digit is part of the Group $n_{Tm}\,\overline{T_mT_mT_m}\,\overline{D_m}$ and the symbolic letters for the second and third digits are part of the Group $\overline{D_mD_m}\,n_{vm}r_{fm}r_{fm}$.

n_{vm} – Number of days missing from the record for wind observations at specified pressure surface m

n_{vm} shall be encoded as the value of m_{mf}, with the following regulations. Only the singles digit of m_{mf} shall be encoded in n_{vm}. For values of m_{mf} above 9 ($m_{mf} \geq 10$), n_{vm} shall be encoded as “9”.

$r_{fm}r_{fm}$ – Steadiness of wind at specified pressure surface m

$\overline{d_{vm}d_{vm}d_{vm}}$ – Direction of the monthly mean vector wind at specified pressure surface m *and* hundreds digit identification of the speed of the monthly mean vector wind

$\overline{f_{vm}f_{vm}}$ – Speed of the monthly mean vector wind at specified pressure surface m

Note that depending on the used units for wind speed (m/s or knots), the coding of **MM** in the Report Header Group **MMJJJ** shall be altered, see above (4.2.1.1.2).

The wind characteristics at specified pressure surface m shall be calculated on the basis of the parameters U_m, V_m and S_m. Note that some parameters have to be calculated to allow the calculation of some other parameters, see below.

The monthly mean zonal wind speed at specified pressure surface m U_m shall be calculated as

$$U_m = \frac{\sum_{j=1}^{N-m_{mf}} U_{m\_day-j}}{N - m_{mf}} \quad (58)$$

U_{m_day-j} daily mean zonal wind speed at specified pressure surface m for day j of the respective month

$N\text{-}m_{mf}$ number of available values for U_{m_day-j}

The monthly mean meridional wind speed at specified pressure surface m V_m shall be calculated as

$$V_m = \frac{\sum_{j=1}^{N-m_{mf}} V_{m\_day-j}}{N - m_{mf}} \quad (59)$$

V_{m_day-j} daily mean meridional wind speed at specified pressure surface m for day j of the respective month

$N\text{-}m_{mf}$ number of available values for V_{m_day-j}

The monthly mean scalar wind speed at specified pressure surface m S_m shall be calculated as

$$S_m = \frac{\sum_{j=1}^{N-m_{mf}} S_{m\_day-j}}{N - m_{mf}} \quad (60)$$

S_{m_day-j} daily mean scalar wind speed at specified pressure surface m for day j of the respective month (wind direction disregarded)

$N\text{-}m_{mf}$ number of available values for S_{m_day-j}

The steadiness of wind at specified pressure surface m r_{fm} shall be calculated as

$$r_{fm} = \begin{cases} 100\% \text{, if } S_m = 0 \\ 100\% \cdot \frac{f_{Vm}}{S_m} \text{, if } S_m \neq 0 \end{cases} \quad (61)$$

S_m speed of monthly mean scalar wind at specified pressure surface m (see above)

f_{Vm} speed of monthly mean vector wind at specified pressure surface m (see below)

r_{fm} shall be rounded to percent (1 %).

$r_{fm}r_{fm}$ shall be encoded as the value of r_{fm}, with the following regulations. Only the tens and singles digits of r_{fm} shall be encoded in $r_{fm}r_{fm}$ (inclusive preceding zeros, if necessary). If r_{fm} equals 100 %, $r_{fm}r_{fm}$ shall be encoded as “99”.

The direction of the monthly mean vector wind at specified pressure surface m d_{Vm} shall be calculated as

$$d_{Vm} = \begin{cases} 0^{o}\text{ , if } f_{Vm} = \begin{cases} 0\,\frac{m}{s} \\ 0 \text{ knots} \end{cases} \\ \begin{cases} 180^{o} + \arccos\left(\frac{V_m}{f_{Vm}}\right), \text{if } U_m \leq 0 \\ 180^{o} - \arccos\left(\frac{V_m}{f_{Vm}}\right), \text{if } U_m > 0 \end{cases}, \text{if } f_{Vm} \neq \begin{cases} 0\,\frac{m}{s} \\ 0 \text{ knots} \end{cases} \end{cases} \quad (62)$$

S_m speed of monthly mean scalar wind at specified pressure surface m (see above)

f_{Vm} speed of monthly mean vector wind at specified pressure surface m (see below)

d_{Vm} shall be rounded to degrees (1°).

$\overline{d_{vm}d_{vm}d_{vm}}$ shall be encoded as the value of d_{Vm}, with the following regulations. The hundreds, tens and singles digits of d_{Vm} shall be encoded in $\overline{d_{vm}d_{vm}d_{vm}}$ (inclusive preceding zeros, if necessary). For values of f_{Vm} (see below) above 99 m/s or 99 knots, respectively, 500 shall be added to the absolute value of d_{Vm} before encoding it into $\overline{d_{vm}d_{vm}d_{vm}}$.

The speed of the monthly mean vector wind at specified pressure surface m f_{Vm} shall be calculated as

$$f_{Vm} = \sqrt{U_m^2 + V_m^2} \quad (63)$$

U_m speed of monthly mean zonal wind at specified pressure surface m (see above)

V_m speed of monthly mean meridional wind speed at specified pressure surface m (see above)

f_{Vm} shall be rounded to metres per second or knots (1 m/s or 1 knot), respectively.

$\overline{f_{vm}f_{vm}}$ shall be encoded as the value of f_{Vm}, with the following regulations. Only the tens and singles digits of f_{Vm} shall be encoded in $\overline{f_{vm}f_{vm}}$ (inclusive preceding zeros, if necessary), the hundreds digit shall be omitted. For values of f_{Vm} above 99 m/s or 99 knots, respectively ($f_{Vm} \geq 100$ m/s or $f_{Vm} \geq 100$ knots), the coding of $\overline{d_{vm}d_{vm}d_{vm}}$ shall be altered, see above.

The examples listed below apply for any specified pressure surface m and coding shall be analogue to these examples for all specified pressure surfaces.

Example 1:

H_m = 982 gpm ➔ $\overline{H_mH_mH_mH_m}$ = “0982”

m_{mT} = 0 ➔ $n_{Tm}\,n_{Tm}$ = "0 0"

T_m = 1.6 ºC ➔ $\overline{T_mT_mT_m}$ = "016"

D_m = 4.3 ºC ➔ $\overline{D_m\,D_mD_m}$ = "0 43"

m_{mf} = 2 ➔ n_{Vm} = "2"

r_{fm} = 40 % ➔ $r_{fm}r_{fm}$ = "40"

d_{Vm} = 56 º ➔ $\overline{d_{vm}d_{vm}d_{vm}}$ = "056"

f_{Vm} = 6 m/s ➔ $\overline{f_{vm}f_{vm}}$ = "06"

The Groups $\overline{H_mH_mH_mH_m}$ $n_{Tm}\,n_{Tm}$ $\overline{T_mT_mT_m}$ $\overline{D_m\,D_mD_m}$ $n_{vm}r_{fm}r_{fm}$ $\overline{d_{vm}d_{vm}d_{vm}}$ $\overline{f_{vm}f_{vm}}$, including the spaces " " between the Groups, for this example shall be coded "09820 00160 43240 05606".

Example 2:

H_m = 18104 gpm ➔ $\overline{H_mH_mH_mH_m}$ = "8104"

m_{mT} = 12 ➔ $n_{Tm}\,n_{Tm}$ = "1 2"

T_m = -36.4 ºC ➔ $\overline{T_mT_mT_m}$ = "864"

D_m = 18.2 ºC ➔ $\overline{D_m\,D_mD_m}$ = "1 82"

m_{mf} = 12 ➔ n_{Vm} = "9"

r_{fm} = 78 % ➔ $r_{fm}r_{fm}$ = "78"

d_{Vm} = 56 º ➔ $\overline{d_{vm}d_{vm}d_{vm}}$ = "556" (altered due to f_{Vm}, see below)

f_{Vm} = 100 knots ➔ $\overline{f_{vm}f_{vm}}$ = "00" (because unit being knots, **MM** in the Report Header Group **MMJJJ** gets altered, see 4.2.1.1.2; because $f_{Vm} \geq 100$ knots, $\overline{d_{vm}d_{vm}d_{vm}}$ gets altered, see above)

The Groups $\overline{H_mH_mH_mH_m}$ $n_{Tm}\,n_{Tm}$ $\overline{T_mT_mT_m}$ $\overline{D_m\,D_mD_m}$ $n_{vm}r_{fm}r_{fm}$ $\overline{d_{vm}d_{vm}d_{vm}}$ $\overline{f_{vm}f_{vm}}$, including the spaces " " between the Groups, for this example shall be coded "81041 28641 82978 55600".

(Example 3:

For the sake of completeness, another example is given for an air temperature ≤ -50 ºC at standard isobaric surface m:

T_m = -76.2 ºC ➔ $\overline{T_mT_mT_m}$ = "271")

4.2.3 An example of a full CLIMAT TEMP Report

The following sample shows a real CLIMAT TEMP Report from the aerological land station in Schleswig, Germany (international station index 10035), for August, 1998, with wind speed in knots, including data for the station level and the nine specified pressure surfaces.

Example:

"CLIMAT TEMP 58998 10035
30091 50039
14790 00620 61083 27517
30480 05151 17084 27920
56540 06701 21084 28331
92930 09301 04076 28042
19590 00122 20082 28140
38320 00072 95086 28031
64650 00153 12087 27519
09850 0005/ //069 26204
43260 0990/ //050 12303="

4.2.4 Check lists for CLIMAT TEMP (SHIP) Reports / Bulletins

Rigorous checking of formed CLIMAT TEMP (SHIP) Reports is strongly recommended. Table 32 and Table 34 show check lists to simplify checking. In the "Example" and "Data Range" columns, line breaks are inserted to simplify the distinction of the descriptions of the different symbolic letters. (For example, in Table 32, in the column "Example" of the row "**MMJJJ**", the first line "01" describes the contents of "**MM**" and the second line "004" those of "**JJJ**".) For parameters that are divided among two Groups, borders of "Example" and "Data Range" were erased and the example and the data range for the respective parameter are between the two Groups (for example, in Table 32, in the Groups **g $\overline{P_0P_0P_0}$ $\overline{T_0}$** and **$\overline{T_0T_0}$ $\overline{D_0D_0D_0}$** the third line in "Example" and "Data Range" is shared by both Groups). All Groups have to be included in any CLIMAT TEMP (SHIP) Report (no Group shall be omitted from the Report in case there is no data available but the respective number of slashes ("/") shall be inserted instead).

Table 32: Check list for a CLIMAT TEMP Report / Bulletin.

Group	Example	Data Range	Remarks
CLIMAT TEMP	CLIMAT TEMP	CLIMAT TEMP	Only included in the first Report of any Bulletin
MMJJJ	01 977	01 - 12 009 - 999 (year 2009 - 2999)	Only included in the first Report of any Bulletin
IIiii	10035	01001 - 98998 (for land stations as of Jan 2009)	
g $\overline{P_0P_0P_0}$ $\overline{T_0}$	3 009 1 50 039	1 - 9 000 - 999 0 00 - 9 99 000 - 999	Station level
$\overline{T_0T_0}$ $\overline{D_0D_0D_0}$			
$\overline{H_1H_1H_1H_1}$ n_{T1}	1479 0 0 062	0000 - 9999 0 0 - 3 1 000 - 999	850 hPa level
n_{T1} $\overline{T_1T_1T_1}$ $\overline{D_1}$			

$\overline{D_1D_1}$ $n_{V1}r_{f1}r_{f1}$	0 61 0 83	0 00 - 9 99 0 - 9 00 - 99	
$\overline{d_{V1}d_{V1}d_{V1}}$ $\overline{f_{V1}f_{V1}}$	275 17	000 - 360, 500 - 860 00 - 99	
$\overline{H_2H_2H_2H_2}$ n_{T2} n_{T2} $\overline{T_2T_2T_2}$ $\overline{D_2}$ $\overline{D_2D_2}$ $n_{V2}r_{f2}r_{f2}$	3048 0 0 515 1 17 0 84	0000 - 9999 0 0 - 3 1 000 - 999 0 00 - 9 99 0 - 9 00 - 99	700 hPa level
$\overline{d_{V2}d_{V2}d_{V2}}$ $\overline{f_{V2}f_{V2}}$	279 20	000 - 360, 500 - 860 00 - 99	
$\overline{H_3H_3H_3H_3}$ n_{T3} n_{T3} $\overline{T_3T_3T_3}$ $\overline{D_3}$ $\overline{D_3D_3}$ $n_{V3}r_{f3}r_{f3}$	5654 0 0 670 1 21 0 84	0000 - 9999 0 0 - 3 1 000 - 999 0 00 - 9 99 0 - 9 00 - 99	500 hPa level
$\overline{d_{V3}d_{V3}d_{V3}}$ $\overline{f_{V3}f_{V3}}$	283 31	000 - 360, 500 - 860 00 - 99	
$\overline{H_4H_4H_4H_4}$ n_{T4} n_{T4} $\overline{T_4T_4T_4}$ $\overline{D_4}$ $\overline{D_4D_4}$ $n_{V4}r_{f4}r_{f4}$	9293 0 0 930 1 04 0 76	0000 - 9999 0 0 - 3 1 000 - 999 0 00 - 9 99 0 - 9 00 - 99	300 hPa level
$\overline{d_{V4}d_{V4}d_{V4}}$ $\overline{f_{V4}f_{V4}}$	280 42	000 - 360, 500 - 860 00 - 99	
$\overline{H_5H_5H_5H_5}$ n_{T5} n_{T5} $\overline{T_5T_5T_5}$ $\overline{D_5}$ $\overline{D_5D_5}$ $n_{V5}r_{f5}r_{f5}$	1959 0 0 012 2 20 0 82	0000 - 9999 0 0 - 3 1 000 - 999 0 00 - 9 99 0 - 9 00 - 99	200 hPa level
$\overline{d_{V5}d_{V5}d_{V5}}$ $\overline{f_{V5}f_{V5}}$	281 40	000 - 360, 500 - 860 00 - 99	
$\overline{H_6H_6H_6H_6}$ n_{T6} n_{T6} $\overline{T_6T_6T_6}$ $\overline{D_6}$ $\overline{D_6D_6}$ $n_{V6}r_{f6}r_{f6}$	3832 0 0 007 2 95 0 86	0000 - 9999 0 0 - 3 1 000 - 999 0 00 - 9 99 0 - 9 00 - 99	150 hPa level
$\overline{d_{V6}d_{V6}d_{V6}}$ $\overline{f_{V6}f_{V6}}$	280 31	000 - 360, 500 - 860 00 - 99	
$\overline{H_7H_7H_7H_7}$ n_{T7} n_{T7} $\overline{T_7T_7T_7}$ $\overline{D_7}$ $\overline{D_7D_7}$ $n_{V7}r_{f7}r_{f7}$	6465 0 0 015 3 12 0 87	0000 - 9999 0 0 - 3 1 000 - 999 0 00 - 9 99 0 - 9 00 - 99	100 hPa level
$\overline{d_{V7}d_{V7}d_{V7}}$ $\overline{f_{V7}f_{V7}}$	275 19	000 - 360, 500 - 860 00 - 99	
$\overline{H_8H_8H_8H_8}$ n_{T8} n_{T8} $\overline{T_8T_8T_8}$ $\overline{D_8}$ $\overline{D_8D_8}$ $n_{V8}r_{f8}r_{f8}$	0985 0 0 005 / // 0 69	0000 - 9999 0 0 - 3 1 000 - 999 0 00 - 9 99 0 - 9 00 - 99	50 hPa level
$\overline{d_{V8}d_{V8}d_{V8}}$ $\overline{f_{V8}f_{V8}}$	262 04	000 - 360, 500 - 860 00 - 99	
$\overline{H_9H_9H_9H_9}$ n_{T9}	4326	0000 - 9999	30 hPa level

n_{T9} $\overline{T_9T_9T_9}$ $\overline{D_9}$	0 0 990	0 0 - 3 1 000 - 999
$\overline{D_9D_9}$ $n_{V9}r_{f9}r_{f9}$	/ // 0 50	0 00 - 9 99 0 - 9 00 - 99
$\overline{d_{V9}d_{V9}d_{V9}}$ $\overline{f_{V9}f_{V9}}$	123 03	000 - 360, 500 - 860 00 - 99

Table 33: Check list for a CLIMAT TEMP SHIP Report / Bulletin (data values from Table 32).

Group	Example	Data Range	Remarks
CLIMAT TEMP SHIP	CLIMAT TEMP SHIP	CLIMAT TEMP SHIP	Only included in the first Report of any Bulletin
MMJJJ	01 977	01 - 12 009 - 999 (year 2009 - 2999)	Only included in the first Report of any Bulletin
99$L_aL_aL_a$	99 450	99 000 - 900	
$Q_cL_oL_oL_oL_o$	1 1806	1, 3, 5, 7 000 - 900	
g $\overline{P_0P_0P_0}$ $\overline{T_0}$	3 009 1 50	1 - 9 000 - 999 0 00 - 9 99	Station level
$\overline{T_0T_0}$ $\overline{D_0D_0D_0}$	039	000 - 999	
$\overline{H_1H_1H_1H_1}$ n_{T1}	1479 0 0	0000 - 9999 0 0 - 3 1	850 hPa level
n_{T1} $\overline{T_1T_1T_1}$ $\overline{D_1}$	062 0 61	000 - 999 0 00 - 9 99	
$\overline{D_1D_1}$ $n_{V1}r_{f1}r_{f1}$	0 83	0 - 9 00 - 99	
$\overline{d_{V1}d_{V1}d_{V1}}$ $\overline{f_{V1}f_{V1}}$	275 17	000 - 360, 500 - 860 00 - 99	
$\overline{H_2H_2H_2H_2}$ n_{T2}	3048 0 0	0000 - 9999 0 0 - 3 1	700 hPa level
n_{T2} $\overline{T_2T_2T_2}$ $\overline{D_2}$	515 1 17	000 - 999 0 00 - 9 99	
$\overline{D_2D_2}$ $n_{V2}r_{f2}r_{f2}$	0 84	0 - 9 00 - 99	
$\overline{d_{V2}d_{V2}d_{V2}}$ $\overline{f_{V2}f_{V2}}$	279 20	000 - 360, 500 - 860 00 - 99	
$\overline{H_3H_3H_3H_3}$ n_{T3}	5654 0 0	0000 - 9999 0 0 - 3 1	500 hPa level
n_{T3} $\overline{T_3T_3T_3}$ $\overline{D_3}$	670 1 21	000 - 999 0 00 - 9 99	
$\overline{D_3D_3}$ $n_{V3}r_{f3}r_{f3}$	0 84	0 - 9 00 - 99	
$\overline{d_{V3}d_{V3}d_{V3}}$ $\overline{f_{V3}f_{V3}}$	283 31	000 - 360, 500 - 860 00 - 99	
$\overline{H_4H_4H_4H_4}$ n_{T4}	9293 0 0	0000 - 9999 0 0 - 3 1	300 hPa level
n_{T4} $\overline{T_4T_4T_4}$ $\overline{D_4}$	930 1 04	000 - 999 0 00 - 9 99	
$\overline{D_4D_4}$ $n_{V4}r_{f4}r_{f4}$	0 76	0 - 9 00 - 99	
$\overline{d_{V4}d_{V4}d_{V4}}$ $\overline{f_{V4}f_{V4}}$	280 42	000 - 360, 500 - 860 00 - 99	
$\overline{H_5H_5H_5H_5}$ n_{T5}	1959 0 0	0000 - 9999 0 0 - 3 1	200 hPa level
n_{T5} $\overline{T_5T_5T_5}$ $\overline{D_5}$	012	000 - 999	

$\overline{D_5D_5}$ $n_{V5}r_{f5}r_{f5}$	2 20 0 82	0 00 - 9 99 0 - 9 00 - 99	
$\overline{d_{V5}d_{V5}d_{V5}}$ $\overline{f_{V5}f_{V5}}$	281 40	000 - 360, 500 - 860 00 - 99	
$\overline{H_6H_6H_6H_6}$ n_{T6}	3832	0000 - 9999	150 hPa level
n_{T6} $\overline{T_6T_6T_6}$ $\overline{D_6}$	0 0 007	0 0 - 3 1 000 - 999	
$\overline{D_6D_6}$ $n_{V6}r_{f6}r_{f6}$	2 95 0 86	0 00 - 9 99 0 - 9 00 - 99	
$\overline{d_{V6}d_{V6}d_{V6}}$ $\overline{f_{V6}f_{V6}}$	280 31	000 - 360, 500 - 860 00 - 99	
$\overline{H_7H_7H_7H_7}$ n_{T7}	6465	0000 - 9999	100 hPa level
n_{T7} $\overline{T_7T_7T_7}$ $\overline{D_7}$	0 0 015	0 0 - 3 1 000 - 999	
$\overline{D_7D_7}$ $n_{V7}r_{f7}r_{f7}$	3 12 0 87	0 00 - 9 99 0 - 9 00 - 99	
$\overline{d_{V7}d_{V7}d_{V7}}$ $\overline{f_{V7}f_{V7}}$	275 19	000 - 360, 500 - 860 00 - 99	
$\overline{H_8H_8H_8H_8}$ n_{T8}	0985	0000 - 9999	50 hPa level
n_{T8} $\overline{T_8T_8T_8}$ $\overline{D_8}$	0 0 005	0 0 - 3 1 000 - 999	
$\overline{D_8D_8}$ $n_{V8}r_{f8}r_{f8}$	/ // 0 69	0 00 - 9 99 0 - 9 00 - 99	
$\overline{d_{V8}d_{V8}d_{V8}}$ $\overline{f_{V8}f_{V8}}$	262 04	000 - 360, 500 - 860 00 - 99	
$\overline{H_9H_9H_9H_9}$ n_{T9}	4326	0000 - 9999	30 hPa level
n_{T9} $\overline{T_9T_9T_9}$ $\overline{D_9}$	0 0 990	0 0 - 3 1 000 - 999	
$\overline{D_9D_9}$ $n_{V9}r_{f9}r_{f9}$	/ // 0 50	0 00 - 9 99 0 - 9 00 - 99	
$\overline{d_{V9}d_{V9}d_{V9}}$ $\overline{f_{V9}f_{V9}}$	123 03	000 - 360, 500 - 860 00 - 99	

Table 34: Check list for mandatory End Identifier.

Group	Inclusion	Example	Data Range	Remarks
=	Always	=	=	Attached to last Group of Report without a space

5 CLIMAT (SHIP) and CLIMAT TEMP (SHIP) Bulletins

Several CLIMAT (SHIP) Reports may be combined in a so-called CLIMAT (SHIP) Bulletin. Several CLIMAT TEMP (SHIP) Reports may be combined in a so-called CLIMAT TEMP (SHIP) Bulletin. In a Bulletin, the Groups **CLIMAT** / **CLIMAT SHIP** / **CLIMAT TEMP** / **CLIMAT TEMP SHIP** and **MMJJJ** shall only be included in the first Report of the Bulletin and shall not be repeated for any of the following Reports. These following Reports shall begin with the Group **IIiii** (for CLIMAT and CLIMAT TEMP Reports) and **99$L_aL_aL_a$** (for CLIMAT SHIP and CLIMAT TEMP SHIP Reports).

Every Report in a Bulletin shall end with the End Identifier "=" attached to the last Group of the respective Report without a space, as mentioned in the general regulations of the CLIMAT (TEMP) (SHIP) codes (2.1.3, 3.1.3, 4.1.3) and as indicated in the full Report examples and check lists of the CLIMAT (TEMP) (SHIP) codes (2.2.6, 3.2.3, 4.2.3 and 2.2.7, 3.2.4, 4.2.4).

A CLIMAT (TEMP) (SHIP) Bulletin consists of three Bulletin Header Groups (**$T_1T_2A_1A_2$ii CCCC YYGGgg BBB**) which precede the first Report, the included Reports (indicated by the italic "*Reports*" in the example below):

$T_1T_2A_1A_2$ii CCCC YYGGgg *Reports*

If all Groups of Section 1 of a CLIMAT (SHIP) Report are missing, only Section 0, followed by a space (" ") and the word "NIL" shall be included (Sections 1-4 shall not be included in this case).

For detailed information on GTS bulletins, please refer to the *Manual on the Global Telecommunication System* (WMO No. 386), Volume I – Global Aspects ([8]), Part II, Operational Procedures for the Global Telecommunication System.

5.1 $T_1T_2A_1A_2$ii

Code, country of origin, attribute and number identification

T_1T_2 – Identification of the Bulletin code

The Bulletin code shall be encoded in T_1T_2, according to Table 35.

Table 35: Encoding the Bulletin code in T_1T_2.

Bulletin code	T_1T_2 (designator)
FM 71 CLIMAT	CS
FM 72 CLIMAT SHIP	CH
FM 75 CLIMAT TEMP	CU
FM 76 CLIMAT TEMP SHIP	CE

A_1A_2 – Identification of the country of origin

The country where the Bulletin was formed shall be encoded in A_1A_2 as the respective two-letter country code.

ii – Identification of the Bulletin attribute and number

The Bulletin attribute and number shall be encoded in ii, according to Table 36. When an originator or compiler of Bulletins issues two or more Bulletins with the same $T_1T_2A_1A_2$ (see 5.1) and CCCC (see 5.2) ii shall be used to differentiate the Bulletins and will be unique to each Bulletin.

Alphanumeric Bulletins containing Reports prepared at the main synoptic hours for the stations included in the Regional Basic Synoptic Networks or stations included in the Regional Basic Climatological Networks shall be compiled into Bulletins with ii in the series 01 to 19. This does not apply to Bulletins compiled in CREX code. Alphanumeric Bulletins containing "additional" data as defined in Resolution 40 (Cg-XII) shall be compiled into Bulletins with ii above 19. This does not apply to Bulletins compiled in CREX code.

Table 36: Encoding the Bulletin number and attribute in ii.

Bulletin attribute	Bulletin number	ii (designator)
Bulletin containing Reports for the main synoptic hours	1 - 19	01 - 19
Bulletins containing "additional" data as defined in Resolution 40 (Cg-XII)	20 - 99	20 - 99

Note that Table 36 does not apply to Bulletins compiled in BUFR, CREX, GRIB codes and Bulletins containing pictoral information.

5.2 CCCC
Distributing data centre identification

The centre of the data distribution shall be encoded in CCCC, according to *Weather Reporting* (WMO-No. 9) [10], *Volume C1 – Catalogue of Meteorological Bulletins*.[6]

5.3 YYGGgg
Time of sending identification

YY – Identification of the day of sending

The day of the month of sending the Bulletin (inclusive preceding zeros, if necessary) shall be encoded in YY.

[6] http://www.wmo.int/pages/prog/www/ois/Operational_Information/VolumeC1/CCCC_en.html

GGgg – Identification of the hour and minute of sending

The hour of the day of sending the Bulletin (inclusive preceding zeros, if necessary) shall be encoded in **GG**.

The minute of the hour of sending the Bulletin (inclusive preceding zeros, if necessary) shall be encoded in **gg**.

5.4 BBB
Additional indicator

"BBB" shall be placed after the Group **YYGGgg** in case the Groups **$T_1T_2A_1A_2$ii CCCC YYGGgg** are the same for all Reports included in the Bulletin, otherwise, "BBB" shall not be included. For more information, please refer to *Manual on the Global Telecommunication System* (WMO-No. 386), *Volume I – Global Aspects* [8].

5.5 An example of a full CLIMAT TEMP Bulletin

The following sample shows a real CLIMAT TEMP Bulletin (note that as mentioned in the introduction, the quotation marks do not belong to the sample):

"CUDL01 EDZW 040000 BBB
CLIMAT TEMP 58998
10035 30091 50039 14790 00620 61083 27517 30480 05151 17084
27920 56540 06701 21084 28331 92930 09301 04076 28042 19590
00122 20082 28140 38320 00072 95086 28031 64650 00153 12087
27519 09850 0005/ //069 26204 43260 0990/ //050 12303=
10238 30081 63054 15020 00780 55086 27617 30810 00011 05086
27921 57080 06541 23084 27830 93810 09121 07076 27940 20580
00181 11079 27741 39400 00161 21087 27833 65580 00121 25089
27021 10610 0010/ //156 26004 44060 2993/ //338 13103=
10410 30001 73064 15160 00860 66084 27514 30980 00101 33085
27919 57300 06441 56085 28029 94030 09121 15078 28241 20660
00341 86078 28337 39180 00332 78088 27932 65210 00383 06087
27420 09840 0018/ //059 25104 43090 0997/ //064 10505=
10739 39811 96090 15340 01090 70078 27408 31270 00261 47083
27016 57710 06311 63083 27925 94630 09041 13075 27931 21220
00461 71076 27831 39650 00462 86088 27230 65530 00563 06091
26621 09860 0029/ //038 23203 42960 0002/ //084 10407=
10868 39621 86068 15360 01160 67066 27808 31320 00261 12087
27018 57760 06311 52085 27622 94680 09031 16078 27730 21320
00421 84079 27130 39750 00442 86091 26832 65630 00583 02092
26022 09880 0032/ //047 22003 42980 0005/ //083 11908="

6 Quality control

CLIMAT (TEMP) (SHIP) Reports require rigorous quality control of the measurements themselves and their encoding in Reports to ensure an accurate transmission to national, regional and world centres for their use. Quality control checks should be made on site and at a central location designed to detect equipment faults at the earliest stage possible. The *Guide to Meteorological Instruments and Methods of Observation* (WMO No. 8) provides the appropriate recommendations.

6.1 Basic characteristics of quality control

Quality control shall be a real-time activity which has to be performed prior to the transmission of the observational data on the GTS. The purpose of quality control of observational data is error detection, possible error correction and, therefore, error prevention, in order to ensure the highest possible standard of accuracy for the optimum use of these data by all possible users.

The primary responsibility for quality control of all observational data shall remain with the WMO Members from whose Services the observations originated. WMO Members should pay due attention to the quality control of observational data at the national level, aiming at the prevention of errors at the observational site, as well as the National Meteorological Centres. WMO Members shall inform the Secretary-General (for general dissemination) of any special features of their observing systems which may be important in the correct interpretation of the data provided. Quality control of observational data needed for operational use shall not cause any significant delay in onward transmission on the GTS.

The site and instruments should be inspected regularly and maintained according to WMO recommended practices: to obtain homogeneous datasets, maintenance should be carried out as is documented in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8). The quality of the measured variables should be guaranteed by appropriate inspection of sites, instruments and exposure to be based on the procedures given in the Guide. As part of the maintenance, the necessary calibration practices should be traceable to the standards provided by the Guide.

6.2 Errors in data

Most errors in climatological data fall into the following broad categories:

- Instrumental error,
- Errors made by the observer (or observational method),
- Errors introduced by data transmission and key entry.

A set of comprehensive quality control procedures should be developed to reduce inherent observer and data errors. The most effective method of quality control involves a mix of manual and automated procedures. The automated procedures shall “flag” suspect data, and these flags are then reviewed by trained personnel to determine their validity. Manual review should also identify patterns of errors that may have resulted from software errors, improper adherence to instructions or procedures, inadequate procedures or instructions, etc.

After the data have been quality controlled, corrected and edited, the final data set should once again be cycled through the quality control error checks. This last step will help ensure that errors were not introduced during the quality control procedures.

6.3 Internal consistency check

All elements firstly should be checked for the allowable physical limits. These limits should be established for every station on the base of historical observations or for the region where the station is located.

All elements should be thoroughly checked against any associated elements within each observation. For example, all reported temperature data should be checked to ensure that the maximum temperature equals or exceeds a reported minimum temperature There are many more possible relationships, and these should be developed for use.

6.4 Time consistency check

Assuming that observations are of a continuous nature, a check should be made by comparing the prior and subsequent observations with the one in question. Using experience, analytical or statistical methodologies, data reviewers can establish the amount of change that might be expected in a particular element in any time interval. This test is particularly valuable in detecting a sign shift from one observation to the next that might not be recognized visually.

6.5 Spacial consistency check

For this test, each observation should be compared with all those taken at the same time at other stations in the climatic region. This may be done by direct comparison or by means of a spatial analysis scheme. Data with a significant difference between the expected and actual observations should be reviewed. The effectiveness of this test will depend on the availability of suitable neighbouring stations. It may be difficult or impossible to implement for some elements at stations in data sparse areas or which have a climate that differs significantly from their neighbours (e.g., mountain or coastal stations).

For upper air observations vertical consistency check should be performed assuming smoothing change of upper-air parameters during a sonde ascend.

6.6 Format check of CLIMAT (TEMP) (SHIP) Reports

After the CLIMAT (TEMP) (SHIP) Report forming the coded Report should be carefully checked (both manually and automatically) for any errors and mistakes during coding procedure. The most common errors CLIMAT (TEMP) (SHIP) Reports are listed below.

- the code name CLIMAT, CLIMAT SHIP, CLIMAT TEMP, CLIMAT TEMP SHIP is written in the wrong manner, or is missing
  (error examples: “Climat”, “KLIMAT”, “TEMP”, …)
- the Groups CLIMAT, CLIMAT SHIP, CLIMAT TEMP or CLIMAT TEMP SHIP appear between different station Reports in a Bulletin

- needless words like “PART I”, “PART II” are reported
- the Group **MMJJJ** is reported not only in the first line but also in each Report in the Bulletin
- the month is wrong (e.g. preceding or following month) or even missing
- the year is reported in four digits instead of three
  (example: for June 2004, **MMJJJ** should be “06004” and *not* “062004”)
- there is added 50 to the month for the CLIMAT Report *
- the block and station numbers are reported twice **
- **IIiii** (for CLIMAT (TEMP)) or **99**$L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ (for CLIMAT (TEMP) SHIP) are exchanged with **MMJJJ**
- the name of the station is added to **IIiii** (for CLIMAT (TEMP)) or **99**$L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ (for CLIMAT (TEMP) SHIP)
- a Section Identifier is given twice ***
- a Section Identifier contains brackets ***
- a Section Identifier is Roman numbered or written as a word
  (error example: “III” or “one” is encoded instead of “111”) ***
- a Section Identifier is missing, too short or at a wrong position ***
- a Section Identifier and a Group Identifier are not separated by a blank ***
- a Group Identifier is missing or wrong;***
- there is a blank (“ ”)missing between two Groups
- there is a blank (“ ”)within one Group
- a Group is too long or too short
- slashes (“/”) for digits with missing data are missing
- the Report End Identifier “=” is missing
- the Report End Identifier “=” is written behind every Section of a Report
- the Bulletin End Identifier “NNNN” is missing (for International telegraph alphabet No.2)

* only applies to CLIMAT
** only applies to CLIMAT and CLIMAT TEMP
*** only applies to CLIMAT and CLIMAT SHIP

7 Submission of CLIMAT (TEMP) (SHIP) Reports

According to WMO Technical Regulations, CLIMAT (TEMP) (SHIP) Reports should be provided not later than the 5th day of the month following the month to which the data refer.

Adherence to the rules for dissemination of CLIMAT (TEMP) (SHIP) Reports includes the assignment of a WMO block and index number to the station.

Regular submission of CLIMAT (TEMP) (SHIP) Reports via WMO/GTS channels in the current code is a minimum requirement.

Even observational data to set up the data-containing Groups of CLIMAT (TEMP) (SHIP) Reports are not available due to any reason, a Report containing only the respective Report Header and the single Group “NIL” shall be submitted.

It is not possible to define exact minimum requirements for the provision of data, except by the time limit for submission. However, when an included station fails consistently to provide the expected Reports, a decision on exclusion will be taken on the basis of an assessment of whether this failure is of a temporary nature or not.

In some National Meteorological Services, the collection and compilation of coded climatic data from national segments of the Global Telecommunication System has proved to be more efficient and timely than the traditional method of monthly clerical Report forms. Report forms continue to be required from such stations, however, as a means of verification and in some countries to meet legal or statutory needs. For automated systems, it is obviously necessary to use equally robust and reliable communications systems. The other commonly used forms of data transmission are regular mail, electronic mail, facsimile, telephone and hard copies.

8 Procedures and practices used in GCOS Monitoring Centers

At the time being two Global Climate Observing System (GCOS) atmospheric network have been established: the GCOS Upper Air network (GUAN) and the GCOS Surface Network (GSN). For both GCOS atmospheric networks monitoring centres have been designated. The GUAN performance is monitored by the European Centre for Medium Range Weather Forecast (ECMWF), and the GSN is monitored jointly by the Japan Meteorological Agency (JMA) and the Deutscher Wetterdienst (DWD). The monitoring centres provide Reports on the monitoring results on a regular basis.

8.1 Monitoring the GCOS Upper Air Network (GUAN)

The principal aims of the GUAN are to ensure a relatively homogenous distribution of upper-air stations that meet specific record length and homogeneity requirements outlined by GCOS and to develop, and make available, their current and historical data.

Monitoring activities are currently occurring at both ECMWF and the UK MetOffice Hadley Centre providing Reports on quality and receipt of daily TEMP and PILOT observations, and receipt of monthly CLIMAT TEMP data respectively.

CLIMAT TEMP Reports are received at the Met Office routinely each month via the GTS, email, post, and fax. These pass though in-house decode and hydrostatic quality control procedures and are maintained on the Hadley centre CLIMAT TEMP archive. The monthly receipt of CLIMAT TEMP Reports is monitored. A reference list of the reliability of all GUAN and other CLIMAT TEMP stations based on percentage of Reports received in the 1990s is compared against stations received each month and presented graphically on the Met Office GUAN website. Assessments of station reliability over 6 month to annual timescales are produced on request, with work underway to routinely provide these and other statistics via the web interface.

ECMWF provides Reports on the quality and availability of daily TEMP and PILOT radiosonde messages received and decoded at ECMWF in time for the appropriate analysis.

8.2 Monitoring the GCOS Surface Network (GSN)

In order to start from identical information, the GSNMCs at JMA and DWD agreed on using identical procedures to analyze CLIMAT Bulletins received via GTS.

Monitoring CLIMAT Reports at JMA and DWD is a multiple step procedure:

1. Bulletins with CLIMAT Reports are collected until a cut off date (21st day 00 UTC of the following month).
2. Received Bulletins are analyzed and decoded with the GSNMC monitoring software ‘FORMCHECK’
3. Statistical information about the received Bulletins and CLIMAT Reports are generated at each centre separately.
4. The files with statistical information generated by ‘FORMCHECK’ are exchanged between the centres, and information included is stored into the GSNMC RDBMS operated by DWD.

5. Missing CLIMAT Reports at JMA and DWD are identified and the information is exchanged, so that, at the end, both centres have an identical list of GSN stations received.
6. DWD and JMA apply their quality check procedures for monthly precipitation amount and monthly mean temperature respectively.
7. At the end of procedure of data analysis a GSN data set for every station is generated which consists of
    a) a block with station meta data,
    b) the CLIMAT Reports (if available),
    c) information on the format errors detected,
    d) the Bulletin Header by which the CLIMAT Reports was received, and
    e) a block with the quality information.

9 Migration to Table Driven Code Forms (TDCF)

9.1 Background

The table driven code forms BUFR (Binary Universal Form for the Representation of meteorological data) and CREX (Character form for the Representation and EXchange of data) offer the great advantages of flexibility and expandability compared with the traditional alphanumeric code forms. These beneficial attributes arise because BUFR and CREX are self-descriptive. The term "self-descriptive" means that the form and content of the data contained within a BUFR or CREX message are described within the BUFR or CREX message itself. In addition, BUFR offers condensation, or packing, while the alphanumeric code CREX provides human readability.

BUFR was first approved for operational use in 1988. Since that time, it has been used for satellite, aircraft, wind profiler, and tropical cyclone observations, as well as for archiving of all types of observational data. In 1994, CREX was approved as an experimental code form by the WMO Commission on Basic Systems. In 1998, CBS (CBS-Ext. 98) recommended CREX be approved as an operational data representation code form as from 3 May 2000. In 1999, this recommendation was endorsed by the WMO Executive Council. CREX is already used among centres for exchange of ozone, radiological, hydrological, tide gauge, tropical cyclone, and soil temperature data. BUFR should always be the first choice for the international exchange of observational data. CREX should be used only when BUFR cannot. BUFR and CREX are the only code forms the WMO needs for the representation and exchange of observational data and are recommended for all present and future WMO applications.

For more information on how to compile CLIMAT (TEMP) (SHIP) Reports in BURF/CREX table-driven code forms, please refer to [11].

9.2 Migration to BUFR

Taking account of the above-mentioned great advantages of TCDF, in particular of BUFR, the Fourteenth World Meteorological Congress (Cg-XVI) endorsed the plan for the migration to TDCF. In the plan, the CLIMAT (SHIP) codes are in Category 1 (Common) and Category 4 (Maritime), respectively. For Category 1, the migration has started in November 2005 and should be completed by November 2010, while the migration of Category 4 has started in November 2007 and should be completed by 2012. Members of WMO are invited to be ready for the migration to TDCF and implement it as soon as possible.

Information on software necessary for the migration, which were developed by advanced centres, is available at the WMO website.[7]

[7] http://www.wmo.int/pages/prog/www/cbs-software-exchange/introduction.html

10 References

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[11] World Meteorological Organization, 2009: *WMO Codes – BUFR/CREX Templates and Regulations*. As of 5 February 2009, Geneva.[10]

[8] http://www.wmo.int/pages/prog/www/ois/volume-a/vola-home.htm
[9] http://www.wmo.int/pages/prog/www/ois/Operational_Information/VolC1_en.html
[10] http://www.wmo.int/pages/prog/www/WMOCodes/TemplateExamples.html

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