

BUFR Template for VOS data

This template was developed by the JCOMM DMPA Task Team on Table Driven Codes (TT-TDC), whose Terms of Reference, Membership, and associated information are provided here: http://www.jcomm.info/index.php?option=com_content&task=view&id=66&Itemid=0.

The task team was formed in response to the need for a unified development of templates for marine data. Up until its formation, templates have been developed by individual panels in the JCOMM OPA. Some of these have been taken to WMO and approved, while others need additional work to complete. DMPA noticed that there were differences in how information on the same physical variable was inserted into different templates. The task team was formed to deal with templates that still needed work, and then to address how to develop consistency across templates.

Annex 1 presents this template and provides any added instructions that will be helpful in both encoding and decoding data into and from BUFR. An add-on field (JCOMM field abbreviation) is used to show the mapping of the information in BUFR to the IMMT-IV format used in MCSS and ICOADS. If a class D descriptor appears in the table, it is expanded to the class B descriptors in notes and where JCOMM field abbreviations exist, these appear in brackets. Please pay particular attention to notes since these explain details of use of the descriptor.

Annex 2 provides a mapping of the existing SHIP code variables to the VOS template.

Annex 3 provides a listing of the associated Regulations from WMO Manual on Codes (WMO #306 2009 edition). This is to ensure that no existing information, or guidance that still may be relevant on coding or observational practices, is left out without good reason.

Annex 4 provides the marine template common sequences.

While a template for VOS data currently exists, it is closer to a simple translation of FM-13 fields to BUFR descriptors. The template described here goes further in repackaging the measurements that appear in FM-13 into more consistent packages, in adding important metadata elements that should accompany the data, and in showing the relationship between the data transmitted in BUFR to the international formats used in the delayed mode data processing, the Marine Climatological Summaries Scheme, MCSS, and in the larger ICOADS historical archive (<http://icoads.noaa.gov/>).

A feature of this template is that it takes some of the information about measurement practices that is imbedded in the many regulations attached to FM-13 and incorporates the information into explicit BUFR fields. This is done for two reasons. One, it reminds the people making the measurements of what the regulations say, and two, it attaches this information, particularly that which is important for correct interpretation of the measurements reported, to the measurements themselves. We feel this is an important attribute and is worth the extra bits needed even though the information can be repetitive across BUFR messages.

Another feature of this template is that it has grouped measurement values and information about those measurements into discrete packages. Whereas in FM-13 for some variables such as water temperature, information is spread out over a number of symbolic letters and can appear in different sections, we have grouped these all together into a single information package. The reason for this is because we want observing information about the variable to be clearly associated with the variable, but also it gives a sub-template (Table D descriptor) that can be used in other BUFR templates where that same variable is measured and reported. This provides a consistency in reporting that is not now present.

The existing FM-13 code form allows for a section for regional exchange (section 3) and for national use (section 5). In BUFR such practices are handled by using local BUFR descriptors that are numbered from 192 to 255 in the yyy component of the Class B descriptor (F-xx-yyy). It allows individual nations or partners to define whatever variables they wish and to use these in regional exchange without impacting international BUFR exchanges and decoders. In spite of this, certain of the fields in section 3 do have BUFR descriptors that can be used to report them. In this case, the template does include the facility to report the information. Where BUFR descriptors do not exist, the reporting of such information is left to the use of local use descriptors as described above.

FM-13 also allows for free text components to be used when describing icing or ice information. BUFR is designed primarily for binary encoding of information, but it does have the facility to include free text. A scan of FM-13 messages over the last few years shows that there is still use of this free text component but it is not obvious that it is being used as originally intended. Nevertheless, this template provides the facility for free text transmissions.

Converting VOS observations from FM-13 code figures to BUFR descriptors in some cases means a conversion of units, or the use of different code tables. This conversion process risks losing information.

A BUFR message is made up of 5 sections (see the WMO manual for detailed descriptions). A section size is measured in octets where 1 octet = 8 bits = 1 alphanumeric character. We assume section 0 = 8 octets, section 1 = 22 octets, section 2 = 0 octets, section 3 = 9 octets (assuming a single class D descriptor is used for the template), section 4 = 160 octets (all fields are filled except plain language and local use), section 5 = 4 octets, for a total of about 203 octets.

References

- Berry, D., 2009: Comparison of BUFR template from Appendix G of SOT-IV/DOC. I-6.2.2 to FM 13-XII Ext. SHIP [http://www.noc.soton.ac.uk/ooc/SURFACE/BUFR/bufr_template.php].
- WMO, 1995: *Manual on Codes*. International Codes, Vol. I.1, Part A – Alphanumeric Codes. WMO–No.306, Geneva, Switzerland (1995 Ed., Suppl. No. 6 (VIII.2007), Rec. 5 (CBS-Ext.(06))); with undated Corrigendum to Suppl. 6) [available from: <http://www.wmo.int/pages/prog/www/WMOCodes/Volumel1.html#Volumel1>].
- WMO, 2001: *Manual on Codes*. International Codes, Vol. I.2, Part B – Binary Codes. WMO–No.306, Geneva, Switzerland (2001 Ed., Suppl. No. 3 (XI.2007), Rec. 4 (CBS-Ext.(06))) [available from: <http://www.wmo.int/pages/prog/www/WMOCodes/Volumel2.html#Volumel2>].

Annex 1: BUFR Voluntary Observing Ship (VOS) template (for synoptic reports from sea stations suitable for VOS observation data)

F	X	Y	Name	Unit	Scale	Ref value	Data Width (bits)	Notes
3	01	200	Ship information					(1)
3	01	204	OR Buoy / platform information					
3	01	202	Location information					
3	01	203	Date and time information					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	200	Air pressure data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	201	Air temperature data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	202	Cloud data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	203	Horizontal visibility data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	204	Wind data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	205	Wave data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	06	200	Surface water temperature data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	

3	02	206	Weather data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	207	Precipitation data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
3	02	208	Ice data					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
2	05	YYY	Plain language reporting (icing)					
1	01	000	Delayed replication of 1 descriptors					(2)
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1	
2	05	YYY	Plain language – used to send original SHIP message					(3)

Notes:

1. A BUFR message using this template is composed of this descriptor and the next 2 (location and time), plus one or more of the other descriptors in this table.
2. This descriptor and the next (0-31-000) are used to allow for optional reporting of data described by the following descriptor. If such measurements are to be made, the value of 0-31-000 is 1, otherwise it is 0.
3. The original SHIP message may be placed here. Note that YYY is the number of characters in the message (including white space).

Annex 2: Mapping of the contents of the SHIP (FM 13–XIV) code (WMO 2009) to the BUFR template

Table B1: The present SHIP Traditional Alphanumeric Code (TAC) form (FM 13–XII Ext.) (report of a surface observation from a sea station). Associated NOTES (“Brief explanations of the code form...”) from WMO (1995) are listed below the table, of which those deemed not applicable to marine data, or not in the BUFR context, are lettered in grey. The same method is employed in the code explanation below. The usage of curly brackets (“{” and “}”) and parentheses is explained as follows (WMO 1995):

“Groups in brackets are drop-out items and may or may not be included, depending on specified conditions. The absence of round brackets means that the inclusion of the group concerned is determined by international decision; these decisions are indicated in the regulations appearing under each code form.”

Note that wording in the column marked “Meaning” reproduces the wording in the Manual on Codes, Part A. BUFR descriptors that replace the symbolic letters will use the wording found in the BUFR tables.

SECTION 0	M _i M _i M _i M _j	{ D....D or A ₁ b _w n _b n _b n _b }	YYGGi _w	{ Iiii or 99L _a L _a L _a Q _c L _o L _o L _o L _o }	MMMU _{La} U _{Lo}
	h _o h _o h _o h _o i _m	99L _a L _a L _a	Q _c L _o L _o L _o L _o		
SECTION 1	i _R i _x hVV	Nddff	(00fff)	1s _n TTT	{ 2s _n T _d T _d T _d or 29UUU }
	3P ₀ P ₀ P ₀ P ₀	{ 4PPPP or 4a ₃ hhh }	5appp	6RRRt _R	{ 7wwW ₁ W ₂ or 7w _a w _a w _a W _{a1} W _{a2} }
	8N _h C _L C _M C _H	9GGgg			
SECTION 2	222D _s V _s	(0s _s T _w T _w T _w)	(1P _{wa} P _{wa} H _{wa} H _{wa})	(2P _w P _w H _w H _w)	((3d _{w1} d _{w1} d _{w2} d _{w2})
		(4P _{w1} P _{w1} H _{w1} H _{w1})	(5P _{w2} P _{w2} H _{w2} H _{w2})	({ 6I _s E _s E _s R _s or ICING + plain language })	(70H _{wa} H _{wa} H _{wa})
		(8s _w T _b T _b T _b)	(ICE + { c _i S _b D _i Z _i or plain language })		
SECTION 3	333	(0)	(1s _n T _x T _x T _x)	(2s _n T _n T _n T _n)	(3Ejjj)
		(4E'sss)	(5j ₁ j ₂ j ₃ j ₄ (j ₅ j ₆ j ₇ j ₈ j ₉))	(6RRRt _R)	(7R ₂₄ R ₂₄ R ₂₄ R ₂₄)
		(8N _s Ch _s h _s)	(9S _p S _p S _p S _p)	(80000 (0....))	(1....))
SECTION 4	444	N'C'H'H'C _t			
SECTION 5	555	Groups to be developed nationally			

Notes:

- (1) The code form FM 12 SYNOP is used for reporting synoptic surface observations from a fixed land station, manned or automatic. The code form FM 13 SHIP is used for the same kind of observations from a sea station, manned or automatic. The code form FM 14 SYNOP MOBIL is used for surface observations from an automatic or manned land station not at a fixed location.
- (2) A SYNOP report from a fixed land station is identified by the symbolic letters MiMiMjMj = AAXX.

- (3) A SHIP report from a sea station is identified by the symbolic letters $M_i M_i M_j M_j = BBXX$.
- (4) A SYNOP MOBIL report from a mobile land station is identified by the symbolic letters $M_i M_i M_j M_j = OOXX$.
- (5) The code form is made up of figure groups arranged by sections in ascending order of their numerical indicators with the exception of the following:
- All the groups of Section 0 and for the first two groups of Section 1, which are always included in the report of any surface observing station;
 - The first data group of Section 2 – 222D_sv_s, which is always included in the report of a sea station if data are available;
 - The data group of Section 4, which is clearly identified by a three-figure indicator group.

As a result, the following features are achieved:

- The loss of information due to the accidental loss of any one of these groups is strictly limited to the information content of that group;
- The rules of inclusion or omission of sections or of groups between brackets can be laid down for each specific case of station type or of data requirements;
- The length of the report can be kept to a strict minimum by dropping out some groups whenever their information content is considered insignificant or when that information content is not normally available.

It is to be noted that the code word ICE of Section 2 plays the role of a numerical indicator for the last data group of the section or for the equivalent plain language information.

- (6) The code form is divided into a number of sections as follows:

<i>Section number</i>	<i>Symbolic figure group</i>	<i>Contents</i>
0	—	Data for reporting identification (type, ship's call sign/buoy identifier, date, time, location) and units of wind speed used
1	—	Data for global exchange which are common to the SYNOP, SHIP and SYNOP MOBIL code forms
2	222	Maritime data for global exchange pertaining to a sea, or to a coastal station
3	333	Data for regional exchange
4	444	Data for national use for clouds with base below station level, included by national decision
5	555	Data for national use

Table B2: Mapping of SHIP symbolic letters (Table B1) to BUFR template descriptors. The meaning of "Not mapped" is that this information is not in the BUFR template because it was considered no longer necessary.

Symbolic letters	Meaning	BUFR descriptor(s)
$M_i M_i$	Identification letters of the report (Code table 2582)	Not mapped – describes the TAC identifier and is not needed for BUFR
$M_j M_j$	Identification letters of the part of the report or the version of the code form (Code table 2582)	Not mapped – describes the TAC identifier and is not needed for BUFR
D....D	Ship's call sign consisting of 3 or more alphanumeric characters	0 01 011
A ₁	WMO regional association area in which buoy, drilling rig or oil- or gas-production platform has been deployed (1 - Region I; 2 - Region II, etc.) (code table	Not mapped – A lookup matching latitude and longitude will provide region.

	0161).	The group A ₁ b _w n _b n _b n _b in section 0 is only used for buoys.
b _w	Subarea belonging to the area indicated by A ₁ (code table 0161).	Not mapped – same as for A ₁
n _b n _b n _b	Type and serial number of buoy.	Not mapped– see note for A ₁
YY	Day of the month (UTC), with 01 indicating the first day, 02 the second day, etc.	0-04-003
GG	Actual time of observation, to the nearest whole hour UTC	0-04-004
i _w	Indicator for source and units of wind speed. (Code table 1855)	0-11-002 uses units of m/s. 0-02-002 specifies the units of wind speed.
ll	Block number (defines the area in which the reporting station is situated)	Not mapped – this is not used in FM-13
iii	Station number	Not mapped – this is not used in FM-13
L _a L _a L _a	Latitude in tenths of a degree	0-05-002
Q _c	Quadrant of the globe (Code table 3333)	Not mapped – the quadrant is specified in the latitude and longitude specification
L _o L _o L _o L _o	Longitude in tenths of a degree	0-06-002
MMM	Number of Marsden square in which the station is situated at the time of observation	Not mapped – this is not used in FM-13
U _{La}	Units digit in the reported latitude	Not mapped – this is not used in FM-13
U _{Lo}	Units digit in the reported longitude	Not mapped – this is not used in FM-13
h _o h _o h _o h _o	Elevation of a mobile land station making surface or upper air observations in either m or feet as indicated by i _m	Not mapped – this is not used in FM-13
i _m	Indicator for units of elevation and confidence factor for accuracy of elevation	Not mapped – this is not used in FM-13
i _R	Indicator for inclusion or omission of precipitation data (Code table 1819)	Not mapped – precipitation data are all grouped into the precipitation component
i _x	Indicator for type of station operation (manned or automatic) and for present and past weather data (Code table 1860)	0-02-001
h	Height above surface of the base of the lowest cloud seen (Code table 1600)	0-20-013
VV	Horizontal visibility at surface (Code table 4377)	0-20-001
N	Total cloud cover (Code table 2700)	0-20-010
dd	True direction, in tens of degrees, from which wind is blowing (or will blow) (Code table 0877; stations within 1 degree of the North Pole use Code table 0878)	0-11-001
ff	Wind speed in units indicated by i _w	Wind speed is reported using 0-11-002 with units of m/s

fff	Wind speed in units indicated by i_w of 99 units or more	Wind speed is reported using 0-11-002 with units of m/s
s_n	Sign of the data and relative humidity indicator (Code table 3845)	Not mapped – the sign of a variable is accommodated in the BUFR variable.
TTT	Air temperature, in tenths of a degree Celsius, its sign being given by s_n	0-12-101
$T_d T_d T_d$	Dew point temperature, in tenths of a degree Celsius, its sign being given by s_n	0-12-103
UUU	Relative humidity of the air, in per cent, the first figure being zero except for UUU = 100 percent	0-13-003
$P_0 P_0 P_0 P_0$	Pressure at station level, in tenths of a hectopascal, omitting thousands digit of hectopascals of the pressure value	0-10-004
PPPP	Pressure at mean sea level, in tenths of a hectopascal, omitting thousands digit of hectopascals of the pressure value	0-10-051
a_3	Standard isobaric surface for which the geopotential is reported (Code table 0264)	Not mapped – this is not used in FM-13
hhh	Geopotential of an agreed isobaric surface given by a_3 , in standard geopotential metres, omitting the thousands digit	Not mapped – this is not used in FM-13
a	Characteristic of pressure tendency during the three hours preceding the time of observation (Code table 0200)	0-10-063
ppp	Amount of pressure tendency at station level during the three hours preceding the time of observation, expressed in tenths of a hectopascal	0-10-060
RRR	Amount of precipitation that has fallen during the period preceding the time of observation as indicated by t_R (Code table 3590)	0-13-011
t_R	Duration of period of reference for amount of precipitation, ending at the time of the report (Code table 4019)	0-04-024
ww	Present weather reported from a manned weather station (Code table 4677)	0-20-003 but also other descriptors. See note in weather data component.
W_1	Past weather (Code table 4561)	0-20-004 but also other descriptors. See note in weather data component.
W_2	Past weather (Code table 4561)	0-20-005 but also other descriptors. See note in weather data component.
$W_a W_a$	Present weather reported from an automatic weather station (Code table 4680)	0-20-003 but also other descriptors. See note in weather data component.
W_{a1}	Past weather reported from an automatic weather station (Code table 4531)	0-20-004 but also other descriptors. See note in weather data component.
W_{a2}	Past weather reported from an automatic weather station (Code table 4531)	0-20-005 but also other descriptors. See note in

		weather data component.
N_h	Amount of all the C_L cloud present or, if no C_L cloud is present, the amount of all the C_M cloud present (Code table 2700)	0-20-011
C_L	Clouds of the genera Stratocumulus, Stratus, Cumulus and Cumulonimbus (Code table (0513)	0-20-012
C_M	Clouds of the genera Altocumulus, Altostratus and Nimbostratus (Code table (0515)	0-20-012
C_H	Clouds of the genera Cirrus, Cirrocumulus and Cirrostratus (Code table 0509)	0-20-012
gg	Time of observation, in minutes (UTC)	0-04-005
D_s	True direction of resultant displacement of the ship during the three hours preceding the time of observation (Code table 0700)	0-01-012
V_s	Ship's average speed made good during the three hours preceding the time of observation (Code table 4451)	0-01-013
S_s	Indicator for the sign and type of measurement of sea surface temperature (Code table 3850)	Not mapped – the sign of a variable is accommodated in the BUFR variable.
$T_w T_w T_w$	Sea surface temperature, in tenths of a degree Celsius, its sign being given by s_n	0-22-045
$P_{wa} P_{wa}$	Period of waves, obtained by instrumental methods, in seconds	Instrumentation is provided by 0-02-046 and period by 0-22-011
$H_{wa} H_{wa}$	Height of waves, obtained by instrumental methods, in the same units as $H_w H_w$	Instrumentation is provided by 0-02-046 and height by 0-22-021
$P_w P_w$	Period of wind waves, in seconds	0-22-012
$H_w H_w$	Height of wind waves, in units of 0.5 metres	0-22-022
$d_{w1} d_{w1}$	True direction, in tens of degrees, from which swell waves are coming (Code table 0877)	0-22-003
$d_{w2} d_{w2}$	True direction, in tens of degrees, from which swell waves are coming (Code table 0877)	0-22-003
$P_{w1} P_{w1}$	Period of predominant swell waves, in seconds	0-22-013
$H_{w1} H_{w1}$	Height of predominant swell waves, in the same units as $H_w H_w$	0-22-023
$P_{w2} P_{w2}$	Period of secondary swell waves, in seconds	0-22-013
$H_{w2} H_{w2}$	Height of secondary swell waves, in the same units as $H_w H_w$	0-22-023
I_s	Ice accretion on ships (Code table 1751)	0-20-033
$E_s E_s$	Thickness of ice accretion on ships, in centimetres	0-20-031
R_s	Rate of ice accretion on ships (Code table 3551)	0-20-032
$H_{wa} H_{wa} H_{wa}$	Height of waves, obtained by instrumental methods, in units of 0.1 metre	Instrumentation is provided by 0-02-046 and height by 0-22-021
S_w	Indicator for the sign and type of wet-bulb temperature reported (Code table 3855)	The type of measurement is by 0-02-039 and the sign is not mapped because it is included in the variable.
$T_b T_b T_b$	Wet-bulb temperature, in tenths of a degree Celsius,	0-12-102

	its sign being given by s_w	
C_i	Concentration or arrangement of sea ice (Code table 0639)	0-20-034
S_i	Stage of development (Code table 3739)	0-20-037
b_i	Ice of land origin (Code table 0439)	0-20-035
D_i	True bearing of principal ice edge (Code table 0739)	0-20-038
Z_i	Present ice situation and trend of conditions over preceding three hours (Code table 5239)	0-20-036
$T_x T_x T_x$	Maximum air temperature, in tenths of a degree Celsius, its sign being given by s_n	0-12-111
$T_n T_n T_n$	Minimum air temperature, in tenths of a degree Celsius, its sign being given by s_n	0-12-112
E	State of the ground without snow or measurable ice cover (Code table 0901)	Not mapped – this is not used in FM-13
$j_j j_j$	Supplementary information to be developed regionally (see Volume II)	Not mapped – this is not used in FM-13
E'	State of the ground with measurable snow or ice cover (Code table 0975)	Not mapped – this is not used in FM-13
sss	Total depth of snow (Code table 3889)	Not mapped – this is not used in FM-13
j_1	Supplementary information indicator (Code table 2061)	See note 1
$j_2 j_3 j_4$	Specifications relating to supplementary information (Code table 2061)	See note 1
$j_5 j_6 j_7 j_8 j_9$	Supplementary group which follows $5j_1 j_2 j_3 j_4$ (code table 2061)	See note 1
$R_{24} R_{24} R_{24} R_{24}$	Total amount of precipitation during the 24-hour period ending at the time of observation, in tenths of a millimetre	0-13-023
N_s	Amount of individual cloud cover layer or mass whose genus is indicated by C (Code table 2700)	0-20-011
C	Genus of cloud (Code table 0500)	0-20-012
$h_s h_s$	Height of base of cloud layer or mass whose genus is indicated by C (Code table 1677)	0-20-013
$S_p S_p S_p S_p$	Supplementary information (Code table 3778)	Supplementary information can be expressed using the existing B and D descriptors from the international portion of the tables (X = 1 to 47, Y = 1 to 191).
N'	Amount of cloud whose base is below the level of the station (Code table 2700)	Not mapped – this is not used in FM-13
C'	Genus of cloud whose base is below the level of the station (Code table 0500)	Not mapped – this is not used in FM-13
$H'H'$	Altitude of upper surface of clouds reported by C' , in hundreds of metres	Not mapped – this is not used in FM-13
C_t	Description of the top of the cloud whose base is below the level of the station (Code table 0552)	Not mapped – this is not used in FM-13
Plain language		2-05-YYY

Notes:

1. The coding of information by these code figures is very complicated. The variable coded is dependent on the value of j_1 .

Value of j_1	BUFR descriptor	Comments
0,1,2,3	0-13-033 0-02-004	Evaporation or evapotranspiration Type of instrument used
4	0-12-049	Temperature change
5	0-14-034 0-04-xxx 0-14-016 0-04-xxx 0-14-013 0-04-xxx 0-14-025 0-04-xxx	Duration of sunshine is the variable, and duration is specified with a class 4 descriptor. Radiation is measured, and period is specified with a class 4 descriptor. Short-wave radiation is measured, and period is specified with a class 4 descriptor. Direct radiation is measured, and period is specified with a class 4 descriptor.
6	0-20-012 0-20-054	Type of cloud (low, medium, high), and direction from which clouds are moving.
7	No descriptors	Direction from which clouds are seen and elevation angle of the cloud top.
8,9	0-10-060, 0-07-031	Pressure change (at the surface), and height of the barometer above sea level (set to 0)

Annex 3: Regulations associated with the SHIP (FM 13–XIV) code (WMO, 2009)

Notes: Regulations deemed not applicable to marine data, or in the BUFR context, are lettered in grey

<http://www.wmo.int/pages/prog/www/WMOCodes/Volumel1.html#Volumel1>

WMO regulations for reporting SHIP data (B/C10) in table-driven code format (TDCF) can be found at: <http://www.wmo.int/pages/prog/www/WMOCodes/TemplateExamples.html#Regulations>

[“Regulations: The regulations, which follow the notes, contain standard coding procedures in the sense given to these procedures in the *Technical Regulations*. The standard coding procedures are distinguished by the use of the term “shall” in the English text, and by suitable equivalent terms in the French, Russian and Spanish texts. Where national practices do not conform with these regulations, Members concerned shall formally notify the Secretary-General of WMO for the benefit of other Members. Explanatory notes are sometimes added to regulations.”]

12.1 **General**

12.1.1 The code name SYNOP, SHIP or SYNOP MOBIL shall not be included in the report.

Note: See Regulation 12.1.7.

12.1.1.1 SYNOP MOBIL is intended for encoding meteorological observations from a non-fixed location. SYNOP MOBIL shall not be used as a replacement to SYNOP from a fixed location.

Note: An example of the intended application is to temporarily monitor meteorological parameters in the area of an environmental emergency.

12.1.2 **Use of groups** $M_i M_j M_k M_l \{ D D^{**} \}$ or $A_1 b_w n_b n_b n_b^* \}$ YYGGi_w

* Used in FM 13 only.

** Used in FM 13 and FM 14 only.

Note: See Regulation 18.2.3, Notes (1), (2) and (3).

Above referenced FM 18 BUOY code Regulation:

18.2.3 *Group* $A_1 b_w n_b n_b n_b$

Only buoy numbers ($n_b n_b n_b$) 001 through 499 are assigned. In the case of drifting buoy, 500 shall be added to the original $n_b n_b n_b$ number.

Notes:

- (1) $A_1 b_w$ normally corresponds to the maritime zone in which the buoy was deployed. The WMO Secretariat allocates to Members, who request and indicate the maritime zone(s) of interest, a block or blocks of serial numbers ($n_b n_b n_b$) to be used by their environmental buoy stations.
- (2) The Member concerned registers with the WMO Secretariat the serial numbers actually assigned to individual stations together with their geographical positions of deployment.
- (3) The Secretariat informs all concerned of the allocation of serial numbers and registrations made by individual Members.

12.1.2.1 In a bulletin of SYNOP reports from fixed land stations, the groups $M_iM_jM_kM_l$ $YYGGi_w$ shall be included only as the first line of the text, provided all the reports of the bulletin were taken at the same time and use the same unit for reporting wind speed.

12.1.2.2 In a bulletin of SHIP reports from sea stations or SYNOP MOBIL reports from mobile land stations, the group $M_iM_jM_kM_l$ shall be included only as the first line of the text, and the groups { $D D^{**}$ or $A_1b_wn_b n_b n_b^*$ } $YYGGi_w$ shall be included in every individual report.
Note: See Regulation 12.1.7.

12.1.3 Use of sections

12.1.3.1 Reports from a fixed or mobile land station shall always contain at least Sections 0 and 1. When a report from a coastal land station contains maritime data, that report shall also include Section 2. The identification and position of a fixed land station shall be indicated by means of the group $liiii$.

12.1.3.2 The identification of a mobile land station shall be indicated by the group $D D$. The observing station shall indicate its position by means of the groups $99L_aL_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $MMM U_{L_a}U_{L_o}$ for mobile land stations. In addition, a mobile land station shall include the group $h_0h_0h_0h_0i_m$ to indicate the elevation of the station, including the units of measure for the elevation and the accuracy of the elevation.

12.1.3.3 Mobile land station reports shall include (besides Sections 0 and 1), whenever the corresponding data are available, Section 3 containing at least the groups with indicator figures 5, 8 and 9.

12.1.3.4 Reports from a sea station shall always include Sections 0 and 1 and, whenever the corresponding data are available, Section 2. Section 2 shall always include the maximum number of data groups consistent with observed conditions. The identification of a sea station shall be indicated by either the group $D D$ or the group $A_1b_wn_b n_b n_b$. The position of a sea station shall be indicated by the groups $99L_aL_aL_aL_a$ $Q_cL_oL_oL_oL_o$.

12.1.3.5 Ocean weather station reports shall include (besides Sections 0, 1 and 2), whenever the corresponding data are available, Section 3 containing at least the groups with indicator figures 5, 8 and 9.

12.1.3.6 In reports from supplementary ships, Section 1 shall contain at least:
 $i_R i_x h V V N d d f f 1 s_n T T T 4 P P P P 7 w w W_1 W_2 8 N_h C_L C_M C_H$
where
(a) i_R shall be set to code figure 4;
(b) i_x shall be coded as 1 or 3 as the case may be.

12.1.3.7 In reports from auxiliary ships, Section 1 shall contain at least:
 $i_R i_x h V V N d d f f 1 s_n T T T 4 P P P P 7 w w W_1 W_2$
where
(a) i_R shall be set to code figure 4;
(b) i_x shall be coded as 1 or 3 as the case may be.

Notes:

- (1) The above-mentioned version of Section 1 is considered suitable for any ship which is not supplied with tested instruments and may be requested to report

in areas where shipping is relatively sparse, or on request, and especially when storm conditions threaten or prevail. These ships may report in plain language if the use of code is impracticable.

- (2) If the ship does not report cloud data, h should be coded with a solidus (/).
- (3) If the ship is not equipped with tested instruments permitting the determination of tenths of degrees of air temperature and/or tenths of hectopascals of pressure, a solidus should be coded for the tenths of degrees and/or tenths of hectopascals, as appropriate.

12.1.4 In reports from automatic stations, mandatory group elements specified by symbolic letters shall be coded with solidi (/) if the station is not equipped to report the relevant data, taking into account that i_R , i_x , and $N = 0$, $N = 9$, $N = /$ provide for omission of groups 6RRRt_R, 7w_aw_aW_{a1}W_{a2} and 8N_hC_LC_MC_H, as the case may be.

12.1.5 A fixed sea station (other than an ocean weather station or a moored buoy), which is considered by the Member operating it to be in the same category as a fixed land station, shall report its identification and position by means of the group IIIii.

12.1.6 The actual time of observation shall be the time at which the barometer is read.

12.1.7

- (a) The identification of stations located at sea on a drilling rig or an oil- or gas-production platform shall be indicated by the group A₁b_wn_bn_bn_b.
- (b) In reports of sea stations other than buoys, drilling rigs and oil- or gas-production platforms, and in the absence of a ship's call sign, the word SHIP shall be used for D D.
- (c) In reports from a mobile land station, only in the absence of a suitable call sign, the word MOBIL shall be used for D D.

12.2 Section 1

12.2.1 Group $i_R i_x h VV$

12.2.1.1 This group shall always be included in the report.

12.2.1.2 Base of lowest cloud: h

When the station is in fog, a sandstorm or a duststorm or in blowing snow but the sky is discernible, h shall refer to the base of the lowest cloud observed, if any. When, under the above conditions, the sky is not discernible, h shall be reported as /.

Note: See regulations relative to the use of Section 4.

12.2.1.3 Visibility: VV

12.2.1.3.1 When the horizontal visibility is not the same in different directions, the shortest distance shall be given for VV.

12.2.1.3.2 In reporting visibility at sea, the decile 90–99 shall be used for VV.

12.2.2 Group Nddff

12.2.2.1 This group shall always be included in the report.

12.2.2.2 Total cloud cover: N

- 12.2.2.2.1 N shall be reported as actually seen by the observer during the observation.
- 12.2.2.2.2 Altocumulus perlucidus or Stratocumulus perlucidus (“mackerel sky”) shall be reported using N = 7 or less (unless overlying clouds appear to cover the whole sky) since breaks are always present in this cloud form even if it extends over the whole celestial dome.
- 12.2.2.2.3 N shall be coded as 0 when blue sky or stars are seen through existing fog or other analogous phenomena without any trace of cloud being seen.
- 12.2.2.2.4 When clouds are observed through fog or analogous phenomena, their amount shall be evaluated and reported as if these phenomena were non-existent.
- 12.2.2.2.5 The total cloud cover shall not include the amount resulting from rapidly dissipating condensation trails.
- 12.2.2.2.6 Persistent condensation trails and cloud masses which have obviously developed from condensation trails shall be reported as cloud, using the appropriate C_H or C_M code figure.
- 12.2.2.3 *Wind direction and speed: ddff*
- 12.2.2.3.1 The mean direction and speed of the wind over the 10-minute period immediately preceding the observation shall be reported for ddff. However, when the 10-minute period includes a discontinuity in the wind characteristics, only data obtained after the discontinuity shall be used for reporting the mean values, and hence the period in these circumstances shall be correspondingly reduced.
- 12.2.2.3.2 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, and this speed is reported for ff.
- 12.2.2.3.3 When the wind speed, in units indicated by i_w , is 99 units or more:
 (a) ff in the group Nddff shall be encoded 99;
 (b) The group 00ff shall be included immediately following the group Nddff.
- Note: The apparent wind speed measured on board a moving ship is to be corrected for the course and the speed of the ship, in order to obtain the speed of the true wind, which is to be reported. The correction can be made on the basis of the parallelogram of velocities or by means of special tables.
- 12.2.3 **Groups** $1s_n TTT$, $2s_n T_d T_d T_d$, 4PPPP, 5appp
- 12.2.3.1 Groups $1s_n TTT$, $2s_n T_d T_d T_d$ and 4PPPP shall be included whenever the corresponding data are available, unless stated otherwise in specific regulations.
- Note: See Regulation 12.2.3.5 relative to group 5appp.
- 12.2.3.2 *Group* $1s_n TTT$
 When the data are not available as a result of a temporary instrument failure, automatic weather stations programmed to transmit this group shall either omit the group altogether or include it in their reports in the form 1////.
- 12.2.3.3 *Group* $2s_n T_d T_d T_d$

- 12.2.3.3.1 Under unusual conditions, when the dew-point temperature is temporarily unavailable (e.g. because of instrument failure) but relative humidity is available, the group 29UUU shall replace the group 2s_nT_dT_dT_d. Every attempt shall first be made, however, to convert relative humidity to dew-point temperature, and the relative humidity included only as a last resort.
- 12.2.3.3.2 Regulation 12.2.3.2 shall apply to this group, which shall in that case either be omitted or encoded as 2////.
- 12.2.3.4 *Group 4PPPP*
- 12.2.3.4.1 Whenever air pressure at mean sea level can be computed with reasonable accuracy, this pressure shall be reported in the 4PPPP group.
Notes:
(1) For a station situated in a region of normal synoptic network density, the pressure at mean sea level is considered not to be computed with reasonable accuracy when it introduces a deformation into the analysis of the horizontal pressure field which is purely local and recurring.
(2) For a station lying in a data-sparse area of the synoptic network, reasonable accuracy will be obtained when using a reduction method which has proved to be satisfactory in a region of normal network density and under similar geographical conditions.
- 12.2.3.4.2 By regional decision, a high-level station which cannot give pressure at mean sea level to a satisfactory degree of accuracy shall report both the station-level pressure group 3P₀P₀P₀P₀ and the geopotential height of an agreed standard isobaric surface. In that case, the group 4PPPP shall be replaced by the group 4a₃hhh.
- Note: The level chosen for each station is indicated in Volume A of publication WMO – No. 9.
- 12.2.3.5 *Group 5appp*
- 12.2.3.5.1 Unless specified otherwise by regional decision, this group shall be included whenever the three-hourly pressure tendency is available.
- 12.2.3.5.2 The pressure tendency over the past three hours, a, shall, wherever possible, be determined on the basis of pressure sampled at equi-spaced intervals not exceeding one hour.
- Note: Algorithms for selecting the appropriate code figure are included in publication WMO – No. 8 — *Guide to Meteorological Instruments and Methods of Observation*.
- 12.2.3.5.3 Where it is not possible to apply the algorithms specified in Regulation 12.2.3.5.2 in reports from automatic weather stations, a shall be coded as 2 when the tendency is positive; as 7 when the tendency is negative; and as 4 when the atmospheric pressure is the same as three hours before.
- 12.2.4 *Group 3P₀P₀P₀P₀*
This group shall be included in reports for global exchange from land stations, together with either the group 4PPPP or, in accordance with Regulation 12.2.3.4.2, the group 4a₃hhh.

Note: Inclusion of this group at other times is left to the decision of individual Members.

- 12.2.5 **Group 6RRRt_R**
- 12.2.5.1 When precipitation data are to be exchanged in time periods of six hours at main standard times (i.e. to report the amount of precipitation over the preceding 6, 12, 18 and 24 hours), this group shall be included in Section 1.
- 12.2.5.2 When precipitation data are to be exchanged in time periods of three hours or other periods required for regional exchange, this group shall be included in Section 3.
- 12.2.5.3 For lightships reporting in the SHIP code form and for ocean weather stations, the use of this group shall be fixed regionally or nationally. In the case of mobile ship stations which make precipitation observations, the group shall be included in each SHIP report.
- 12.2.5.4 This group shall:
(a) Coded with RRR = 000 (3 zeros) when precipitation is measured but no precipitation occurred during the reference period;
(b) Coded with RRR = /// (3 solidi) when precipitation is normally measured but is not available for the current report;
(c) Omitted when precipitation is not normally measured. In this case, i_R should be coded as 4;
(d) Existing automated weather stations (AWS) may continue to report no precipitation with i_R coded as 3 and the 6RRRt_R group omitted. New systems and human observer should report the 6RRRt_R group with RRR = 000 (3 zeros) to indicate no precipitation occurred during the reference period.
- 12.2.6 **Group 7wwW₁W₂ or 7w_aw_aW_{a1}W_{a2}**
- 12.2.6.1 This group shall be included in an observation by a manually operated station after a period of closure or at start up, when past weather conditions for the period applicable to the report are unknown, and shall take the form 7ww// (with i_x = 1), even if ww = 00–03. Otherwise it shall only be included if present or past weather phenomena of significance, or both, were observed. W₁W₂ = // shall indicate that previous conditions are unknown. This regulation shall also apply to automatic reporting stations with the facility to report present and past weather. Where a single past weather form is recognized it shall take the form of 7wwW₁/ or 7w_aw_aW_{a1}/.
- 12.2.6.2 Code figures 00, 01, 02, 03 of the ww code table and code figures 0, 1 and 2 of the W₁, W₂ code table shall be considered to represent phenomena without significance.
- Note: All present weather and past weather including phenomena without significance observed at sea shall be reported in the SHIP message.
- 12.2.6.3 This group shall be omitted if both present and past weather were:
(a) Not available (no observation made); or
(b) Observation made but observed phenomena were not of significance. The indicator i_x shall indicate which one of these conditions applies.
- 12.2.6.4 *Present weather reported from a manned weather station: ww*

- 12.2.6.4.1 If more than one form of weather is observed, the highest applicable code figure shall be selected for the group 7wwW₁W₂. Other weather may be reported in Section 3, using the group 960ww or 961w₁w₁, repeated as necessary. In any case, in the group 7wwW₁W₂, code figure 17 shall have precedence over figures 20–49.
- 12.2.6.4.2 In coding 01, 02 and 03, there is no limitation on the magnitude of the change of the cloud amount. ww = 00, 01 and 02 can each be used when the sky is clear at the time of observation. In this case, the following interpretation of the specifications shall apply:
00 is used when the preceding conditions are not known;
01 is used when the clouds have dissolved during the past hour;
02 is used when the sky has been continuously clear during the past hour.
- 12.2.6.4.3 When the phenomenon is not predominantly water droplets, the appropriate code figure shall be selected without regard to VV.
- 12.2.6.4.4 The code figure 05 shall be used when the obstruction to vision consists predominantly of lithometeors.
- 12.2.6.4.5 National instructions shall be used to indicate the specifications for ww = 07 and 09.
- 12.2.6.4.6 The visibility restriction on ww = 10 shall be 1 000 metres or more. The specification refers only to water droplets and ice crystals.
- 12.2.6.4.7 For ww = 11 or 12 to be reported, the apparent visibility shall be less than 1 000 metres.
- 12.2.6.4.8 For ww = 18, the following criteria for reporting squalls shall be used:
(a) When wind speed is measured: A sudden increase of wind speed of at least eight metres per second (16 knots), the speed rising to 11 metres per second (22 knots) or more and lasting for at least one minute;
(b) When the Beaufort scale is used for estimating wind speed: A sudden increase of wind speed by at least three stages of the Beaufort scale, the speed rising to force 6 or more and lasting for at least one minute.
- 12.2.6.4.9 Figures 20–29 shall never be used when precipitation is observed at the time of observation.
- 12.2.6.4.10 For ww = 28, visibility shall have been less than 1 000 metres.

Note: The specification refers only to visibility restrictions which occurred as a result of water droplets or ice crystals.
- 12.2.6.4.11 For synoptic coding purposes, a thunderstorm shall be regarded as being at the station from the time thunder is first heard, whether or not lightning is seen or precipitation is occurring at the station. A thunderstorm shall be reported in present weather if thunder is heard within the normal observational period preceding the time of the report. A thunderstorm shall be regarded as having ceased at the time thunder is last heard and the cessation is confirmed if thunder is not heard for 10–15 minutes after this time.
- 12.2.6.4.12 The necessary uniformity in reporting ww = 36, 37, 38 and 39 which may be desirable within certain regions shall be obtained by means of national instructions.

- 12.2.6.4.13 A visibility restriction “less than 1 000 metres” shall be applied to ww = 42–49. In the case of ww = 40 or 41, the apparent visibility in the fog or ice fog patch or bank shall be less than 1 000 metres. 40–47 shall be used when the obstructions to vision consist predominantly of water droplets or ice crystals, and 48 or 49 when the obstructions consist predominantly of water droplets.
- 12.2.6.4.14 When referring to precipitation, the phrase “at the station” in the ww table shall mean “at the point where the observation is normally taken”.
- 12.2.6.4.15 The precipitation shall be encoded as intermittent if it has been discontinuous during the preceding hour, without presenting the character of a shower.
- 12.2.6.4.16 The intensity of precipitation shall be determined by the intensity at the time of observation.
- 12.2.6.4.17 Code figures 80–90 shall be used only when the precipitation is of the shower type and takes place at the time of observation.

Note: Showers are produced by convective clouds. They are characterized by their abrupt beginning and end and by the generally rapid and sometimes great variations in the intensity of the precipitation. Drops and solid particles falling in a shower are generally larger than those falling in non-showery precipitation. Between showers openings may be observed unless stratiform clouds fill the intervals between the cumuliform clouds.

- 12.2.6.4.18 In reporting code figure 98, the observer shall be allowed considerable latitude in determining whether precipitation is or is not occurring, if it is not actually visible.
- 12.2.6.5 *Present weather reported from an automatic weather station: w_aw_a*
- 12.2.6.5.1 The highest applicable figure shall be selected.
- 12.2.6.5.2 In coding 01, 02 and 03, there is no limitation on the magnitude of the change of the cloud amount. w_aw_a = 00, 01 and 02 can each be used when the sky is clear at the time of observation. In this case, the following interpretation of the specifications shall apply:
00 is used when the preceding conditions are not known;
01 is used when the clouds have dissolved during the past hour;
02 is used when the sky has been continuously clear during the past hour.
- 12.2.6.5.3 When the phenomenon is not predominantly water droplets, the appropriate code figure shall be selected without regard to VV.
- 12.2.6.5.4 The code figures 04 and 05 shall be used when the obstruction to vision consists predominantly of lithometeors.
- 12.2.6.5.5 The visibility restriction on w_aw_a = 10 shall be 1 000 metres or more. The specification refers only to water droplets and ice crystals.
- 12.2.6.5.6 For w_aw_a = 18, the following criteria for reporting squalls shall be used: A sudden increase of wind speed of at least eight metres per second (16 knots), the speed rising to 11 metres per second (22 knots) or more and lasting for at least one minute.
- 12.2.6.5.7 Code figures 20–26 shall never be used when precipitation is observed at the time of observation.

12.2.6.5.8 For $w_a w_a = 20$, visibility shall have been less than 1 000 metres.

Note: The specification refers only to visibility restrictions which occurred as a result of water droplets or ice crystals.

12.2.6.5.9 For synoptic coding purposes, a thunderstorm shall be regarded as being at the station from the time thunder is first detected, whether or not lightning is detected or precipitation is occurring at the station. A thunderstorm shall be reported in present weather if thunder is detected within the normal observational period preceding the time of the report. A thunderstorm shall be regarded as having ceased at the time thunder is last detected and the cessation is confirmed if thunder is not detected for 10–15 minutes after this time.

12.2.6.5.10 A visibility restriction “less than 1 000 metres” shall be applied to $w_a w_a = 30–35$.

12.2.6.5.11 The precipitation shall be encoded as intermittent if it has been discontinuous during the preceding hour, without presenting the character of a shower.

12.2.6.5.12 The intensity of precipitation shall be determined by the intensity at the time of observation.

12.2.6.5.13 Code figures 80–89 shall be used only when the precipitation is intermittent or of the shower type and takes place at the time of observation.

Note: Showers are produced by convective clouds. They are characterized by their abrupt beginning and end and by the generally rapid and sometimes great variations in the intensity of the precipitation. Drops and solid particles falling in a shower are generally larger than those falling in non-showery precipitation. Between showers openings may be observed unless stratiform clouds fill the intervals between the cumuliform clouds.

12.2.6.6 *Past weather reported from a manned weather station: $W_1 W_2$*

12.2.6.6.1 The period covered by W_1 and W_2 shall be:

- (a) Six hours for observations at 0000, 0600, 1200 and 1800 UTC;
- (b) Three hours for observations at 0300, 0900, 1500 and 2100 UTC;
- (c) Two hours for intermediate observations if taken every two hours.

12.2.6.6.2 The code figures for W_1 and W_2 shall be selected in such a way that $W_1 W_2$ and *ww* together give as complete a description as possible of the weather in the time interval concerned. For example, if the type of weather undergoes a complete change during the time interval concerned, the code figures selected for W_1 and W_2 shall describe the weather prevailing before the type of weather indicated by *ww* began.

12.2.6.6.3 When W_1 and W_2 are used in hourly reports other than those covered by Regulation 12.2.6.6.1 (a) and (b), they cover a short period of time and Regulation 12.2.6.6.2 shall apply.

12.2.6.6.4 If, using Regulation 12.2.6.6.2, more than one code figure may be given to W_1 with regard to the past weather, the highest figure shall be reported for W_1 and the second highest code figure shall be reported for W_2 .

- 12.2.6.6.5 If the weather during the period has not changed so that only one code figure may be selected for the past weather, then that code figure shall be reported for both W_1 and W_2 . For example, rain during the entire period shall be reported as $W_1W_2 = 66$.
- 12.2.6.7 *Past weather reported from an automatic weather station: $W_{a1}W_{a2}$*
- 12.2.6.7.1 The period covered by $W_{a1}W_{a2}$ shall be :
 (a) Six hours for observations at 0000, 0600, 1200 and 1800 UTC;
 (b) Three hours for observations at 0300, 0900, 1500 and 2100 UTC;
 (c) Two hours for intermediate observations if taken every two hours.
- 12.2.6.7.2 The code figures for $W_{a1}W_{a2}$ shall be selected so that the maximum capability of the automatic station to discern past weather is utilized, and so that $W_{a1}W_{a2}$ and $w_a w_a$ together give as complete a description as possible of the weather in the time interval concerned.
- 12.2.6.7.3 In cases where the automatic station is capable only of discerning very basic weather conditions, the lower code figures representing basic and generic phenomena may be used. If the automatic station has higher discrimination capabilities, the higher code figures representing more detailed explanation of the phenomena shall be used. For each basic type of phenomenon, the highest code figure within the discrimination capability of the automatic station shall be reported.
- 12.2.6.7.4 If the type of weather during the time interval concerned undergoes complete and discernible changes, the code figures selected for W_{a1} and W_{a2} shall describe the weather prevailing before the type of weather indicated by $w_a w_a$ began. The highest figure shall be reported for W_{a1} , and the second highest code figure shall be reported for W_{a2} .
- 12.2.6.7.5 If a discernible change in weather has not occurred during the period, so that only one code figure may be selected for the past weather, then that code figure shall be reported for both W_{a1} and W_{a2} . For example, rain during the entire period shall be reported as $W_{a1}W_{a2} = 44$ in the case of an automatic station incapable of differentiating types of precipitation, or $W_{a1}W_{a2} = 66$ in the case of a station with the higher discrimination capability.
- 12.2.7 **Group** 8 $N_h C_L C_M C_H$
- 12.2.7.1 This group shall be omitted in the following cases:
 (a) When there are no clouds ($N = 0$);
 (b) When the sky is obscured by fog and/or other meteorological phenomena ($N = 9$);
 (c) When the cloud cover is indiscernible for reasons other than (b) above, or observation is not made ($N = /$).
- Note: All cloud observations at sea including no cloud observation shall be reported in the SHIP message.
- 12.2.7.2 Certain regulations concerning the coding of N shall also apply to the coding of N_h .
- 12.2.7.2.1
 (a) If there are C_L clouds then the total amount on all C_L clouds, as actually seen by the observer during the observation, shall be reported for N_h ;
 (b) If there are no C_L clouds but there are C_M clouds, then the total amount of the C_M clouds shall be reported for N_h ;

(c) If there are no C_L clouds and there are no C_M level clouds, but there are C_H clouds, then N_h shall be coded as 0.

12.2.7.2.2 If the variety of the cloud reported for N_h is *perlucidus* (*Stratocumulus perlucidus* for a C_L cloud or *Altostratus perlucidus* for a C_M cloud) then N_h shall be coded as 7 or less.

Note: See Regulation 12.2.2.2.2.

12.2.7.2.3 When the clouds reported for N_h are observed through fog or an analogous phenomenon their amount shall be reported as if these phenomena were not present.

12.2.7.2.4 If the clouds reported for N_h include contrails, then N_h shall include the amount of persistent contrails. Rapidly dissipating contrails shall not be included in the value for N_h .

Note: See Regulation 12.5 concerning the use of Section 4.

12.2.7.3 The coding of C_L , C_M and C_H clouds shall be as specified in publication WMO-No. 407 *International Cloud Atlas*, Volume I.

Note: It is recommended that the pictorial guides included at the end of Chapter II.8 in the *International Cloud Atlas*, Volume I, be fully utilized in determining the priority of reporting the code figures for C_L , C_M and C_H .

12.2.8 **Group** 9GGgg

This group shall be included:

- (a) When the actual time of observation differs by more than 10 minutes from the standard time GG reported in Section 0;
- (b) When additionally specified by regional decision.

Note: See Regulation 12.1.6.

12.3 **Section 2**

General

The inclusion of the groups of Section 2 in reports of merchant ships shall be determined by the Member who recruits the ship. The same rule shall be applied for automatic sea stations.

Note: Members are recommended to encourage the inclusion of the maximum possible number of data groups in Section 2 in accordance with Regulation 12.1.3.4.

12.3.1 **Group** 222D_sV_s

12.3.1.1 This group shall always be included in reports from stations which have observed maritime conditions and in reports from ships being requested to include D_sV_s as a routine procedure.

12.3.1.2 This group shall be encoded as:

- (a) 22200 for a stationary sea station;
- (b) 222// for:
 - (i) A coastal land station which reports maritime conditions;

- (ii) A supplementary or auxiliary ship, except when reporting from an area for which the ship report collecting centre, in order to meet a requirement of a search and rescue centre, has requested inclusion of $D_s v_s$ as a routine procedure.

12.3.2 **Group** ($0s_s T_w T_w T_w$)

This group shall always be included in reports from ocean weather stations, when data are available.

12.3.3 **Groups** ($1P_{wa}P_{wa}H_{wa}H_{wa}$), ($2P_wP_wH_wH_w$), ($70H_{wa}H_{wa}H_{wa}$)

12.3.3.1 Regulation 12.3.2 shall apply to these groups.

12.3.3.2 The group $1P_{wa}P_{wa}H_{wa}H_{wa}$ shall be used to report instrumental wave data in units of 0.5 metre.

12.3.3.3 The group $2P_wP_wH_wH_w$ shall be used to report wind waves, when instrumental wave data are not available.

12.3.3.4

- (a) When the sea is calm (no waves and no swell) $1P_{wa}P_{wa}H_{wa}H_{wa}$, or $2P_wP_wH_wH_w$ as the case may be, shall be reported as 0000;
- (b) When the estimation of the period is impossible owing to confused sea, P_wP_w shall be reported as 99. When, for the same reason, the height of the waves cannot be determined, H_wH_w shall be encoded as //;
- (c) In a report from a station that includes instrumental wave data, if data are not available for any other reason for either period or height of waves, $P_{wa}P_{wa}$ or $H_{wa}H_{wa}$, as the case may be, shall be encoded as //. If data are not available for either period or height of waves, Regulation 12.2.3.2 shall apply and the group $1P_{wa}P_{wa}H_{wa}H_{wa}$ shall either be omitted or encoded as 1///;
- (d) In a report from a station that does not include instrumental wave data, if data are not available for any other reason for either period or height of waves, P_wP_w or H_wH_w , as the case may be, shall be encoded as //. If data are not available for either period or height of waves, the group $2P_wP_wH_wH_w$ shall be omitted.

12.3.3.5 The group $70H_{wa}H_{wa}H_{wa}$ shall be reported in addition to the group $1P_{wa}P_{wa}H_{wa}H_{wa}$ when the following conditions have been met:

- (a) The sea is not calm (e.g. $P_{wa}P_{wa}H_{wa}H_{wa}$ has not been reported as 0000);
- (b) $H_{wa}H_{wa}$ has not been reported as //;
- (c) The station has the capability of accurately measuring instrumental wave height in units of 0.1 metre.

12.3.4 **Groups** ($(3d_{w1}d_{w1}d_{w2}d_{w2})$) ($4P_{w1}P_{w1}H_{w1}H_{w1}$) ($5P_{w2}P_{w2}H_{w2}H_{w2}$)

12.3.4.1 These groups shall be used to report swell data only when swell can be distinguished from wind waves.

12.3.4.2 If only one system of swell is observed:

- (a) Its direction, period and height shall be indicated, respectively, by $d_{w1}d_{w1}$, $P_{w1}P_{w1}$, $H_{w1}H_{w1}$;
- (b) $d_{w2}d_{w2}$ shall be encoded as //;
- (c) Group $5P_{w2}P_{w2}H_{w2}H_{w2}$ shall be omitted.

12.3.4.3 If a second system of swell is observed:

- (a) Its direction, period and height shall be indicated, respectively, by $d_{w2}d_{w2}$, $P_{w2}P_{w2}$, $H_{w2}H_{w2}$;

(b) The corresponding data for the first system of swell shall be reported as prescribed by Regulation 12.3.4.2 (a).

12.3.4.4 Ocean weather stations shall always include swell data when data are available.

12.3.5 **Group** (6I_sE_sE_sR_s)

When the ice accretion on ships is reported in plain language, it shall be preceded by the word ICING.

12.3.6 **Group** (8S_wT_bT_bT_b)

When the wet bulb is used to derive dew-point value in a SHIP report, the group 8S_wT_bT_bT_b shall be included to report the wet-bulb temperature measurement.

12.3.7 **Groups** (ICE + { c_iS_ib_iD_iz_i or plain language})

12.3.7.1 The reporting of sea ice and ice of land origin in FM 13 shall not supersede the reporting of sea ice and icebergs in accordance with the International Convention for the Safety of Life at Sea.

12.3.7.2 The group c_iS_ib_iD_iz_i shall be reported whenever sea ice and/or ice of land origin are observed from the ship's position at the time of observation, unless the ship is required to report ice conditions by means of a special sea-ice code.

12.3.7.3 When an ice edge is crossed or sighted between observation hours, it shall be reported as a plain-language addition in the form "ice edge lat. long." (with position in degrees and minutes).

12.3.7.4 If the ship is in the open sea reporting an ice edge, the concentration c_i and stage of development S_i shall be reported only if the ship is close to the ice (i.e. within 0.5 nautical mile).

12.3.7.5 The situation in which the ship is in an open lead more than 1.0 nautical mile wide shall be coded as c_i = 1 and D_i = 0. The situation in which the ship is in fast ice with ice boundary beyond limit of visibility shall be coded as c_i = 1 and D_i = 9.

12.3.7.6 If no sea ice is visible and the code group is used to report ice of land origin only, the group shall be coded as 0/b_i/0; e.g. 0/2/0 would mean 6–10 icebergs in sight, but no sea ice.

12.3.7.7 In coding concentration or arrangement of sea ice (code c_i), that condition shall be reported which is of the most navigational significance.

12.3.7.8 The bearing of the principal ice edge reported shall be to the closest part of that edge.

Note: The requirements for sea-ice reporting are covered in the following way by the associated code tables:

Symbolic code letter c_i

(a) The purpose of the first code figure (0) is to establish in relation to code z_i (code figure 0) and code b_i whether the floating ice that is visible is only ice of land origin;

(b) The possible variations in sea-ice concentration and arrangement within an area of observation are almost infinite. However, the field of reasonably accurate observation from a ship's bridge is limited. For this reason, and also because minor variations are of temporary significance, the choice of

concentrations and arrangements has been restricted for reporting purposes to those representing significantly different conditions from a navigational point of view. The code figures 2–9 have been divided into two sections depending on:

- (i) Whether sea-ice concentration within the area of observation is more or less uniform (code figures 2–5); or
- (ii) Whether there are marked contrasts in concentration or arrangement (code figures 6–9).

Symbolic code letter S_i

- (a) This table represents a series of increasing navigational difficulties for any given concentration; i.e. if the concentration is, for example, 8/10ths, then new ice would hardly have any effect on navigation while predominantly old ice would provide difficult conditions requiring reductions in speed and frequent course alterations;
- (b) The correlation between the stage of development of sea ice and its thickness is explained in publication WMO-No. 8 — *Guide to Meteorological Instruments and Methods of Observation*.

Symbolic code letter b_i

- (a) This code provides a scale of increasing navigational hazard;
- (b) Growlers and bergy bits, being much smaller and lower in the water than icebergs, are more difficult to see either by eye or radar. This is especially so if there is a heavy sea running. For this reason, code figures 4 and 5 represent more hazardous conditions than code figures 1 to 3.

Symbolic code letter D_i

There is no provision in this code for the reporting of distance from the ice edge. It will be assumed by those receiving the report that the bearing has been given to the closest part of the ice edge. From the reported code figures for concentration and stage of development, it will be clear whether the ship is in ice or within 0.5 nautical mile of the ice edge. If the ship is in open water and more than 0.5 nautical mile from the ice edge, the ice edge will be assumed to be aligned at right angles to the bearing which is reported.

Symbolic code letter z_i

- (a) The purpose of this element in the code is to establish:
 - (i) Whether the ship is in pack ice or is viewing floating ice (i.e. sea ice and/or ice of land origin) from the open sea; and
 - (ii) A qualitative estimate, dependent on the sea-ice navigation capabilities of the reporting ship, of the penetrability of the sea ice and of the recent trend in conditions;
- (b) The reporting of the conditions represented by code figures 1–9 in Code table 5239 can be used to help in the interpretation of reports from the two code tables (concentration c_i and stage of development S_i).

12.4

Section 3

This section shall be used for regional exchange.

12.4.1

The inclusion of groups with indicator figures 1 to 6, 8 and 9 shall be decided regionally. However, group 7R₂₄R₂₄R₂₄R₂₄ shall be included by all stations (with the exception of stations situated in the Antarctic) capable of doing so, once a day at one appropriate time of the main standard times (0000, 0600, 1200 or 1800 UTC).

12.4.2

The symbolic form of the group with indicator figure 0 shall be developed regionally, as well as the rules for its inclusion in Section 3.

- 12.4.3 Other figure groups shall be developed regionally in order to cover requirements which cannot be satisfied by the existing groups. In order to avoid ambiguities, these other groups shall be:
- (a) Provided with indicator figures 0, 1, 2, etc.;
 - (b) Preceded by an indicator group 80000 located after the last of the existing figure groups that was included in the report.

Notes:

- (1) For example, if three supplementary groups are developed, a report including state of the ground, precipitation and cloud data would present Section 3 as
333 3Ejjj 6RRRt_R 8N_sCh_sh_s 80000 0 1 2
- (2) See Regulation 12.1.3.5.

- 12.4.4 **Groups** (1s_nT_xT_xT_x), (2s_nT_nT_nT_n)
The period of time covered by the maximum and the minimum temperature and the synoptic hour at which these temperatures are reported shall be determined by regional decision.

- 12.4.5 **Group** (3Ejjj)
The use of the parameter(s) jjj shall be fixed regionally.

- 12.4.6 **Group** (4E' sss)

- 12.4.6.1 The measurement shall include snow, ice and all other forms of solid precipitation on the ground at the time of observation.

- 12.4.6.2 When the depth is not uniform, the average depth over a representative area shall be reported.

- 12.4.7 **Groups** (5j₁j₂j₃j₄ (j₅j₆j₇j₈j₉))

- 12.4.7.1 *Symbolic expression*

- 12.4.7.1.1 When the group 5j₁j₂j₃j₄ is used in the form 55j₂j₃j₄, 553j₃j₄, 554j₃j₄ or 555j₃j₄, the supplementary group j₅j₆j₇j₈j₉ shall be added to report net radiation, global solar radiation, diffused solar radiation, long-wave radiation, short-wave radiation, net short-wave radiation or direct solar radiation if data are available. The group shall be repeated as often as necessary.

Note: If sunshine duration is not available, the group shall be reported as 55///, 553//, 55407, 55408, 55507 or 55508 whenever the group j₅j₆j₇j₈j₉ is required to report radiation data.

- 12.4.7.1.2 When the group 5j₁j₂j₃j₄ is used, one or more of the following symbolic expressions shall be adopted:

- (a) (a)5EEEi_E to report the daily amount of either evaporation or evapotranspiration;
- (b) 54g₀s_nd_T to report temperature change data in period covered by w₁w₂;
- (c) 55SSS to report the daily hours of sunshine;
- (d) 553SS to report the duration of sunshine in the past hour;
- (e) 55407 to indicate that the supplementary group 4FFFF, which follows immediately, is used to report net short-wave radiation during the previous hour, in kJ m⁻²;
- (f) 55408 to indicate that the supplementary group 4FFFF, which follows immediately, is used to report direct solar radiation during the previous hour, in kJ m⁻²;

- (g) 55507 to indicate that the supplementary group $5F_{24}F_{24}F_{24}F_{24}$, which follows immediately, is used to report net short-wave radiation during the preceding 24 hours, in $J\ cm^{-2}$;
- (h) 55508 to indicate that the supplementary group $5F_{24}F_{24}F_{24}F_{24}$, which follows immediately, is used to report direct solar radiation during the preceding 24 hours, in $J\ cm^{-2}$;
- (i) $56D_L D_M D_H$ to report data on direction of cloud drift;
- (j) $57CD_a e_C$ to report data on direction and elevation of cloud;
- (k) $58p_{24}p_{24}p_{24}$ to report positive or zero change of surface pressure over the last 24 hours;
- (l) $59p_{24}p_{24}p_{24}$ to report negative change of surface pressure over the last 24 hours.

12.4.7.1.3 When more than one group $5j_1j_2j_3j_4$ is used, these groups shall be included in the order as listed in Regulation 12.4.7.1.2 with the supplementary groups $j_5j_6j_7j_8j_9$ at the appropriate place.

12.4.7.2 *Daily evaporation or evapotranspiration*

12.4.7.2.1 The symbolic expression $5EEEi_E$ shall be used to report either daily evaporation or evapotranspiration.

12.4.7.2.2 EEE shall indicate the amount of either evaporation or evapotranspiration, in tenths of a millimetre, during the preceding 24 hours at either 0000, 0600 or 1200 UTC.

12.4.7.3 *Temperature change*

For a change of temperature to be reported, the change shall be equal to or more than $5^{\circ}C$ and occur in less than 30 minutes during the period covered by W_1W_2 .

Note: The reporting of this information is restricted by regional or national decision to islands or other widely separated stations.

12.4.7.4 *Duration of sunshine and radiation data*

12.4.7.4.1 The symbolic expression SSS shall be used to report the daily sunshine, in hours and tenths of an hour. The symbolic expression SS (in group 553SS) shall be used to report the duration of sunshine in the past hour, in tenths of an hour.

12.4.7.4.2 In the form $55SSS$, this group shall, by regional decision, be reported by all stations capable of doing so and included at either 0000, 0600, 1200 or 1800 UTC.

12.4.7.4.3 When the group $5j_1j_2j_3j_4$ has the form $553SS$, the supplementary group(s) j_5FFFF may take one or more of the following forms:

- $j_5 = 0$ $FFFF$ = positive net radiation during the previous hour, in $kJ\ m^{-2}$;
- $j_5 = 1$ $FFFF$ = negative net radiation during the previous hour, in $kJ\ m^{-2}$;
- $j_5 = 2$ $FFFF$ = global solar radiation during the previous hour, in $kJ\ m^{-2}$;
- $j_5 = 3$ $FFFF$ = diffused solar radiation during the previous hour, in $kJ\ m^{-2}$;
- $j_5 = 4$ $FFFF$ = downward long-wave radiation during the previous hour, in $kJ\ m^{-2}$;
- $j_5 = 5$ $FFFF$ = upward long-wave radiation during the previous hour, in $kJ\ m^{-2}$;
- $j_5 = 6$ $FFFF$ = short-wave radiation during the previous hour, in $kJ\ m^{-2}$.

Note: For reporting net short-wave and direct solar radiation during the previous hour, see Regulation 12.4.7.1.2 (e) and (f), respectively.

- 12.4.7.4.4 When the group 5j₁j₂j₃j₄ has the form 55SSS, the supplementary group(s) j₅F₂₄F₂₄F₂₄F₂₄ may take one or more of the following forms:
- j₅ = 0 F₂₄F₂₄F₂₄F₂₄ = positive net radiation during the preceding 24 hours, in J cm⁻²;
- j₅ = 1 F₂₄F₂₄F₂₄F₂₄ = negative net radiation during the preceding 24 hours, in J cm⁻²;
- j₅ = 2 F₂₄F₂₄F₂₄F₂₄ = global solar radiation during the preceding 24 hours, in J cm⁻²;
- j₅ = 3 F₂₄F₂₄F₂₄F₂₄ = diffused solar radiation during the preceding 24 hours, in J cm⁻²;
- j₅ = 4 F₂₄F₂₄F₂₄F₂₄ = downward long-wave radiation during the preceding 24 hours, in J cm⁻²;
- j₅ = 5 F₂₄F₂₄F₂₄F₂₄ = upward long-wave radiation during the preceding 24 hours, in J cm⁻²;
- j₅ = 6 F₂₄F₂₄F₂₄F₂₄ = short-wave radiation during the preceding 24 hours, in J cm⁻².

Note: For reporting net short-wave and direct solar radiation during the preceding 24 hours, see Regulation 12.4.7.1.2 (g) and (h), respectively.

- 12.4.7.4.5 FFFF shall indicate the absolute value of the amount of solar or terrestrial radiation as appropriate, in kJ m⁻², during the preceding hour. F₂₄F₂₄F₂₄F₂₄ shall indicate the absolute value of the amount of solar or terrestrial radiation as appropriate, in J cm⁻², during the preceding 24 hours at either 0000, 0600, 1200 or 1800 UTC.

12.4.7.5 *Direction, drift and elevation of cloud*

Note: This information is required from land stations and fixed ship stations, mainly in the tropics.

12.4.8 **Group** (6RRRt_R)

12.4.8.1 This group shall be included in Section 3 only when Regulation 12.2.5.2 applies.

12.4.8.2 The decision to implement Regulation 12.2.5.2 shall be taken at the regional level.

12.4.9 *Group* (7R₂₄R₂₄R₂₄R₂₄)

This group shall be used to report the total amount of precipitation during the 24-hour period ending at the time of observation, in tenths of a millimetre (coded 9998 for 999.8 mm or more, and coded 9999 for trace).

12.4.10 *Group* (8N_sCh_sh_s)

12.4.10.1 This group shall be repeated to report a number of different layers or masses of cloud. When reported from a manned station, the number of such groups shall in the absence of Cumulonimbus clouds not exceed three. Cumulonimbus clouds, when observed, shall always be reported, so that the total number of groups can be four. When the station operates in the automatic mode, the total number of groups shall not exceed four.

The selection of layers (masses) to be reported shall be made in accordance with the following criteria:

- The lowest individual layer (mass) of any amount (N_s equals 1 or more);
- The next higher individual layer (mass) the amount of which is greater than two oktas (N_s equals 3 or more);
- The next higher individual layer (mass) the amount of which is greater than four oktas (N_s equals 5 or more);

- (d) Cumulonimbus clouds, whenever observed and not reported under (a), (b) and (c) above by means of a group referring exclusively to Cb.

- 12.4.10.2 The order of reporting the groups shall always be from lower to higher levels.
- 12.4.10.3 In determining the cloud amounts to be reported for individual layers or masses in the 8-group, the observer shall estimate, by taking into consideration the evolution of the sky, the cloud amounts of each layer or mass at the different levels, as if no other clouds existed.
- 12.4.10.4 When the sky is clear ($N = 0$), the 8-group shall not be used.
- 12.4.10.5 When the sky is obscured ($N_s = 9$), the 8-group shall read $89/h_s h_s$, where $h_s h_s$ is the vertical visibility. When the observation of clouds is not made ($N = /$), the 8-group shall not be included.

Note: The vertical visibility is defined as the vertical visual range into an obscuring medium.

- 12.4.10.6 If two or more types of cloud occur with their bases at the same level and this level is one to be reported in accordance with Regulation 12.4.10.1, the selection for C and N_s shall be made in accordance with the following criteria:
- (a) If these types do not include Cumulonimbus then C shall refer to the cloud type that represents the greatest amount, or if there are two or more types of cloud all having the same amount, the highest applicable code figure for C shall be reported. N_s shall refer to the total amount of cloud whose bases are all at the same level;
 - (b) If these types do include Cumulonimbus then one group shall be used to describe only this type with C reported as 9 and N_s as the amount of Cumulonimbus. If the total amount of the remaining type(s) of cloud (excluding Cumulonimbus) whose bases are all at the same level is greater than that required by Regulation 12.4.10.1, then another group shall be reported with C being selected in accordance with (a) and N_s referring to the total amount of the remaining cloud (excluding Cumulonimbus).
- 12.4.10.7 Regulations 12.2.2.2.3 to 12.2.2.2.6, inclusive, shall apply.

- 12.4.11 **Group** (9S_PS_PS_PS_P)
The use of this group and the specifications for the supplementary information shall be as specified in Code table 3778.

12.5 **Section 4**

- 12.5.1 The inclusion of this section shall be fixed nationally.
- 12.5.2 Clouds with tops below station level shall be reported only by this section and any co-existent clouds with bases above station level shall be reported in group $8N_h C_L C_M C_H$ of Section 1.
- 12.5.3 C_L clouds with bases below and tops above station level shall be reported in both $8N_h C_L C_M C_H$ and Section 4, provided that the station is out of cloud sufficiently frequently to enable the various features to be recognized. In this case:
- (a) N_h shall correspond with N' and C_L with C' while h shall be coded as /;
 - (b) If the upper surface of the clouds with tops above station level can be observed, it shall be reported by means of $H'H'$. If the upper surface cannot be observed, $H'H'$ shall be coded as //;

- (c) Other C_L clouds present with tops below station level shall be reported in a second $N'C'H'C_t$ group;
- (d) Other C_L clouds present with bases above station level shall be reported in plain language after the $N'C'H'C_t$ group.

- 12.5.4 If the station is in almost continuous cloud, Regulation 12.2.7.1 shall apply and Section 4 shall be omitted.
- 12.5.5 When two or more cloud layers with their bases below station level occur at different levels, two or more groups $N'C'H'C_t$ shall be used. C_t shall be reported as 9 in the groups indicating the layer of the smaller cloud amount and, in the remaining group, C_t shall be coded in Code table 0552.
- 12.5.6 Rapidly dissipating condensation trails shall not be reported in Section 4.
Note: See Regulation 12.2.2.5.
- 12.5.7 The top of persistent condensation trails and cloud masses which have obviously developed from condensation trails shall be reported, using the appropriate C_t code figure.
- 12.5.8 Regulations 12.2.2.1 to 12.2.2.6, inclusive, shall apply.
- 12.5.9 Spaces occupied by mountains emerging from the cloud layers shall be counted as occupied by cloud.
- 12.6 **Section 5**
- 12.6.1 The use of this section, the symbolic form of groups and the specifications of symbolic letters shall be determined by national decision.
- 12.6.2 Preference shall be given to symbolic 5-figure groups identified by numerical indicator figures.

Annex 4: Marine template common sequences
(see attached document)