NATO STANDARD

AMETOCP-4 Volume I

NATO METEOROLOGICAL AND OCEANOGRAPHIC CODES MANUAL

Edition A Version 1

MAY 2019

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED METEOROLOGICAL AND OCEANOGRAPHIC PUBLICATION

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NATO LETTER OF PROMULGATION

24 May 2019

1. The enclosed Allied Meteorological and Oceanographic Publication AMETOCP-4 Vol. I, Edition A, Version 1, NATO METEOROLOGICAL AND OCEANOGRAPHIC CODES MANUAL, which has been approved by the nations in the Military Committee Joint Standardization Board, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 6015.

2. AMETOCP-4, Vol. I, Edition A, Version 1, is effective upon receipt and supersedes AWP-4(B) which shall be destroyed in accordance with the local procedure for the destruction of documents.

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4. This publication shall be handled in accordance with C-M(2002)60.

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Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS

Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
LVA	Due to limited METOC capabilities, Latvian National Armed Forces will use following codes: Adoption of a standard Atmosphere, MOBOB, METAR, TAF, Airfield Weather Color Code; Standard Ballistic Meteorological Message, Standard Artillery Computer Meteorological Message, Format for Request for Meteorological Messages for Ballistic Purposes, ATP-45. Others METOC codes will not be implemented or will be implemented later, when new meteorological equipment/system will be obtained.
NOR	STANAG 6015, AMETOC-4(A) Vol. I, Annex B, Appendix B4, B5, B6 & B7. NOR does not support MAVOC, MAWEC, RECCO and TARWI codes.
SVK	The Slovak Republic reserves the right not to implement those parts of this STANAG dealing with the maritime operations, since there are no Naval Forces in the structure of the Armed Forces of the Slovak Republic, no organizational branch, nor subject matter expert dealing with the maritime issue listed in this STANAG.
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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References: A. MC 0594/1, Military Committee Policy on Meteorological and Oceanographic (METOC) Support to Allied Forces, 2 Apr 14
B. AJP 3.11, Allied Doctrine for METOC Support to Joint Forces, 4 Nov 16
C. ATP-32, Version E, NATO military Oceanographic and Rapid Environmental Assessment Support Procedures, 17 Oct 16
D. AMETOCP-2, Version A1, NATO Meteorological Support Manual, 27 Jan 16
E. World Meteorological Organization (WMO) Publication No. 306, Manual on Codes – International Codes, Vol. I.1, 2016
F. World Meteorological Organization (WMO) Publication No. 306, Manual on Codes – International Codes, Vol. I.2, 2015
G. World Meteorological Organization (WMO) Publication No. 306, Manual on Codes – Regional Codes and National Coding Practices, Vol. II, 2015

Introduction

1. AMETOCP-4, Vol. I supersedes the current version of AWP-4. The purpose of this manual is to describe in detail the Standard NATO METOC Codes, and those national exceptions to the Meteorological Airfield Report (METAR) Code, the Terminal Aerodrome Forecast (TAF) Code, and the Airfield Weather Colour Code used in NATO and not covered in the WMO Manual on Codes (References E-G). In some circumstances, it is recognized information on the weather may be used for internal national or command use, and these differences from standard codes are not detailed in this publication.

2. Dissemination of meteorological and oceanographic (METOC) information to NATO forces should use standard World Meteorological Organization (WMO) codes whenever possible. If there is no suitable WMO code to meet an operational requirement, a Standard NATO METOC Code may be developed. Such codes should be approved by the Meteorological and Oceanographic Military Committee Working Group, MCWG (METOC), and details published in this manual to ensure their availability to all users.

Discussion

3. The transmission of METOC information in code form permits the passage of large amounts of information in a relatively short time. These code forms may consist of groups of figures or letters representing METOC elements. Some information, especially from non-METOC sources, can best be transmitted as formatted and abbreviated plain language. All code forms should be concise, simple and standardized to be effective.

4. The transmission of most METOC information is satisfied by the code forms and formats approved or recognized by the WMO.

5. The introduction of a large number of non-WMO METOC code forms is undesirable and the MCWG (METOC) can advise the Military Committee on which non-WMO code forms should be adopted for use by NATO.

6. Only NATO approved code forms should be used, except in instances where, for internal national or command use, METOC code forms additional to the NATO approved ones may be employed. In some circumstances, it is recognized that information on the weather may be transmitted in plain language.

7. Summary of codes described in Annexes A – E:

General NATO METOC Codes

Appendix A.1 Adoption of a Standard Atmosphere

Appendix A.2 MOBOB - Mobile Meteorological Observing Unit Code

Appendix A.3 SUPRP - Supplementary Surface Weather Reports Code

Appendix A.4 METGM - Adoption of a Standard Gridded Data Meteorological Message

NATO Meteorological Codes for Aviation

Appendix B.1 METAR including national exceptions

Appendix B.2 TAF including national exceptions

Appendix B.3 Airfield Weather Colour Code including national exceptions

Appendix B.4 MAVOC - Military Aircraft Voice Weather Code

Appendix B.5 MAWEC - Maritime Aircraft Weather Code

Appendix B.6 RECCO - Report from Meteorological Reconnaissance Aircraft Code

Appendix B.7 TARWI - Target Weather Information Reporting Code

Appendix B.8 RAFOR - Range Forecast Code

NATO METOC Codes for Artillery

Appendix C.1 Standard Ballistic Meteorological Message

Appendix C.2 Standard Artillery Computer Meteorological Message

Appendix C.3 Format for Requests for Meteorological Messages for Ballistic Purposes

Appendix C.4 Standard Target Acquisition Meteorological Message

NATO Meteorological Codes for CBRN

Appendix D.1 Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas (Operators Manual, ATP-45)

NATO Maritime METOC Codes

Appendix E.1 VELO Code

Appendix E.2 Noise Measurement Code

Appendix E.3 Standard Format for Oceanographic Forecasts

Appendix E.4 OPTASK METOC

Appendix E.5 OPTASK REA

Appendix E.6 MIHUSOFOR Forecast Format

Appendix E.7 Marine Mammal Sighting Report Format

Appendix E.8 BATHY Code

Appendix E.9 Additional Military Layers (AML)

Appendix E.10 BOWWAVE Acronym

8. AMETOCP-4 contains codes that were not part of AWP-4(B). The following table shows these codes and their origin prior to being included in AMETOCP-4 (e.g., Appendix A.1, Adoption of Standard Atmosphere was previously STANAG 4044).

Code content	Appendix	Origin
Adoption of a Standard Atmosphere	A.1	STANAG 4044
METGM - Adoption of a Standard Gridded Data Meteorological Message	A.4	STANAG 6022, Ed. 2
Standard Ballistic Meteorological Message	C.1	STANAG 4061, Ed. 4
Adoption of a Standard Artillery Computer Meteorological Message (METCM)	C.2	STANAG 4082
Format for Requests for Meteorological Messages for Ballistic Purposes	C.3	STANAG 4103
Adoption of a Standard Target Acquisition Meteorological Message (METTA)	C.4	STANAG 4140, Ed. 2

Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas (Operators Manual, ATP-45)	D.1	STANAG 2103
VELO Code	E.1	Annex D, Appendix 1 of ATP-32(D)
Noise Measurement Code	E.2	Annex D, Appendix 2 of ATP-32(D)
Standard Format for Oceanographic Forecasts	E.3	Annex D, Appendix 3 of ATP-32(D)
OPTASK METOC	E.4	Annex D, Appendix 4 of ATP-32(D)
MIHUSOFOR Forecast Format	E.6	Annex D, Appendix 5 of ATP-32(D)
NATO UNDERSEA RESEARCH CENTRE – Marine Mammal Sighting Report Format	E.7	Annex D, Appendix 6 of ATP-32(D)
Additional Military Layers (AML) – Digital Geospatial Data Products	E.9	STANAG 7170, Ed. 2

Units of Measure

9. The following units of measure are used throughout the document:

cm	centimeter(s)	in	inch(es)
m	meter(s)	ft	foot (feet)
km	kilometer(s)	yd	yard(s)
		nm	nautical mile(s)
m/s	meter(s) per second	kt	knot(s)
km/h	kilometer(s) per hour		
s	second(s)	hPa	hectopascal(s)
min	minute(s)	°C	degree(s) Celsius
		°	degree(s)

Annex A

GENERAL NATO METOC CODES

Overview

Appendix A.1 Adoption of a Standard Atmosphere

Appendix A.2 MOBOB - Mobile Meteorological Observing Unit Code

Appendix A.3 SUPRP - Supplementary Surface Weather Reports Code

Appendix A.4 METGM - Adoption of a Standard Gridded Data Meteorological Message

Annex A

Appendix A.1

Adoption of a Standard Atmosphere

Agreement

The armed forces of the NATO countries have agreed:

a. To adopt the International Civil Aviation Organization (ICAO) Standard Atmosphere, as stated in Amendment 87 to Annex 8 to the Convention on International Aviation, dated 10 September 1963, as the standard reference for all NATO purposes.

b. To include in this agreement any extension of the ICAO Atmosphere to greater altitudes, if such extensions are subsequently approved by the ICAO.

Annex A

Appendix A.2

MOBOB - Mobile Meteorological Observing Unit Code

1. General This is a Standard NATO Meteorological Code for reporting the position in the transmission of surface and upper air meteorological reports in WMO code provided by mobile meteorological observing units.

2. Form of Code

MOBOBQ $i_m i_m$HHH $L_aL_aL_aL_oL_oL_o$ or $X_BX_BX_B$ $X_LX_LX_NX_NX_NX_NX_NX_N$

Note: These groups replace the group IIiii or CCCC in the corresponding WMO code form.

3. Specification of Symbolic Letters

MOBOB	Code identifier for the position of a mobile meteorological unit.
Q	Octant of the globe (see Code Table).
$i_m i_m$	KAC cryptographic code set-reference identifier.; When encryption is not required, use //.
HHH	Altitude above Mean Sea Level of reporting mobile station in decameters.
$L_aL_aL_a$	Latitude in tenths of a degree.
$L_oL_oL_o$	Longitude in tenths of a degree. The hundreds digit is omitted for longitude 100° to 180°.
$X_BX_BX_B$	Identification of Grid Zone Designation UTM.
X_LX_L	100,000 meter square identification UTM.
$X_NX_NX_NX_NX_NX_N$	Numerical Grid co-ordinates UTM of the observation point given to the desired accuracy. Or, instead of latitude/longitude or UTM Grid co-ordinates, the location in plain language.

Note:

All latitude/longitude and/or location identifiers may be encrypted, as necessary.

APPENDIX 2 TO
ANNEX A TO
AMETOCP-4 VOL I

Code Table

Q Octant of the globe

Code Figure	Greenwich Longitude	Hemi-sphere	Code Figure	Greenwich Longitude	Hemi-sphere
0	0° - 90°W	North	5	0° - 90°W	South
1	90° - 180°W	North	6	90° - 180°W	South
2	180° - 90°E	North	7	180° - 90°E	South
3	90° - 0°E	North	8	90° - 0°E	South
			9	if area of applicability is not indicated by latitude and longitude	

Annex A

Appendix A.3

SUPRP - Supplementary Surface Weather Reports Code

1. General This is a Standard NATO Meteorological Code for reporting weather observations obtained by non-professional observers having limited or no meteorological instrumental facilities.

2. Form of Code

SUPRPQ $L_aL_aL_aL_oL_oL_o$ YYGGgg N_aDFVwA' HHHRTA

or

SUPRP9 XXXXXX YYGGgg N_aDFVwA' HHHRTA

(TTPPPP) (ddff) (N_hh_a) ($99H_sP_sD_wW_s$) [Supplementary information]

Notes:

a. (1) SUPRPQ $L_aL_aL_aL_oL_oL_o$ should be used when the location of the observer can be given by means of geographical latitude ($L_aL_aL_a$) and longitude ($L_oL_oL_o$).

(2) SUPRP9 XXXXXX should be used when the location of the observer can be given by UTM grid or can be identified only in some other way, e.g., by place name/unit etc. When UTM grid is used, six digits are required as follows:

$X_LX_LX_NX_NX_NX_N$, where X_LX_L = the 100,000 meter square identification, and $X_NX_NX_NX_N$ = numerical grid co-ordinates given to the desired accuracy. If the location can only be identified by some other means, then the group XXXXXX may contain any arbitrary number of digits.

b. The bracketed groups are optional. Significant supplementary information can be given in plain language at the end of the report.

c. The order of the groups must be maintained. Only optional groups can be omitted.

d. If an element cannot be reported, it must be entered as /, or //, or ///, or ////, as appropriate.

e. A hyphen (-) in a code table signifies that the corresponding number is not used.

f. The group ddff, if reported, will be given as 99ff when the wind speed is less than 5 kt.

3. Specification of Symbolic Letters

SUPRP	Code identifier
Q	Octant of the globe (as given in WMO Code Table 3300)
$L_aL_aL_a$	Latitude in tenths of a degree
$L_oL_oL_o$	Longitude in tenths of a degree; the hundreds digit is omitted for longitude 100° to 180°
XXXXXX	Arbitrary number of digits to specify position in UTM grid or name of place, lake, road crossing, etc.
YY	Day of the month (UTC). The first day of the month is coded as 01, the second as 02, etc.
GGgg	Time of observation in hours and minutes UTC
N_a	Total amount of cloud (Table 1 and Table 10)
D	Direction of surface wind (coming from) (Table 2)
F	Force of surface wind (Table 3)
V	Visibility at surface (Table 4)
w	Present weather (Table 5)
A'	Amplification of phenomenon reported by w (Table 6)
HHH	Height of observation point/station above Mean Sea Level in decameters
R	State of road in vicinity of the observation point/station (Table 7)
T	State of terrain, prevailing in vicinity of the observation point/station (Table 8)
A	State of water surface (Table 9)
TT	Air temperature in whole degrees Celsius (negative temperature are encoded by adding 50 to the absolute value of the temperature; example: -20° is encoded as 70)
PPPP	Pressure at observer's level in a. tenths of a hectopascal (thousands of hectopascals are omitted), or b. hundredths of inches
dd	Direction, in tens of degrees, from which the surface wind is blowing
ff	Wind speed in knots (measured)
N_h	Amount of cloud reported at height h_a (Table 10)
h_a	Height of lowest cloud layer above observation point/station (Table 11)

99	Group identifier
H_s	Average height of breakers (Table 12)
P_s	Period of breakers (Table 13)
D_w	Direction of approach of waves to beach (observer's back to sea) (Table 14)
W_s	Width of surf zone (Table 15)

4. Code Tables

Table 1

N_a Total amount of cloud

Code Figure		Code Figure	
0	Clear	5	Broken
1	Few	6	Broken (hills in clouds)
2	Scattered	7	Overcast
3	Scattered (hills in clouds)	8	Overcast (hills in clouds)
4	-	9	-

Table 2

D Direction of surface wind (coming from)

Code Figure		Code Figure	
0	Calm	5	SW
1	NE	6	W
2	E	7	NW
3	SE	8	N
4	S	9	Variable

Table 3

F Force of surface wind (Beaufort Scale)

Code Figure		Code Figure	
0	Calm	5	-
1	-	6	6 (Strong breeze)
2	2 (Light breeze)	7	-
3	-	8	8 (Gale)
4	4 (Moderate breeze)	9	-

Table 4

V Visibility at surface

Code Figure		Code Figure	
0	Less than 50 m	5	2 - 4 km
1	50 - 200 m	6	4 - 10 km
2	200 - 500 m	7	10 - 20 km
3	500 – 1,000 m	8	20 - 50 km
4	1 - 2 km	9	50 km or more

Table 5

w Present weather

Code Figure

0	No significant weather
1	Smoke, haze, or volcanic ashes (see Remark 1)
2	(not used)
3	Sandstorm, dust storm or blowing snow
4	Fog (see Remark 2)
5	Drizzle
6	Rain
7	Snow or rain and snow mixed
8	Shower
9	Thunderstorm

Remark 1: Smoke, haze, or volcanic ashes (Code Figure 1) shall only be reported if visibility is ≤ 5 km.

Remark 2: Fog (Code Figure 4) shall only be reported if visibility is < 1 km.

Table 6

A' Descriptor of phenomenon reported by w

Code Figure		Code Figure	
0	No specification	5	In valley
1	Light	6	-
2	Heavy	7	-
3	In the past hour, but not at time of observation	8	Freezing precipitation
		9	Hail
4	Within sight		

Table 7

R State of road in vicinity of observation point/station

Code Figure		Code Figure	
0	Dry	5	Glazed ice
1	Wet	6	Snow depth 0 - 19 cm
2	Flooded	7	Snow depth 20 cm or more
3	Slush	8	Snowdrift
4	Ice patches	9	-

Table 8

T State of terrain prevailing in the vicinity of the observation point/station

Code Figure		Code Figure	
0	Dry	5	Ground frozen $\geq$ 5 cm
1	Wet	6	Snow depth 0 - 4 cm
2	Pools of water on the surface	7	Snow depth 5 - 24 cm
3	Flooded	8	Snow depth 25 - 44 cm
4	Ground frozen 0 - 4 cm (use of spade possible)	9	Snow depth $\geq$ 45 cm

Table 9

A State of water surface

Code Figure

0	Water level normal
1	Water level much below normal
2	Water level high, but not overflowing
3	Banks overflowing
4	Floating ice (more than half)
5	Thin ice, complete cover, impassable for persons, 0 - 4 cm thick
6	Ice, complete cover, passable for persons, depth unknown
7	Ice, complete cover, 5 - 9 cm thick
8	Ice, complete cover, 10 - 24 cm thick
9	Ice, complete cover, 25 cm or more thick

Table 10

N_h Amount of cloud reported at height h_a

Code Figure		Code Figure	
0	0	5	5/8
1	1/8 or less, but not 0	6	6/8
2	2/8	7	7/8 or more, but not 8/8
3	3/8	8	8/8
4	4/8	9	Sky obscured or cloud amount cannot be estimated

Table 11

h_a Height of the lowest cloud layer above the observation point

Code Figure		Code Figure	
0	0 - 99 m	5	500 - 599 m
1	100 - 199 m	6	600 - 699 m
2	200 - 299 m	7	700 - 799 m
3	300 - 399 m	8	800 - 899 m
4	400 - 499 m	9	900 m or more or no cloud

Table 12

H_s Average height of breakers

Code Figure

0	Less than 1 m
1	1 - 2 m
2	2 - 3 m
3	More than 3 m

Table 13

P_s Period of breakers, the time required for successive breakers to pass a given point

Code Figure

0	Less than 4 s
1	4 - 8 s
2	8 - 12 s
3	More than 12 s

Table 14

D_w Direction of approach of waves to beach (observer's back to sea)

Code Figure

0 Waves approaching from right side
1 Waves approaching directly from rear
2 Waves approaching from left side

Table 15

W_S Width of surf zone (distance from edge of water to the point (seaward) that the white caps of the surf begin to appear)

Code Figure

0 0 - 10 m
1 10 - 20 m
2 20 - 30 m
3 More than 30 m

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Annex A

Appendix A.4

METGM - Adoption of a Standard Gridded Data Meteorological Message

RELATED DOCUMENTS

STANAG 4537 LAND	SG/2 Shareable (Fire Control) Software Suite (S4) [formerly NATO Armaments Ballistic Kernel]
Appendix C.2	Adoption of Standard Artillery Computer Meteorological Message
Appendix C.5	Adoption of Standard Target Acquisition Meteorological Message
STANAG 2211 IGEO	Geodetic Datum's, Ellipsoids, Grids and Grid References.
ATP-45 Edition F	Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas
ISO 2533	ISO Standard Atmosphere
Appendix A.1	Adoption of a Standard Atmosphere, Edition 2
AMETOCP-4.2	SRD to AMETOCP-4, METGM Parameters

AIM

1. The aim of this agreement is to define a meteorological message for gridded meteorological data, and to standardise the number of information digits and their meanings, for use by the Armed Forces of any country. This will make it possible for the Armed Forces of all NATO nations to be able to receive gridded meteorological data for operational use in S4 software within Artillery fire control systems, CBRN Warning & Reporting (CBRN W&R), and various computer-based Battlefield (or Tactical) Decision Aids (BDAs).

AGREEMENT

2. Participating nations agree to adopt the message/data format for a standard gridded data meteorological message as detailed in this Appendix. The format is intended for the provision of gridded meteorological data required to support the use of the S4, CBRN W&R and other computer-based BDAs.

GENERAL

3. The format will allow gridded meteorological data to be generated for a grid of any defined size and resolution and containing only those parameters specifically requested by users. Thus, it can be used to pass data sets varying from coarse resolution, single-parameter data through to very high resolution, multi-parameter data depending upon specific data requirements and communications capabilities. The format may also be used to pass observed data from the field back to meteorological centres or higher HQ.

FORMAT FOR GRIDDED METEOROLOGICAL DATA

INTRODUCTION

The required meteorological data for a series of specified times will be provided in a series of arrays of the form:

Data (iz,ix,iy,it), where

iz = index of points in the z-direction (vertical from surface upwards),
iz = 1 .. nz (nz is the number of points on the z-axis);
ix = index of points in the x-direction (W to E),
ix = 1 .. nx (nx is the number of points on the x-axis);
iy = index of points in the y-direction (S to N),
iy = 1 .. ny (ny is the number of points on the y-axis);
it = index of points in the time domain,
it = 1 .. nt (nt is the of points [time steps] on the t-axis).

Notes:
1. Each of the values nx, ny, nz and nt must be greater than zero; the first grid point is defined as nz=1, nx=1, ny=1, and is located in the lower left corner of the grid.

2. The message header sections (Groups 0 & 1) are in standard text format (ISO/IEC 8859-1:1987). The remainder of the message (data sections) is to be transferred as binary values in accordance with IEEE standards (see Groups 2 – 5 descriptions below). Group 2 are binary unsigned integer values, while the data set sections (Groups 3 – 5) are binary real values.

3. A special text character prefixes group 0 (see PNG standard formatting) so that the whole file will be recognised as binary, the initial text data notwithstanding, in order to assist national systems to properly recognize the true file type. This character also allows easy viewing of groups 0 and 1 within any standard ASCII text viewer. The text data are separated from the subsequent binary data by the use of a LF/NULL combination (char 10/char 0, signifying a ø) at the end of group 1.

MESSAGE/DATA FORMAT

GROUP 0:	Binary Identifier, METGM, Endian, Version, Producing Nation
‰	Special Text Character (Text character 137) signifying a binary file to follow
METGM	Text Code/format identifier signifying it is a METGM file
Endian	Endian type (see Appendix A.4.1.0.1 for legal entries)
Version	Version string signifying STANAG version against which data will be compliant (see Appendix A.4.1.0.2 for legal entries)
Producing Nation	Producing nation identifier (see Appendix A.4.1.0.3 for legal entries)
GROUP 1:	$Y_0,M_0,D_0,h_0,m_0,Y_S,M_S,D_S,h_S,m_S$, Data-Type, Model Type, Free-Text, Gp1 terminator
Y_0,M_0,D_0,h_0,m_0	Full date/time (UTC) of the analysis upon which the prediction is based, or the valid time of the observations (see Appendix A.4.1.1.1 for legal entries)
Y_S,M_S,D_S,h_S,m_S	Full date/time (UTC) of the first time step (see Appendix A.4.1.1.1 for legal entries)
Data-Type	Code indicating type of data (see Appendix A.4.1.1.2 for legal entries)
Model-Type	Text indicating source of data (see Appendix A.4.1.1.3 for legal entries)
Free-Text	Free text field, (see Appendix A.4.1.1.4 for legal entries)
Group 1 Terminator	LF (text char 10)/Null (Text char 0) symbol combination to formally end text blocks for Groups 0 & 1

Note: Group 2 and later groups follow in binary structures conforming to IEEE standards. Group 2 data are to be binary 32-bit unsigned integers, while data for Groups 3-5 are to be 32-bit binary real values. This distinction is important for efficient machine memory allocation within user systems.

GROUP 2: ndp; ([p(i),ndpr(i), hd(i)]; i = 1,ndp)

ndp - Total number of distinct parameters to be transmitted (see Appendix A.4.1.2.1 for legal entries)

p - Parameter identifier (see AMETOCP-4.2 for legal entries)

Note: All parameters, including the related 1000 & 5000 series (fluctuations and errors) are defined and described in AMETOCP-4.2.

ndpr - the number of times the distinct parameter is to be repeated (see Appendix A.4.1.2.3 for legal entries)

Note: It is permissible to include up to three separate instances of a given parameter, each referenced to a different vertical coordinate (see Appendix A.4.1.2.5 for details)

hd - Code for highest array dimension of each parameter to be expected (see Appendix A.4.1.2.4 for legal entries and details)

Note: The three parameters in parentheses shall be provided for each distinct parameter that is to be included within the METGM. The 32-bit unsigned integer values have no separator in practice but are shown above with one for clarity. The rationale for explicitly stating these values is to assist automatic data parsers to predict the content of the METGM and to check it for consistency. An example is provided at Appendix 2.

GROUP 3: p,nz,nx,ny,nt,dx,dy,dt,cx,cy,pm,pr,pz

p - identifier of parameter[1]
nz - number of points in z direction (vertical)
nx - number of points in x direction (W - E)
ny - number of points in y direction (S - N)
nt - number of time steps
dx - grid spacing in x direction[2]
dy - grid spacing in y direction[2]
dt - time step in seconds[6]
cx - centre point of grid in longitude[3]
cy - centre point of grid in latitude[3]
pm - reference meridian longitude[2]
pr - identifier for reference level[4]
pz - identifier for format of vertical coordinates[5]

Note 1: Legal entries for p are listed in AMETOCP-4.2
Note 2: Legal entries and clarifications for dx,dy are listed in Appendix A.4.1.3.2
Note 3: Legal entries and clarifications for cx,cy are listed in Appendix A.4.1.3.3

Note 4: Legal entries and clarifications for pr are listed in Appendix A.4.1.3.4
Note 5: Legal entries and clarifications for pz are listed in Appendix A.4.1.3.5
Note 6: Clarifications for dt are listed in Appendix A.4.1.3.6

GROUP 4: (((z(iz,ix,iy), iz=1,mz), ix=1,mx), iy=1,my)

z(iz,ix,iy)	vertical coordinates for grid points
mz	number of points in z direction (vertical)
mx	number of points in x direction (W-E)
my	number of points in y direction (S-N)

Note: Legal values and clarifications are listed at Appendix A.4.1.4

GROUP 5: ((((data(iz,ix,iy,it), iz=1,nz),ix=1,nx),iy=1,ny),it=1,nt)

data(iz,ix,iy,it)	The value of the parameter p at each grid point location

Note: Legal values and clarifications are listed in AMETOCP-4.2.
Group 3 to Group 5 are repeated for as many parameter entries as are specified in Group 2. Each parameter is supplied in ascending order and immediately repeated if multiple instances of a parameter are included (see Appendix A.4.1.2.3). The total number of loops can be determined in the formula below:

$$\text{Loops} = \sum_{1}^{ndp} ndpr_i$$

Appendices:

1. Legal Entries
2. Examples

APPENDIX A.4.1 - Legal Entries

A.4.1.0 Group 0: Header information (TEXT)

A.4.1.0.0 Group 0 is a character string that must contain exactly 12 characters without internal delimiters. The starting character is a special ‰ symbol (Text Character 137) that is used to force systems to accept the METGM file as binary in spite of the text data contained within Groups 0 and 1. The data within these groups will read with a standard ASCII text viewer. The 1 byte ‰ symbol is followed by the

word METGM. Group 0 is immediately followed by a second text string for Group 1 values with no separator between Group 0 & 1.

A.4.1.0.1. Producing System Endian Type 1 digit
Letter identifier using B=Big Endian, and L=Little Endian Processor systems.

Note: Where the METGM is a request-for-message (REQGM) rather than an actual data message, this parameter can be either value.

A.4.1.0.2. Version 2 digits
The value of VERSION must be greater than or equal to 02 signifying compliance with this or later editions of the STANAG.

Note: Where the METGM is a request-for-message (REQGM) rather than an actual data message, this value indicates the version (ed.2 or later) of data message required by the requester.

A.4.1.0.3. Producing Nation 3 digits
STANAG 1059 compliant nation identifier showing the country of origin, e.g. Demark is DNK. A value of ZZZ is reserved for any METGM produced outside of a national WAC.

Note: Where the METGM is a request-for-message (REQGM) rather than an actual data message, this value indicates which nation is requested to supply the data message. This is operationally important.

A.4.1.1 Group 1: <u>Header information (TEXT)</u>

A.4.1.1.0 Group 1 is a character string in text consisting of exactly 83 characters without internal delimiters, and any unused space is packed out using dashes (-). The end of the free text field (end-of-text) is signified by the use of a LF/NULL combination that prevents an ASCII browser from trying to load the subsequent binary data. The free text field is immediately followed by the Group 2 values as little-endian or big-endian IEEE binary 32 bit unsigned integer values (Groups 3 – 5 follow Group 2 as binary real values).

A.4.1.1.1. Date/Time Groups (DTGs) 12 digits per DTG

Y	year	4 digits
M	month (01 - 12)	2 digits
D	day of month (01 - 31)	2 digits
h	hour (00 - 23)	2 digits
m	minute (00 - 59)	2 digits

Note: When the entry for Data-Type is 1 or 3 (analysis or observations; see A.1.2 below), the two date/time entries in Group 1 are identical and indicate the date and time the analysis or observation was made. Where the METGM is a request-for-message (Data-Type 5, REQGM) rather than an actual data message, the first instance of DTG (analysis/observation time) is unimportant and can be any legal value. However, the second value indicates the operationally important start time of the data METGM that the WAC is requested to supply.

A.4.1.1.2 Data-Type 1 digit

0 - Climatological data
1 - Numerical weather analysis
2 - Numerical weather predictions
3 - Observations
4 - Compound data composed of any of the above
5 - Request-for-METGM identifier (REQGM); with Group 5 not included

Note: The use of code 5 as a Request for METGM will allow systems to ignore missing or empty group 5 blocks rather than generating formatting errors.

A.4.1.1.3 Model Type 16 digits

Consists of letters, numbers, and other symbols. Unused character spaces at the end of the string must be padded with dashes (-) until the field is exactly 16 characters long. It is expected to use this field for model name, spatial resolution and any other model information needed by the user.

Note: Where the METGM is a request-for-message (REQGM) rather than an actual data message, and the user cannot or does not wish to indicate model specifics, this parameter shall consist entirely of dashes (-).

A.4.1.1.4 Free text 40 characters
Consists of letters, numbers, and other text symbols. The unused character spaces at the end of the string must be padded with dashes (-) until the field is exactly 40 characters long.

A.4.1.2 Group 2: Number of Parameters to be Transmitted (BINARY)

A.4.1.2.0 The total number of unique or distinct parameters must be explicitly specified. The identifier for each included parameter, along with the number of occurrences of each parameter, and the highest dimensional level (array dimensionality) for each parameter must also be explicitly stated. The parameters must be identified in order of increasing parameter number, and each [p(i), ndpr(i), hd(i)] block

must be complete before the next is started. This will support format error checking in a parser. Group 3 follows in binary structures.

A.4.1.2.1 ndp (>= 1)
The number of distinct parameters in the message. At least 1 parameter must be included to be considered a valid METGM.

A.4.1.2.2 p (>= 0)
The parameter identifier (see AMETOCP-4.2 for valid parameter identifiers and descriptions).

A.4.1.2.3 ndpr (1-3)
The number of times a distinct parameter is repeated in Groups 3, 4 and 5 (e.g. p = 07; pressure with both an isobaric and geopotential height dataset will have ndpr=2). A maximum of three instances of any one parameter are permitted and data must be structured in accordance with para A.2.5 below.

A.4.1.2.4 hd (1-6)
The highest dimensional configuration of any of the included parameters.

Note: This dimensional tag relates to the array requirements of processors in allocating memory in advance of reading the METGM and may not reflect the true physical nature of the parameter.

1 - 3D+T	volume + multiple time steps (highest dimensionality)
2 - 3D	volume (single time step volume)
3 - 2D+T	horizontal or vertical slice (meteorological cross section) + multiple time steps
4 - 2D	horizontal or vertical slice (single time step)
5 - 1D+T	linear profile + multiple time steps
6 - 1D	linear profile “METCM equivalent” (single time step profile)
7 - 0D+T	single grid point + multiple time steps
8 - 0D	single grid point (single time step) (lowest dimensionality)

Note: All data held in Group 5 must be one of these 8 types. The highest dimensionality of a parameter is reported if multiple instances of data for that parameter are included in the message.

Example:
ndp = 2
p=0, ndpr=1, hd=4 (parameter 0 – terrain, 1 instance, 2D
p=2, ndpr=2, hd=1 (parameter2, 2 instances, highest dimensionality being 3D+T)

A.4.1.2.5 Multiple occurrences of like data (same parameter) shall always be aggregated:

1. Into a higher dimensional structure.
   For example, two vertical levels holding geophysical height at specific isobaric levels will be included in a single 3D structure instead of two distinct 2D structures; or

2. Into larger datasets of the same dimensionality.
   For example, use a 3D-T structure with four time intervals rather than two different 3D-T structures, each of two time intervals, for the same parameter.

Multiple instances of data for the same parameter shall occur in the following order:

1. pr = 0 Geopotential height above MSL;
2. pr = 1 Geopotential height above (ground) surface; and
3. pr = 2 Isobaric pressure levels

A single message shall contain a maximum of three instances of data for any one parameter and there shall be only one instance of a given parameter for each pr value.

A.4.1.3 Group 3: Array Specification (BINARY)

A.4.1.3.0 The dimensional assignment of each parameter within the table (Max D) refers to the inherent physical nature of the parameter, excluding time. Data for a parameter cannot exceed its specified maximum dimension, other than for the addition of time, but it is possible for it to be included on fewer axes than implied (e.g. a METGM containing air temperature (a 3D parameter) only at a standard 2m layer; or even at a single grid point).
Dimensional distinction is necessary to assist parser design, memory allocation within operational systems, and to avoid ambiguity and production errors.

A.4.1.3.1 Parameter identifier (p)
All valid parameters are described in AMETOCP-4.2. New parameters, their definitions, legal entries, examples and other relevant information can be defined by having them included in an update of AMETOCP-4.2.

A.4.1.3.2 Grid spacing in x and y directions (dx & dy), and the reference meridian (pm).

Note: A METGM will have all included data archived on the same X-Y coordinate framework, horizontal grid spacing, projection, and with the same spatial extent.

A.4.1.3.2.1 If the value specified for pm is 9999 then the array is based on a regular λ-φ coordinate system. In this case dx pertains to longitude (λ) and dy pertains to latitude (φ). The use of WGS-84 latitude/longitude coordinates is mandatory and all values are given in decimal degrees.

A.4.1.3.2.2 If the value specified for pm is a real number other than 9999 it is the reference meridian in decimal degrees for the rectangular UTM coordinate system on which the array is based. In this case dx and dy are given in meters.

A.4.1.3.3 The centre point of the area covered (cx, cy) is specified in longitude and latitude, and it does not have to be a grid point.

Note: In specifying the centre point of the AOI the user is unlikely to know the specifics of various meteorological models, including the nature of their grid.

A.4.1.3.3.1 Geographical coordinates are given in decimal degrees with a sign for the hemisphere; W and S are negative, E and N are positive.

A.4.1.3.3.2 The WGS 84 ellipsoid is to be used for all position referencing whether Lat/Long or UTM grids are used (see STANAG 2211).

A.4.1.3.4 Identifier for vertical coordinate reference (pr)

0 - vertical coordinate is height in meters above mean sea level (MSL)

1 - vertical coordinate is height in meters above ground level (GND) at each grid point. In this case the field for p=0 (terrain elevation above MSL) must be included in the message.

2 - vertical coordinate is pressure in hPa

A.4.1.3.4.1 If the value specified for pr is 0, then the values for z in Group 4 are heights above MSL given in meters and the values for p=7 (if reported) are pressure levels given in hPa.

A.4.1.3.4.2 If the value specified for pr is 1, then the values for z in Group 4 are heights above GND given in meters and the values for p=7 (if reported) are pressure levels given in hPa. For this case the message must include the data parameter (p=0) for terrain elevation above MSL in order to reference the data properly.

A.4.1.3.4.3 If the value specified for pr is 2, then the values for z in Group 4 are pressure levels given in hPa and the values for p=7 (if reported) are heights given in meters above MSL.

A.4.1.3.5 Identifier for format of vertical coordinates (pz)

A.4.1.3.5.1 If the value specified for pz is 0 the last values specified in Group 4 for the z-array are also valid for the next data field following in Group 5. In this case Group 4 must not be included.

A.4.1.3.5.2 If the value specified for pz is 1 the vertical profile specified in Group 4 is the same for every grid point in the data field.

A.4.1.3.5.3 If the value specified for pz is 2 the complete z-array is reported in Group 4 and the vertical profiles may be different for each grid point in the data field.

A.4.1.3.5.4 The first time Group 3 is reported pz must either be 1 or 2.

A.4.1.3.6 Clarification for dt. If the METGM has only one time slice, dt is the number of seconds the data are valid for from the Y_S,M_S,D_S,h_S,m_S DTG provided. Where a number of time slice volumes are provided, all slices are separated by dt seconds.

A.4.1.4 Group 4: Vertical Coordinates for Grid Points (BINARY)

A.4.1.4.0 This array specifies the vertical coordinates for each grid point. These are either heights (m) or pressure levels (hPa) (see A.3.4 above).

A.4.1.4.1 The amount of data transmitted in this group depends on the value of pz from Group 3 (see A.3.5 above).

A.4.1.4.2 If pz is 0 this group is not transmitted;
If pz is 1 then mz=nz, mx=my=1; and
If pz is 2 then mz=nz, mx=nx, my=ny.

A.4.1.5 Group 5: Data Array Entries (BINARY)

Note 1: The data are specified in the array such that the vertical profile (iz-direction) is stored contiguously for each grid point in the row (ix-direction) followed by the vertical profiles for the next row in the iy-direction. The next time-block follows in the same order as specified above: iz, ix, iy.

Note 2: Parameters are to be included in numerical order to assist error checking in a parser.

Note 3: Missing Data. A value of 999999 indicates that the parameter value at that specific grid point location is not known, non-existent, or invalid (missing data code). If a parameter value will equal or exceed 999999, the METGM producer shall artificially reduce the real value of that specific instance of the parameter to 999998 to preserve the validity of the missing data code. This action must be documented in the Group 1 free text field accordingly.

APPENDIX A.4.2 – Examples

Example 1:
Artillery METGM: Single time-slice orography, two time-slice u-wind & v-wind component.
The format is:
Gp 0: Binary-Identifier, METGM, Endian, VER, Producing-Nation
Gp 1: Y_0, M_0, D_0, h_0, m_0, Y_S, M_S, D_S, h_S, m_S, Data-Type, Model-Type, Free-Text, Gp1-Term
Gp 2: ndp; ([p(i),ndpr(i), hd(i)]; i=1,ndp)
Gp 3: p, nz, nx, ny, nt, dx, dy, dt, cx, cy, pm, pr, pz
Gp 4: (((z(iz, ix, iy), iz=1,mz), ix=1,mx), iy=1,my)
Gp 5: ((((data(iz, ix, iy, it), iz=1,nz), ix=1,nx), iy=1,ny), it=1,nt)

NB. Throughout the following example an "¤" is used to separate individual items to enhance readability within this document only – the separator symbol is not part of the actual METGM.

The header would contain the following text:
Gp 0 Gp 1
‰METGML02GBR200809120000200809121200 2UKMETOFFICE-CAMMRoutine-production------LFø

This is equivalent to (with artificial separations):
‰¤METGM¤L¤0¤2¤GBR¤2008¤09¤12¤00¤00¤2008¤09¤12¤12¤00¤2¤UKMETOFFICE-CAMMRoutine-production------¤LFø

Which means:
METGM v2 produced on a Little Endian NWP system in UK on 12th September 2008 at 0000z for time valid at 1200z on same day.

The group 2 are 32-bit unsigned integer values and not text as shown here:
Gp 2
3¤0¤1¤4¤2¤1¤1¤3¤1¤1

This indicates that the METGM includes 3 distinct parameters:

- 0 (terrain elevation above MSL), only included once, 2D (single time step volume)
- 2 (U), only included once, 3D+T (volume + multiple time steps)
- 3 (V), only included once each, 3D+T (volume + multiple time steps)

Groups 3 to group 5 are repeated for as many parameter entries as specified in Group 2.

First Block:

The first group 3 are 32-bit real values and not text as shown here:
Gp 3
0¤1¤3¤3¤1¤0.25¤0.4¤7200¤-3¤52¤9999¤0¤1

For parameter 0 (orography), this means that there is 1 z value, and a horizontal grid of 3x3 points with a single time slice. The grid spacing is 0.25 degrees in X and 0.4 degrees in Y and is valid for 7200 seconds (2 hrs). The METGM is centred on 52ºN and 3ºW. The vertical coordinate is referenced against MSL.

The vertical profile is specified in Group 4.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
0
Height in metres above mean sea level because pr=0 in group 3.

The group 5 are 32-bit real values:
Gp 5
10¤20¤25¤15¤27¤22¤19¤32¤42

There is 1 vertical level and a 3 x 3 grid as specified in group 3. The data are given at MSL (0m), as specified in Group 4.

Second Block:

The second group 3 are 32-bit real values and not text as shown here:
Gp 3
2¤36¤3¤3¤2¤0.25¤0.4¤3600¤-3¤52¤9999¤1¤1

For parameter 2 (u-wind component), this means that there are 36 z values, and horizontal grid of 3x3 points with two time slices. The grid spacing is 0.25 degrees in X and 0.4 degrees in Y and is valid for 7200 seconds (2 hours: each time step covers 3600 seconds). The METGM

is centred on 52ºN and 3ºW. The vertical coordinate is referenced against GND and ALL values use the same vertical profile described in group 4.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
10¤50¤100¤250¤500¤750¤1000¤1250¤1500¤1750¤2250¤2750¤3250¤3750¤4250¤4750¤5500¤6500¤7000¤7500¤8000¤8500¤9000¤9500¤10000¤10500¤11500¤12500¤13500¤14500¤15500¤16500¤17500¤18500¤20000¤24500¤29000

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)
This would be a block of 648 (3x3x36x2) 32-bit real values, not included here for brevity.

Third Block:

The third group 3 are 32-bit real values and not text as shown here:
Gp 3
3¤36¤3¤3¤2¤0.25¤0.4¤3600¤-3¤52¤9999¤1¤0

For parameter 3 (v-wind component), this means that there are 36 z values, and horizontal grid of 3x3 points with two time slices. The grid spacing is 0.25 degrees in X and 0.4 degrees in Y and is valid for 7200 seconds (2 hours: each time step covers 3600 seconds). The METGM is centred on 52ºN and 3ºW. The vertical coordinate is referenced against GND and ALL values use the same vertical profile. As “pz” = 0 Group 4 is omitted and the vertical levels are the same as for the previous parameter.

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)
This would be a block of 648 (3x3x36x2) 32-bit real values, not included here for brevity.

Example 2:
Request for an Artillery METGM from GBR.
The format is:
Gp 0: Binary-Identifier, METGM, Endian, VER, Producing-Nation
Gp 1: Y_0, M_0, D_0, h_0, m_0, Y_S, M_S, D_S, h_S, m_S, Data-Type, Model-Type, Free-Text, Gp1-Term
Gp 2: ndp; ([p(i),ndpr(i), hd(i)]; i=1,ndp)
Gp 3: p, nz, nx, ny, nt, dx, dy, dt, cx, cy, pm, pr, pz

Gp 4: (((z(iz, ix, iy), iz=1,mz), ix=1,mx), iy=1,my)
Gp 5: ((((data(iz, ix, iy, it), iz=1,nz), ix=1,nx), iy=1,ny), it=1,nt)

NB. Throughout the following example an "¤" is used to separate individual items to enhance readability within this document only – the separator symbol is not part of the actual METGM.

The header would contain the following text:
Gp 0 Gp 1
‰METGML02GBR2008091200002008091212005----------LFø

This is equivalent to (with artificial serparators)
‰¤METGM¤L¤02¤GBR¤2008¤09¤12¤00¤00¤2008¤09¤12¤12¤00¤5¤----------¤LFø

Which means:
METGM v2 formatted file to be produced on a Little Endian NWP system in UK on or around 12th September 2008 at 0000z for time valid starting at 1200z on same day. The free text field is packed with "-". In practice, the endian and production time can be anything valid in the request as this is up to the WAC.

The group 2 are 32-bit unsigned integer values and not text as shown here:
Gp 2
6¤0¤1¤4¤2¤1¤1¤3¤1¤1¤4¤1¤1¤5¤1¤1¤6¤1¤1

Indicating the METGM includes 6 distinct parameters:

- 0 (terrain elevation above MSL), only included once, 2D (single time step)
- 2 (U), only included once, 3D+T (volume + multiple time steps)
- 3 (V), only included once, 3D+T (volume + multiple time steps)
- 4 (W), only included once, 3D+T (volume + multiple time steps)
- 5 (T), only included once, 3D+T (volume + multiple time steps)
- 6 (RH), only included once, 3D+T (volume + multiple time steps)

Groups 3 and 4 are repeated for as many parameter entries as specified in Group 2. Group 5 is left out, i.e. not included, as "Data-Type" in Group 1 is 5 which indicates a request message.

First Block:

The 1st group 3 consists of 32-bit real values and not text as shown here:
Gp 3
0¤1¤3¤3¤1¤0.25¤0.4¤7200¤52¤-3¤9999¤0¤1

For parameter 0 (orography), this means that the user wants one z value, and a horizontal grid of 3x3 points with only a single time slice. The grid spacing desired is 0.25 degrees in X and 0.4 degrees in Y and

is valid for 7200 seconds (2 hrs) but it is recognised that the WAC may not be able to support this, i.e. the METGM produced may have a 0.3 by 0.3 degree grid. The METGM should be centred on 52ºN and 3ºW. The vertical coordinate is referenced against MSL. The vertical profile is specified in group 4.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
0

Second Block:

The 2nd group 3 are 32-bit real values and not text as shown here:
Gp 3
2¤37¤3¤3¤2¤0.25¤0.4¤3600¤52¤-3¤9999¤1¤1

For parameter 2 (u-velocity), this means that the user wants 37 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing desired is 0.25 degrees in X and 0.4 degrees in Y and is valid for 3600 seconds (1 hrs). The METGM should be centred on 52ºN and 3ºW. Vertical coordinate is referenced against GND. The vertical profile is specified in group 4.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
10¤50¤100¤250¤500¤750¤1000¤1250¤1500¤1750¤2250¤2750¤3250¤3750¤4250¤4750¤5500¤6500¤7000¤7500¤8000¤8500¤9000¤9500¤10000¤10500¤11500¤12500¤13500¤14500¤15500¤16500¤17500¤18500¤20000¤24500¤29000

Third Block:

The 3rd group 3 are 32-bit real values and not text as shown here:
Gp 3
3¤37¤3¤3¤2¤0.25¤0.4¤3600¤52¤-3¤9999¤1¤0

For parameter 3 (v-velocity), this means that the user wants 37 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing desired is 0.25 degrees in X and 0.4 degrees in Y and is valid for 3600 seconds (1 hrs). The METGM should be centred on 52ºN and 3ºW. As “pz” = 0 Group 4 is omitted and the vertical levels are the same as for the previous parameter.

Fourth Block:

The 4th group 3 are 32-bit real values and not text as shown here:

Gp 3
4¤37¤3¤3¤2¤0.25¤0.4¤3600¤52¤-3¤9999¤1¤0

For parameter 4 (w-velocity), this means that the user wants 37 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing desired is 0.25 degrees in X and 0.4 degrees in Y and is valid for 3600 seconds (1 hrs). The METGM should be centred on 52ºN and 3ºW. As "pz" = 0 Group 4 is omitted and the vertical levels are the same as for the previous parameter.

Fifth Block:

The 5th group 3 are 32-bit real values and not text as shown here:
Gp 3
5¤37¤3¤3¤2¤0.25¤0.4¤3600¤52¤-3¤9999¤1¤1

For parameter 5 (temperature), this means that the user wants 37 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing desired is 0.25 degrees in X and 0.4 degrees in Y and is valid for 3600 seconds (1 hour). The METGM should be centred on 52ºN and 3ºW. The vertical coordinate is referenced against GND. The vertical profile is specified in group 4.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
2¤50¤100¤250¤500¤750¤1000¤1250¤1500¤1750¤2250¤2750¤3250¤37
50¤4250¤4750¤5500¤6500¤7000¤7500¤8000¤8500¤9000¤9500¤10000
¤10500¤11500¤12500¤13500¤14500¤15500¤16500¤17500¤18500¤200
00¤24500¤29000

Sixth Block:

The 6th group 3 are 32-bit real values and not text as shown here:
Gp 3
6¤37¤3¤3¤2¤0.25¤0.4¤3600¤52¤-3¤9999¤1¤0

For parameter 6 (relative humidity), this means that the user wants 36 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing desired is 0.25 degrees in X and 0.4 degrees in Y and is valid for 3600 seconds (1 hrs). The METGM should be centred on 52ºN and 3ºW. As "pz" = 0 Group 4 is omitted and the vertical levels are the same as for the previous parameter.

Example 3:
A response to the request in Example 2 might be a METGM as follows.

The format is:
Gp 0: Binary-Identifier, METGM, Endian, VER, Producing-Nation
Gp 1: Y_0, M_0, D_0, h_0, m_0, Y_S, M_S, D_S, h_S, m_S, Data-Type, Model-Type, Free-Text, Gp1-Term
Gp 2: ndp; ([p(i),ndpr(i), hd(i)]; i=1,ndp)
Gp 3: p, nz, nx, ny, nt, dx, dy, dt, cx, cy, pm, pr, pz
Gp 4: (((z(iz, ix, iy), iz=1,mz), ix=1,mx), iy=1,my)
Gp 5: ((((data(iz, ix, iy, it), iz=1,nz), ix=1,nx), iy=1,ny), it=1,nt)

NB. Throughout the following example an "¤" is used to separate individual items to enhance readability within this document only – the separator symbol is not part of the actual METGM.

The header would contain the following text:
Gp 0 Gp 1
‰METGML02GBR20080912000020080912120 02----------LFø

This is equivalent to (with artificial separators)
‰¤METGM¤L¤02¤GBR¤2008¤09¤12¤0000¤2008¤09¤12¤1200¤2¤----------¤LFø

Which means:
METGM v2 produced on a Little Endian NWP system in UK on 12th September 2008 at 0000z for time valid at 1200z on same day.

The group 2 are 32-bit unsigned integer values and not text as shown here:
Gp 2
6¤014¤211¤311¤411¤511¤611

Indicating the METGM includes 6 distinct parameters:

- 0 (terrain elevation above MSL), only included once, 2D (single time step volume)
- 2 (U), only included once, 3D+T (volume + multiple time steps)
- 3 (V), only included once, 3D+T (volume + multiple time steps)
- 4 (w), only included once, 3D+T (volume + multiple time steps)
- 5 (T), only included once, 3D+T (volume + multiple time steps)
- 6 (RH), only included once, 3D+T (volume + multiple time steps)

Groups 3 to group 5 are repeated for as many parameter entries as specified in Group 2:

First Block:

The 1st group 3 consists of 32-bit real values and not text as shown here:
Gp 3

0¤1¤3¤3¤1¤0.3¤0.3¤7200¤52¤-3¤9999¤0¤1

For parameter 0 (orography), this means that there is one z value, and a horizontal grid of 3x3 points with only a single time slice. The grid spacing is 0.3 degrees in X and 0.3 degrees in Y and is valid for 7200 seconds (2 hours). The METGM is centred on 52ºN and 3ºW. Note that the grid spacing in this case has been changed compared to that requested. The vertical coordinate is referenced against MSL. The vertical profile is specified in group 4.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
0

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)
This would be a block of 9 (3x3x1x1) 32-bit real values, not included here for brevity.

Second Block:

The 2nd group 3 are 32-bit real values and not text as shown here:
Gp 3
2¤36¤3¤3¤2¤0.3¤0.3¤3600¤52¤-3¤9999¤1¤1

For parameter 2 (u-velocity), this means that there are 36 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing is 0.3 degrees in X and 0.3 degrees in Y and is valid for 7200 seconds (2 hours: each time step covers 3600 seconds). The METGM is centred on 52ºN and 3ºW. The vertical coordinate is referenced against GND. The vertical profile is specified in group 4. Note there are only 36 vertical levels compared with the request for 37 because, in this example, the WAC model does not reach that height.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
10¤50¤100¤250¤500¤750¤1000¤1250¤1500¤1750¤2250¤2750¤3250¤3750¤4250¤4750¤5500¤6500¤7000¤7500¤8000¤8500¤9000¤9500¤10000¤10500¤11500¤12500¤13500¤14500¤15500¤16500¤17500¤18500¤20000¤24500

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)

This would be a block of 648 (3x3x36x2) 32-bit real values, not included here for brevity.

Third Block:

The 3rd group 3 are 32-bit real values and not text as shown here:
Gp 3
3¤36¤3¤3¤2¤0.3¤0.3¤3600¤52¤-3¤9999¤1¤0

For parameter 3 (v-velocity), this means that there are 36 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing is 0.3 degrees in X and 0.3 degrees in Y and is valid for 7200 seconds (2 hours: each time step covers 3600 seconds). The METGM should be centred on 52ºN and 3ºW. As “pz” = 0 Group 4 is omitted and the vertical levels are the same as for the previous parameter.

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)
This would be a block of 648 (3x3x36x2) 32-bit real values, not included here for brevity.

Fourth Block:

The 4th group 3 are 32-bit real values and not text as shown here:
Gp 3
4¤36¤3¤3¤2¤0.3¤0.3¤3600¤52¤-3¤9999¤1¤0

For parameter 4 (w-velocity), this means that there are 36 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing is 0.3 degrees in X and 0.3 degrees in Y and is valid for 7200 seconds (2 hours: each time step covers 3600 seconds). The METGM should be centred on 52ºN and 3ºW. As “pz” = 0 Group 4 is omitted and the vertical levels are the same as for the previous parameter.

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)
This would be a block of 648 (3x3x36x2) 32-bit real values, not included here for brevity.

Fifth Block:

The 5th group 3 are 32-bit real values and not text as shown here:
Gp 3
5¤36¤3¤3¤2¤0.3¤0.3¤3600¤52¤-3¤9999¤1¤1

For parameter 5 (temperature), this means that there are 36 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing desired is 0.3 degrees in X and 0.3 degrees in Y and is valid for 7200 seconds (2 hours: each time step covers 3600 seconds). The METGM should be centred on 52ºN and 3ºW. The vertical coordinate is referenced against GND. The vertical profile is specified in group 4.

The group 4 are 32-bit real values and not text as shown here:
Gp 4
2¤50¤100¤250¤500¤750¤1000¤1250¤1500¤1750¤2250¤2750¤3250¤3750¤4250¤4750¤5500¤6500¤7000¤7500¤8000¤8500¤9000¤9500¤10000¤10500¤11500¤12500¤13500¤14500¤15500¤16500¤17500¤18500¤20000¤24500

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)
This would be a block of 648 (3x3x36x2) 32-bit real values, not included here for brevity.

Sixth Block:

The 6th group 3 are 32-bit real values and not text as shown here:
Gp 3
6¤36¤3¤3¤2¤0.3¤0.3¤3600¤52¤-3¤9999¤1¤0

For parameter 6 (relative humidity), this means that there are 36 z values, and a horizontal grid of 3x3 points with two time slices. The grid spacing desired is 0.3 degrees in X and 0.3 degrees in Y and is valid for 7200 seconds (2 hours: each time step covers 3600 seconds). The METGM should be centred on 52ºN and 3ºW. As “pz” = 0 Group 4 is omitted and the vertical levels are the same as for the previous parameter.

The group 5 are 32-bit real values:
Gp 5
data(iz,ix,iy,it)
This would be a block of 648 (3x3x36x2) 32-bit real values, not included here for brevity.

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Annexes B

NATO METOC Codes for Aviation

Overview

Appendix B.1 METAR including National Exceptions

Appendix B.2 TAF including National Exceptions

Appendix B.3 Airfield Weather Colour Code including National Exceptions

Appendix B.4 MAVOC - Military Aircraft Voice Weather Code

Appendix B.5 MAWEC - Maritime Aircraft Weather Code

Appendix B.6 RECCO - Report from Meteorological Reconnaissance Aircraft Code

Appendix B.7 TARWI - Target Weather Information Reporting Code

Appendix B.8 RAFOR - Range Forecast Code

Annex B

Appendix B.1

METAR (FM 15 Ext. METAR) including national exceptions

1. General METAR is the acronym for an Aviation Routine Weather Report (with or without trend forecast).

2. Form of Code (including trend forecast) The code form described in WMO Publication No. 306, Manual on Codes (References E-G) shall be used in its latest version.

3. National Exceptions

Belgium

a. Wind:

(1) The unit for wind speed is kt.

(2) The group $d_nd_nd_nVd_xd_xd_x$ is not used.

b. Visibility: The groups $VVVVD_v$ and $V_xV_xV_xV_xD_v$ are not used. Military stations only report VVVV.

c. Runway Visual Range: The RVR groups are not reported.

d. CAVOK is not used in reports from military stations.

e. The groups WS $RWYD_RD_R$ and WS ALL RWY are not used.

f. Trend Forecast is not reported but is replaced by a Colour State (Annex D) and a Colour State Forecast.

g. When the forecaster leaves the office, the Colour State Forecast is replaced by "FCST CANCEL". The following METARs only report a Colour State.

Canada

METAR or SPECI

15.1.1 METAR or SPECI or LWIS shall appear as the first word of each report. Reports identified by LWIS shall report once per hour the following groups only:

LWIS CCCC YYGGggZ AUTO dddffGf_mf_mKT T´ T´/T´$_d$T´$_d$ AP$_H$P$_H$P$_H$P$_H$

15.4 Groups not reported shall be omitted. Solidi (/) shall only be used for missing wind speed and/or direction.

(BBB)

The BBB format may appear immediately preceding the wind group to indicate if the report has been corrected.

dddffGf_mf_m**KT**

15.5 The averaging period for mean wind speed and direction is two minutes. Speed is reported in nautical miles per hour.

15.5.2 The term VRB may not be used by all AUTO Stations

VVVVD_v

15.6 Prevailing visibility is reported in statute miles and fractions up to three miles, then in whole miles up to 15 miles, and in units of five miles thereafter, where suitable visibility markers are available. Automatic weather stations report sensor visibility in statute miles and fractions up to four miles, then in whole miles up to a maximum of nine miles. Statute miles and fractions of statute miles shall be encoded with a space; for example, 11/8 statute mile shall be reported as 1 1/8SM. D_v is not reported, but sector visibilities half (or less) of prevailing visibility are reported in supplementary information (manned sites only). The letters SM (statute miles) are appended, without a space, to each observation to identify the units.

15.6.1 The abbreviation NDV is not used.

$V_xV_xV_xV_xD_v$

15.6.3 The group $V_xV_xV_xV_xD_v$ is not used.

RD_RD_R/$V_RV_RV_RV_R$i

15.7.1 RVR is reported whenever the prevailing visibility is one statute mile or less and/or the RVR is 6 000 feet or less. The units of measurement are feet and the abbreviation FT will be included in each message according to the following symbolic format: **R**D_RD_R/$V_RV_RV_RV_R$**FT**/i. When the one-minute mean minimum and maximum values are reported, **FT**/i follows the maximum value

without a space. RVR is not used as one of the criteria for reporting a SPECI. RVR may not be reported at some aerodromes.

w´w´

15.8.1 The following weather phenomena/qualifiers will not be reported by automatic weather stations: FC, IC, SG, GS, FU, VA, SA, SS, DS, MI, BC, PR, DR, SH, VC, PO. Depending on station type and capabilities, AUTO stations may report up to three different precipitation types and one obstruction to visibility simultaneously. At staffed stations, more than three w´w´ groups may be reported.

15.8.6 The term + FC will be used to report any tornado or waterspout when within sight. The term FC will be used to report any funnel cloud when within sight. The symbol UP with appropriate intensity shall be used to describe unknown precipitation reported from an automatic weather station.

15.8.7 Precipitation preceded by the descriptor FZ shall always appear as a separate group with its own intensity.

15.8.8 Thunderstorms are reported when thunder is heard or if overhead lightning or hail occurs within the 15-minute period preceding the time of the report.

15.8.10 The terms VCFC shall not be used in Canada. Some AUTO stations are capable of reporting VCTS

15.8.13 The phenomena represented by FU, HZ, DU and SA are reported whenever the visibility is reduced by the reported phenomena to six miles or less.

15.8.14 BR (mist) is reported when it reduces visibility to between 5/8 mile and six miles, inclusive.

15.8.19 The letter abbreviation SQ is reported at manned stations when the wind speed increases by 15 knots over the two-minute average speed that preceded the increase and the duration of the peak speed period is at least two minutes and the wind speed attains a one-minute mean of at least 20 knots, during the peak speed period and the wind speed diminishes by at least five knots.

$N_sN_sN_sh_sh_sh_s$

15.9 The abbreviation SKC is used by Staffed stations when no cloud is visible.

15.9.1.1 The letters CLR may be used when no clouds below 10 000 feet are reported by automatic weather stations.

15.9.1.2 The summation principle is used in determining cloud amount. Automatic weather stations report cloud directly overhead, layer amounts are determined by persistence of cloud over top of the sensor.

15.9.1.3 Significant convective cloud (CB and TCU) information is not available from automatic weather stations.

15.9.1.4 All cloud layers observed are reported.

CAVOK

15.10 The abbreviation CAVOK is not used.

T´´T´/T´$_d$T´$_d$

15.11 This group is not reported in staffed SPECI reports.

QP$_H$P$_H$P$_H$P$_H$

15.12 This group is not reported in staffed SPECI reports.

REw´w´

15.13.2.1 Automatic weather stations cannot report this group.

WS RWYD$_R$D$_R$
or

WS ALL RWY

15.13.3 Automatic weather stations cannot report this group.

RMK

15.13.4 Supplementary remarks may be included in observations from Canadian stations following the identifier group RMK. Remarks will appear in the following order: (layer type and opacity) (general remarks) and SLPppp, where ppp are the last three digits of the sea-level pressure. TORNADO, FUNNEL CLOUD or WATERSPOUT shall be spelled out and entered in the general remarks section whenever observed.

15.14 Trend forecasts shall not be used.

Denmark

a. In case CAVOK and NSC are used, CLD and/or VIS will be included in RMK on military stations.

b. METARs will be disseminated in bulletins with the following headings:

SADN31 EKCH and SADN33 EKCH.

France

As for November 2010, the following differences will exist between current French regulations or practices and the complete set of rules defined in annex 3 and amendment changes, including amendment 78

Definitions

4.6.4.1: Warning for convective activity is not done on automated sites where radar coverage does not allow this function on these sites.

4.6.4.3: In messages which come from fully automated observation systems, there is no information regarding phenomena around airfield except storms (TS).

4.6.8: Messages which come from fully automated observation systems, do not hold information supplemental information.

Appendix 3

2.1.3
METARs are not broadcasted with the BUFR symbols.

2. 2 The CAVOK acronym is used within messages which come from fully automated observation systems.

4.1.3.1 b) Average surface wind observations which are broadcasted in METAR and SPECI do not take possible discontinuities into account.

4.1.5.2 f) Average surface wind observations which are broadcasted in METAR and SPECI do not take possible discontinuities into account.

4.3.1.2 The visibility sensor is set between 120 and 170 m of runway axis.

4.3.5 Intensity of runway lights which is used to compute RVR is the maximal intensity available on the corresponding runway.

4.3.6.5 In METAR, when RVR is measured on both runway ends, the two measurements which are transmitted do not take into account thresholds (?). In this case, a METAR message can contain more than 4 RVR values.

4.4.2.2 Except for storms, distance / proximity of current weather phenomena is not mentioned in messages which come from fully automated observation systems.

4.4.2.3 The following meteorological phenomena are not mentioned in messages which come from fully automated observation systems : SG PL IC GR GS DS SS PO FC SA DU HZ FU VA SQ.

4.4.2.6 MI, BC, PR, DR, et BL are not mentioned in messages which come from fully automated observation systems.

4.4.2.7 Except for VCTS coding, VC is not mentioned in messages which come from fully automated observation systems.

4.5.4.3 c) Vertical visibility is not measured if sensors are not fit for this type of measurement.

4.5.4.3 d) In messages which come from fully automated observation systems, CAVOK is used and NSC, when coded, means that the automated system has not detected significant cloud coverage.

4.5.4.5 b) In messages which come from fully automated observation systems, when cloud type can be observed, then if no cloud is detected, cloud layers are coded as NSC.

4.8. In messages which come from fully automated observation systems, No supplemental information is transmitted.

4.8.1.4 Information on wind shear is not transmitted except when adequate sensors are available.

Appendix 5

2 Weather tendency forecasts are added to messages from fully automated observation systems

Germany

Wind:

In case of variable wind direction, ddd is encoded as VRB when

- the mean wind direction varies more than 90°

and

- the mean wind speed is 3 kt or less.

Runway Visual Range:

(1) The RVR will be reported when

- the airfield is opened for traffic

and

- either the horizontal visibility or the runway visual range of the "runway in use" is observed to be less than 2,000 m.

(2) The RVR will be reported in the form $RD_RD_R/V_RV_RV_RV_Ri$ and will be encoded:

- below 800 m in steps of 50 m
- from 800 m to 5,000 m in steps of 100 m
- from > 5,000 m to 9,000 m in steps of 1,000 m
- ≥ 10,000 m as 9999

(3) Significant variations of RVR ($RD_RD_R/V_RV_RV_RV_RVV_RV_RV_RV_Ri$) will not be reported.

(4) The procedure of reporting extreme RVR values outside the measuring range of the transmissometer ($PV_RV_RV_RV_R$ or $MV_RV_RV_RV_R$) is not used.

Present Weather:

A maximum of two groups w'w' is used to report present weather phenomena.

Cloud Amount and Cloud Height:

The code words SKC and NSC are not used. In case of clear sky no cloud group will be reported.

Vertical Visibility:

(1) The vertical visibility is reported only up to 400 ft.

(2) The report VV/// is not used.

The code word CAVOK is not used.

Supplementary Information:

(1) Recent Weather phenomena of operational significance (REw'w') are reported using only one group. The following sequence sorted to the ranking is used:

- REFC
- RETS
- REFZRA
- REFZDZ
- REPL
- REGR
- REGS
- RESN
- REBLSN
- RESS
- REDS
- RERA
- REDZ

(2) Wind shear in the lower layers is not reported.

Trend Forecast:

(1) Trend forecasts according to FM 15 are not used.

(2) All stations report an actual Colour State (Annex D) and a Colour State Forecast. When the forecaster leaves the office, the Colour State Forecast is replaced by "FCST CANCEL".

Netherlands

Civil stations: FM 15-XIV AUTO METAR and FM 15-XIV METAR
Military stations: FM 15-XIV AUTO METAR and FM 16-XIV AUTO SPECI

a. Both CIVIL and MILITARY stations

(1) With reference to fully automatically produced observations: if any element cannot be observed, the group in which it would have been encoded shall be replaced by the appropriate number of solidi, in accordance with the table below.

Encoding of missing values in reports of AUTO METAR and AUTO SPECI – as of

18Nov2010		
Code group	Reporting practice	Total number of solidi - remarks
Wind	///12KT	3 – wind direction information not available
	230//KT	2 – wind speed information not available
	/////KT	5 – wind speed and wind direction not available
Visibility	////	4 – visibility information not available
RVR	R////////	8 – RVR information not available; 1 group R//////// will replace all possible RVR groups
	R13/////	5 – RVR information not available for given touchdown zone; to be used when at least 1 other RVR value is available (in such case, R//////// cannot be used)
Present weather	//	2 – no PW sensor available or sensor defect; 1 group // will replace all possible present weather groups
Recent weather	RE//	2 – information on recent weather phenomena not available; 1 group RE// will replace all possible recent weather groups
Clouds	/////////	9 – no information on cloud amount, height and type; 1 group ///////// will replace all possible cloud groups
	BKN020///	3 – cloud type not available for given layer
*)	////// (//////CB)	6 – cloud amount and height not available; system is capable of detecting cloud type; 1 group ////// will replace all possible cloud groups
	BKN//////	6 – cloud height and type not available for given amount
	BKN/// (BKN///CB)	3 – cloud height not available; system is capable of detecting cloud type for the given cloud amount
	///020///	6 – cloud amount and type not available for given cloud height
	///020 (///020CB)	3 – cloud amount not available; system is capable of detecting cloud type for the given cloud height
	NCD	no clouds detected
**)	NSC	detected clouds are not operationally significant; system is capable of detecting cloud type
Air temperature and dewpunt temperature	/////	5 – air temperature and dewpoint temperature not available; replaced by **4** ////
	14///	3 – dewpoint temperature not available; replaced by **2** //
	///12	3 – air temperature not available; replaced by **2** //
Atmospheric pressure	Q////	4 – QNH information not available
Water	W/////	5 – water temperature not available; replaced by

temperature and sea state (North Sea platforms)		**2** // and sea state not available; replaced by **2** //
	W///S3	3 – water temperature not available; replaced by **2** //
	W17///	3 – sea state not available; replaced by **2** //

*) If the system is capable of detecting cloud type, but not to associate this type to a given cloud layer, two cases are possible:
1. If the system has not detected CB or TCU, cloud type is nevertheless considered as available for all cloud layers (the group of 3 /// is not added, as information about the absence of CB and TCU is available);
2. If the system has detected CB or TCU, an additional cloud group (//////CB or //////TCU) is included.

**) The abbreviation NSC shall not be used by the ROYAL AIR FORCE and the ROYAL NAVY.

(2) In fully automatically generated reports, qualifier FZ shall only be used to report freezing fog (FZFG) in a situation with subzero temperatures (< 0° C) and a horizontal visibility of < 1000 meters, whether rime ice is deposited or not. Fog types PRFG, BCFG, MIFG and VCFG cannot be detected by the system.

(3) In case of fog, the maximum reported value for hshshs shall be 500 ft. In case of precipitation, the maximum reported value for hshshs shall be 1000 ft.

(4) In fully automatically generated reports, the code word CAVOK shall not be used.

b. <u>CIVIL stations only:</u>
Note: Fully automated observation station **Vlissingen** (EHFS) is not an aeronautical station. It produces AUTO METAR's only (and no TREND).

(1) In METAR (manned situation) the visible deposition of rime ice is used as an extra criterion. In a situation with subzero temperatures (< 0° C), observed rime ice and the fog types FG, PRFG and BCFG, qualifier FZ shall be used to report FZFG. Shallow fog and any fog in the vicinity of the aerodrome shall always be reported as MIFG and VCFG respectively, whether rime ice is deposited or not.

(2) Trend forecasts:
1. Visibility: an extra criterion of 8 km for the horizontal visibility shall be used.
2. Wind: a deviated criterion for the mean surface wind is:
If the mean surface wind direction has changed by 30° or more and the mean speed before and/or after the change is 10 kts or more.

c. <u>Stations of the ROYAL AIR FORCE and the ROYAL NAVY only</u>
<u>Remark: The observations of all military stations are produced fully automatically.</u>

(1) During periods when either the horizontal visibility is observed to be less than 3700 metres or the runway visual range is less than 3000 metres, the group RDRDR/VRVRVRVRi shall be included in the report.
(2) When the RVR is assessed to be more than 3000 metres, it shall be reported as P3000.
(3) IC shall be reported when visibility is less than 10 km.
(4) HZ shall be reported when visibility is less than 10 km.
(5) BR shall be reported when visibility is less than 10 km but 1000 metres or more.
(6) The abbreviation NSC shall not be used. As appropriate, clouds present at and above 5000 ft, also shall be reported.
(7) The wind shear groups WS RDRDR and WS ALL RWY shall not be used.
(8) The state of the runway group RDRDR/ERCReReRBRBR shall not be used.
(9) Trend forecasts:
- The stations of the Royal Air Force and the Royal Navy shall use the 2-ATAF weather colour code, together with the change groups without a time group.
- Also, a CIVIL TREND forecast shall be added to the report, directly after the 2-ATAF weather colour code.

2-ATAF WEATHER COLOUR CODE		
Colour code	Visibility	Cloud base
Blue BLU	8 km or more	2500 ft or more
White WHT	5 km - 8 km	1500 ft - 2500 ft
Green GRN	3.7 km - 5 km	700 ft - 1500 ft
Yellow YLO	1.6 km - 3.7 km	300 ft - 700 ft
Amber AMB	0.8 km - 1.6 km	200 ft - 300 ft
Red RED	Less than 0.8 km	Less than 200 ft
BLACK	Aerodrome not in use due to other reasons than visibility and cloud base	

Slovenia

Wind:
The unit for wind speed is knot (kt).

Runway Visual Range:
The RVR is not reported from station:

14122 LJCE

Weather:
(1) HZ is reported at relative humidity values below 70%.
(2) VC is defined at distance between 2 and 8 km from airport reference point (ARP) or between 2 and 16 km from airport reference point (ARP) in case of TS, SH or FC.

From beginning of November till end of March supplementary information regarding runway state in the form of SNOWTAM is added to reports from inland stations:

14014 LJLJ
14026 LJMB
14122 LJCE

TREND forecasts are only added to reports from station:

14014 LJLJ

AUTO METER is reported outside operational hours from stations:

14026 LJMB
14105 LJPZ
14122 LJCE

United Kingdom

a. The unit to be used for wind speed is knots.

b. The following variants apply:

(1) Military Aerodromes

- Variations in wind direction of 60° or more are not reported.
- Directional variation in horizontal visibility is not reported. The direction of the minimum visibility will not be reported.
- Runway Visual Range (RVR) is not reported.
- Supplementary information regarding wind shear is not given.
- Present weather codes for smoke (FU), haze (HZ), ice crystals (IC), widespread dust (DU) and sand (SA) may only be used when the visibility is reduced by the reported phenomena to less than 10 km. Similarly, mist (BR) may be used subject to a minimum visibility of 1,000 m.
- A maximum of two weather groups may be used to report present weather.

- Vertical visibility is not reported.

(2) Civil Aerodromes

- When snow or other runway contaminant is present, supplementary information will be given in the form of an 8 figure runway state group added to the end of the report.
- Colour states are not added to reports.

Annex B

Appendix B.2

TAF (FM 51 Ext. TAF) including National Exceptions

1. General TAF is the acronym of the code for a Terminal Aerodrome Forecast.

2. Form of Code The code form described in References E-G shall be used in its latest version.

3. National Exceptions

Belgium

a. In principle, the time of validity is 9 hours (0716 - 1019 - 1322) or 12 hours (1907).

b. The unit for wind speed is knots (kt).

c. The groups (TXT_FT_F/G_FG_FZ TNT_FT_F/G_FG_FZ) are not used.

d. At the end of the TAF, "by EBWM" means that the forecast is issued by the Meteorological Wing Beauvechain.

Canada

$dddffGf_mf_m$

51.3.1 Wind speeds are always forecast in knots (KT)

51.3.3 ddd is also encoded as VRB for wind speed greater than 3 knots when associated with TS.

$WSh_xh_xh_x/dddffKT$

New group The strong non-convective low-level wind shear group shall be included in all TAFs whenever this phenomenon is expected to be significant enough to affect adversely aircraft operation within 1 500 feet above ground level. The wind shear group, when included, will be placed after the wind group followed by one space. The wind shear group is decoded according to the following:

WS: is the wind shear term

$h_xh_xh_x$: is the height (above ground) of the top of the layer in which strong low-level wind shear is forecast

ddd: is the wind direction at level $h_xh_xh_x$

ff**KT**: is the wind speed in knots (kt) at level $h_xh_xh_x$. When the wind speed (ff) is expected to be 100 knots or greater, a three-digit figure (fff) shall be used.

VVVV

51.4.1 Prevailing visibility, rather than minimum visibility, is forecast.

Visibility is forecast in statute miles and fractions up to three miles, then in whole miles up to six miles. Visibilities greater than six miles are forecast as P6SM. The letters SM (statute miles) are appended, without a space, to each forecast visibility to identify the units.

w´w´

51.5 When a significant change in visibility is forecast, not only the weather phenomenon responsible for the change shall be indicated, but the entire w´w´ group shall be stated.

51.5.1 Volcanic ash (VA), when expected, is always forecast regardless of visibility.
Smoke (FU), ice crystals (IC), haze (HZ), dust (DU), and sand (SA) are forecast when they are expected to reduce the visibility to six statute miles or less.
Mist (BR) is forecast when it is expected to reduce the visibility between 5/8 mile and six miles inclusive. Fog (FG) is forecast when the visibility is expected to be less than 5/8 mile.

$N_sN_sN_sh_sh_sh_s$

51.6.1 Forecast cloud amounts are cumulative and are forecast for all layers up to and including the first overcast layer, if any.

51.6.1.6 TCU is not forecast

SKC

The abbreviation SKC is used to forecast the absence of cloud or vertical obscuration at the beginning of any self-contained part period. It may also replace the cloud or vertical visibility group after a change of the form TEMPO/BECMG GGG_cG_c,.

NSC

51.6.3 NSC (“No Significant Cloud”) is not used as there is no upper limit to the forecast cloud layers. The abbreviation SKC is used to indicate the absence of cloud.

CAVOK

51.7 CAVOK is not used.

TXT_FT_F/$Y_FY_FG_FG_F$**Z** **TN**T_FT_F/$Y_FY_FG_FG_F$**Z**

51.10 Forecast maximum and minimum temperature are not included.

RMK

Addition

Remarks will always be included at the end of every TAF. These will indicate the time the next forecast will be issued (NXT FCST BY XXZ) or that the forecast is based on the automatic weather observing system (FCST BASED ON AUTO OBS).

Denmark

a. CAVOK and NSC will not be used on military stations.

b. TAFs will be disseminated in bulletins with the following headings:

FTDN31 EKCH and FCDN33 EKCH.

France

As for November 2010, the following differences will exist between current French regulations or practices and the complete set of rules defined in annex 3 and amendment changes, including amendment 78.

Appendix 5

1.1.2

TAF messages are not transmitted with the BUFR symbolic form.

Germany

a. In the group $Y_1Y_1G_1G_1G_2G_2$ the Y1Y1 is not used.

b. Generally, the time of validity is 9 hours.

c. The abbreviation NSC is not used.

d. The code word CAVOK is not used.

e. A change group will always contain all elements.

f. Group PROBC_2C_2:

(1) Only PROB30 is used.

(2) A combination with other change groups is not allowed.

Netherlands

TAF format

From opening until closing of a military aerodrome in the Netherlands, a TAF shall be available. All TAF for military aerodrome are produced by the Royal Netherlands Air Force Joint Meteorological Group. The TAF shall consist of a concise statement of the forecasted meteorological conditions and the forecasted significant changes in the meteorological conditions at that aerodrome. If not cancelled, the TAF shall be monitored at all times and be amended if necessary. The template used for the TAF shall be in accordance to the latest version of Annex 3 to the Convention on International Civil Aviation; Meteorological Service for International Air Navigation. Deviations to this standard for military aerodromes in the Netherlands and agreed upon between meteorological authority and the operators concerned are stated below.

In contrast to Appendix 5, Table A5-1. Template to TAF: TAF CNL shall not be issued in the format as shown in Table A5-1. Military TAF shall be cancelled if not kept or cannot be kept under continuous review by including “CNL DDGGggZ” at the end of the TAF. The term “DDGGggZ” is the date and time (UTC) from which the TAF is cancelled and amendment service stops.

Inclusion of meteorological elements in Terminal Aerodrome Forecast

(1) Temperature
In contrast to Appendix 5, 1.2.5:
The groups (TXTFTF/YFYFGFGFZ TNTFTF/YFYFGFGFZ) shall not be used.

Use of a change group

(1) Surface wind
In contrast to Appendix 5, 1.3.2 a):
The TAF shall indicate changes in the surface wind when the mean surface wind direction is forecast to change by 30º or more, the mean speed before and/or after the change being 5 m/s (10 kt) or more.

(2) Clouds
In contrast to Appendix 5, 1.3.2 g):
When the height of the base of a cloud layer of SCT, BKN or OVC extent is forecast to lift and change to, or pass through, one or more of the following values, or when the height of the base of a cloud layer of SCT, BKN or OVC extent is forecast to lower and pass through one or more of the following values:

100, 200, 500, 1 000, 1 500 or 2 000 ft.

In contrast to Appendix 5, 1.3.2 f):
When the amount of a layer or mass of cloud below 2 000 ft is forecast to change:
- from FEW to SCT, BKN or OVC; or
- from SCT, BKN or OVC to FEW.

(3) Vertical visibility
In contrast to Appendix 5, 1.3.2 i):
When the vertical visibility is forecast to improve and change to, or pass through, one or more of the following values, or when the vertical visibility is forecast to deteriorate and pass through one or more of the following values: 100, 200, 500 or 1 000 ft.

NOTE: *Vertical visibility shall only be included if no cloud layer can be forecast due to fog with a vertical visibility ≤ 500 ft, or heavy precipitation with a vertical visibility ≤ 1 000 ft.*

Slovenia

a. Wind:
The unit for wind speed is knot (kt).

b. Validity:
(1) Validity time is 24 hours for stations:
14014 LJLJ
14026 LJMB
(2) Validity time is 9 hours for stations:
14105 LJPZ
14122 LJCE

c. The groups (TXT_FT_F/G_FG_FZ TNT_FT_F/G_FG_FZ) are not used.

United Kingdom

a. The unit to be used for wind speed is knots (kt).

b. The groups (TXT_FT_F/G_FG_FZ TNT_FT_F/G_FG_FZ) are not generally used in aerodrome forecasts originating from meteorological offices in the United Kingdom.

c. Change groups are to be used only when the following criteria apply:

(1) Surface Wind:

- Military Aerodromes.

-- Mean Wind Direction: A change of 30° or more, the mean wind speed before and/or after the change being 15 kt or more.

-- Mean Wind Speed: A change of 10 kt or more, the mean wind speed before and/or after the change being 15 kt or more.

-- Maximum Wind Speed: An increase of 10 kt or more in maximum wind speed, the mean speed before and/or after the change being 15 kt or more.

- Civil Aerodromes.

-- Mean Wind Direction: A change of 30° or more, the mean wind speed before and/or after the change being 20 kt or more.

Also, a change in mean direction of 60° or more, the mean wind speed before and/or after the change being 10 kt or more.

-- Mean Wind Speed: A change in mean wind speed of 10 kt or more.

-- Maximum Wind Speed: An increase of 10 kt or more in maximum wind speed, the mean speed before and/or after the change being 15 kt or more.

(2) Visibility:

- Military Aerodromes. When visibility is expected to change from one to any other of the following ranges:

-- 5,000 m or more

-- 4,900 m or less but more than 3,600 m

-- 3,600 m or less but more than 1,500 m

-- 1,500 m or less but more than 700 m

-- 700 m or less.

- Civil Aerodromes. When visibility is expected to change from one to any other of the following ranges:

-- 10 km or more

-- Less than 10 km but more than 5,000 m

-- 5,000 m or less but more than 1,500 m

-- 1,500 m or less but more than 800 m

-- 800 m or less but more than 350 m

-- 350 m or less.

(3) Weather:

- When the onset or cessation of any of the following phenomena is expected:

  Thunderstorm — Funnel Cloud

  Hail — Freezing Precipitation

  Freezing Fog — Drifting Snow

  Moderate or Heavy Snow or Snow and Rain (including Showers)

  Heavy Rain (including Showers) and additionally at civil aerodromes:

  Moderate Rain/Showers — Dust/Sandstorm

  CAVOK conditions

  Low Drifting or Blowing Sand or Dust

  Other phenomena if associated with a change in visibility.

- In forecasts for military aerodromes, following any change groups relating to cloud and/or visibility, the relevant forecast weather should be included irrespective of the intensity of the phenomena.

(4) Cloud:

- Military Aerodromes. When the sky is expected to be obscured, vertical visibility will not be forecast and $VVh_sh_sh_s$ shall be coded as VV///.

  -- When the height of the lowest layer of 3 oktas or more (SCT, BKN or OVC) decreases to a value less than or increases to a value equal to or greater than:

  1,500 ft, 700 ft, 300 ft, 200 ft, or sky obscured.

  -- When the amount of cloud associated with the limits above changes from 3 oktas or more, or vice versa.

- Civil Aerodromes.

  -- When the height of the base of the lowest cloud covering more than half the sky (BKN or OVC) changes to or through:

  5,000 ft, 1,500 ft, 1,000 ft, 500 ft, and 200 ft.

  -- When the amount of cloud at or below 1,500 ft changes from half the sky covered or less (nil, FEW or SCT) to more than half covered (BKN or OVC) or vice versa.

-- When Cumulonimbus (CB) is expected to develop or dissipate.

Annex B

Appendix B.3

Airfield Weather Colour Code including National Exceptions

1. General Being an easy reference for operational planners, controllers, and pilots, the Airfield Colour Code is used by many NATO nations as a simple method of transmitting and displaying actual and forecast weather which influences landing capability at an air base.

Figure 1 gives details of the Colour Code to be used primarily in ACE, with different national exceptions.

The observed weather conditions define an airbase's current colour state. The colour state in force is that which indicates the worst/lowest conditions of either of the two relevant factors ceiling or visibility; e.g. ceiling 2,500 ft and surface horizontal visibility 0.5 km is colour state Red (RED). The forecast colour state extends for a two-hour period.

2. Cautions

   a. Actual and forecast weather should be passed to aircraft in plain language in accordance with normal ATC procedures. Colour codes should never be used for this purpose.

   b. Colour codes do not automatically determine whether or not landings are permitted.

3. Definitions

   a. Complying with ICAO, ceiling is generally defined by lowest cloud base OVC or BKN, i.e. $\geq$ 5/8 cloud coverage.

   b. The horizontal visibility used for determining a colour state is independent of the RVR.

4. National Exceptions

   [NOTE: Items a. through e. below refer to annotations in Figure 1.]

   a. For Belgium, France, the Netherlands, and the United Kingdom, ceiling is replaced by lowest cloud base OVC, BKN, or SCT.

   b. If visibility is greater than 8 km, an additional category called Blue Plus (BLU+) is used:

      - by Germany if ceiling is not below 20,000 ft,

      - by France if SKC or FEW.

   c. At United Kingdom military aerodromes, the colour state Yellow is split as follows:

- Yellow 1: visibility 2.5 km (1.4 nm), base of lowest cloud 500 ft agl,
- Yellow 2: visibility 1.6 km (0.9 nm), base of lowest cloud 300 ft agl.

d. For France, colour state RED will also be reported if ceiling or visibility is observed/forecast to be below the published minimum for the airbase's precision approach system, or if this system is out of order.

e. France replaces BLACK by suffix TECHNIQUE appended to the weather related colour state. Belgium, the Netherlands, and Germany append the weather related colour state to BLACK.

f. France, Slovenia and the United States will not append a 2 hour colour state forecast to the observation, but will append an observed colour state.

g. Denmark, Turkey, and Norway do not use colour states.

h. For Slovenia, Airfield Weather Colour Codes are only added as RMK to reports from station: 14122 LJCE. However, colour states are not added to reports from the station outside operational hours when AUTO METAR is reported.

Airfield Weather Colour Codes

Colour State	Abbre-viation	Ceiling (ft)(1) Equal to or Higher than	Surface Visibility (km) Equal to or More than
Blue(2)	BLU(2)	2,500	8
White	WHT	1,500	5
Green	GRN	700	3.7
Yellow(3)	YLO(3)	300	1.6
Amber	AMB	200	0.8
Red(4)	RED(4)	Less than Amber	
Black(5)	BLACK(5)	Airfield not useable for other reasons than cloud and/or visibility	

Figure 1

Annex B

Appendix B.4

MAVOC - Military Aircraft Voice Weather Code

1. General Instructions

   a. This is a Standard NATO Meteorological Code for voice transmission of meteorological reports from aircraft.

   b. All items are reported in the recorded sequence. Items 1-13 are mandatory. Items 14-18 are optional. Items that are unobservable, doubtful or otherwise inapplicable, are not recorded or transmitted but omitted completely from the message. In addition to the basic data, only those words contained in column "VOICE" should be transmitted. For example, a report in Item 8 would be read "on top" and not "Flight conditions - on top". Items are transmitted at each operational position report. Special reports should be rendered whenever moderate or severe icing or severe turbulence is encountered or whenever meteorological conditions are encountered, which may affect the safety of the flight or upon request.

2. Specific Instructions

   ITEM 1 ADDRESSEE. Record station called and when necessary relay required.

   ITEM 2 AIRCRAFT IDENTIFICATION. Record radio call sign for aircraft.

   ITEM 3 CODE INDENTIFICATION. Record "MAVOC" at each position report.

   ITEM 4 POSITION. Record position in latitude and longitude in degrees and minutes or over/abeam (ABM) a reporting point identified by name or in relation to a significant geographical feature. When the position is established by dead reckoning add "DR" to the position recorded.

   ITEM 5 TIME. In hours UTC and minutes.

   ITEM 6 FLIGHT LEVEL (FL) OR ALTITUDE (ALT). Record flight level in hundreds of feet when on standard pressure altimeter settings. Record altitude in hundreds of feet when on QNH. Record "climbing to (ASC)" or "descending to (DES)" when climbing or descending to a new level after passing the reporting point.

ITEM 7 AIR TEMPERATURE. Record temperature in whole degrees Celsius, plus (PS) or minus (MS), corrected for instrument error and airspeed.

ITEM 8 FLIGHT CONDITIONS. Describe general flight conditions recording as "sky clear (SKC)" (meaning no cloud at any level)
or "below clouds (BLO)"
or "on top (OTP)"
or "between layers (BTL)"
or "in and out of clouds (IAO)"
or "in clouds (INC)" (meaning continuously in clouds)
or "below haze (BLO HZ)"
or "above haze (OTP HZ)"
as appropriate.

ITEM 9 PRESENT WEATHER. Describe all weather elements encountered within the last ten minutes if one or more of the following:

Smoke / Haze / Volcanic Ashes (FU / HZ / VA)
Sandstorm / Dust Storm / Blowing Snow (SS / DS / BLSN)
Drizzle (DZ)
Rain (RA)
Snow (SN)
Showers (Rain/Snow) (RA/SNSH)
Hail (GR)
Thunderstorm (TS)

When none of the above is encountered, omit present weather.

ITEM 10 HORIZONTAL VISIBILITY. Record visibility in nautical miles (nm). If below 1 nm, report in fractions of a nautical mile; if above 1 nm, report in whole nautical miles.

ITEM 11 AIRCRAFT ICING (ICE). Record aircraft icing encountered in last ten minutes as Light (LGT), Moderate (MOD), or Severe (SEV).

ITEM 12 TURBULENCE (TURB). Record turbulence encountered in last ten minutes as Light (LGT), Moderate (MOD), or Severe (SEV).

ITEM 13 SPOT WIND or MEAN WIND AND ITS POSITION, or EQUIVALENT TAILWIND. Record (a) spot wind (direction in whole degrees true north and speed in knots) and position (latitude and longitude to nearest whole degree, place, or time) at which it was determined; or (b) mean wind between fixes when sufficiently reliable for operational

use and the position of the mid-point of the sector over which it was calculated; or (c) if unable to determine a reliable spot or mean wind, the equivalent tailwind between fixed reporting points as gain (PS) or loss (MS) of ground speed in knots.

ITEM 14 RADAR DATA.

a. Reported character of radar echo.

Character of Radar Echo

Isolated uniform echo
Isolated irregular echo
Area more than half covered with echoes
Area about half covered with echoes
Area less than half covered with echoes
Area with scattered echoes
Line-shaped echoes
Echoes arranged along a line
Parallel line-shaped echoes
Doubtful echo(es) of uncertain meteorological origin

b. Report orientation of line by compass point of ends of the line.

NNE - SSW
NE - SW
ENE - WSW
E - W
ESE - WNW
SE - NW
SSE - NNW
S - N

c. Report bearing of radar echo centre with respect to the 8 points of the compass
(WMO Code Table 0700).

NE
E
SE
S
SW
W
NW
N

d. Report distance of radar echo centre in nautical miles.

ITEM 15 D-VALUES AND ALTIMETER SETTINGS

D-VALUES: Subtract readings of pressure altimeter set to 29.92 inches Hg or 1013.2 hPa (corrected for calibration and position error) from radio altimeter reading. Record difference plus (PS) or minus (MS) in feet. Omit when aircraft is between 15° N and 15° S or over land.
Altimeter Settings: Report altimeter settings in inches or hectopascals (corrected for instrumental error) determined when aircraft is flying close to sea level.

ITEM 16 CONTRAILS. Report contrails observed as persistent, non-persistent or unknown.

ITEM 17 CLOUD. Describe first as few, scattered, broken or overcast; then as stratiform, cumuliform, towering cumulus or cumulonimbus. Give altitude of base(s) and/or top(s) in feet MSL (to the nearest hundred when estimate is believed sufficiently accurate). Identify the altitude given by "base" or "top". Repeat for additional cloud layers.

ITEM 18 SURFACE CONDITIONS. Report direction of surface wind with respect to the 8 points of the compass (WMO Code Table 0700). Report speed of surface wind in Beaufort Force. If calm, report "calm" instead of direction and speed. If surface wind unobservable, omit.

Report Sea State as (WMO Code Table 3700):

	State of Sea (Descriptive Terms)	Height[1] in Meters
(GLS)	Calm (Glassy)	0
(RPL)	Calm (Rippled)	0 - 0.1
(WVL)	Smooth (Wavelets)	0.1 - 0.5
(SLT)	Slight	0.5 - 1.25
(MOD)	Moderate	1.25 - 2.5
(RUF)	Rough	2.5 - 4
(VRUF)	Very Rough	4 - 6
(HI)	High	6 - 9
(VHI)	Very High	9 - 14
(PNL)	Phenomenal	over 14

Note 1: The average wave height is obtained from the larger well-formed waves of the wave system being observed.

Report direction of swell with respect to the 8 points of the compass: NE, E, SE, S, SW, W, NW, N, or as "CALM" or "CONFUSED".

Report in plain language, position, and extent of any sea ice or icebergs observed.

	Record	Voice			Items	Rec Example	Voice Example
1	Station called (and relay required, if necessary)	-	Mandatory Items	1	Addressee		
2	Identification	-		2	Aircraft Ident	NATO FLT 260	NATO Flight Two Six Zero
3	MAVOC	MAVOC		3	Code Ident	MAVOC	MAVOC
4	(Latitude/Longitude) (in Degrees and Minutes) (Place) ABM (Place) DR	Position ..... Over ..... Abeam ..... Dead Reckoning ..		4	Position	3825N 1830 W	Position Three Eight Two Five North, One Eight Three Zero West
5	(Time) (in Hours UTC and Minutes)	At		5	Time	2215	At Two Two One Five
6	FL (Number) ALT (in Hundreds of Feet) ASC (FL Number or ALT) DES (FL Number or ALT)	Flight Level ..... Altitude ..... Climbing to ..... Descending to		6	Flight Level or Altitude	ALT 110	Altitude One One Thousand
7	PS (Degrees Celsius) MS (Degrees Celsius)	Plus Minus		7	Air Temperature	PS 4	Plus Four
8	SKC BLO OTP BTL IAO INC BLO HZ OTP HZ	Sky Clear Below Clouds On Top Between Layers In and Out of Clouds In Clouds Below Haze Above Haze		8	Flight Conditions	BTL	Between Layers

Military Aircraft Voice Weather Code

	Record	Voice			Items	Rec Example	Voice Example
9	FU / HZ / VA SS / DS / BLSN FG SFC DZ RA SN SHRA / SHSN GR TS	Smoke / Haze / Volcanic Ashes Sandstorm / Dust Storm / Blowing Snow Fog at Surface Drizzle Rain Snow Rain / Snow Showers Hail Thunderstorms	**Mandatory Items**	9	Present Weather	RA	Rain
10	(Distance) (in Nautical Miles)			10	Horizontal Visibility	3	Three
11	ICE LGT ICE MOD ICE SEV	Icing Light Icing Moderate Icing Severe		11	Icing	ICE LGT	Icing Light
12	TURB LGT TURB MOD TURB SEV	Turbulence Light Turbulence Moderate Turbulence Severe		12	Turbulence	TURB LGT	Turbulence Light

13	(Direction/Speed) (in Whole Degrees True North / in Knots) (Latitude/Longitude or Place or Time) PS (Knots) MS (Knots)	…… At ....…..... Plus ..... Minus .....

13	Spot or Mean Wind and Position or Equivalent Tailwind	240/15 38N 20W	Two Four Five at One Five Three Eight North Two Zero West

	Record	Voice			Items	Rec Example	Voice Example
14	SCT (Direction) SLD (Direction/Distance) SCT LN (Orientation/ Direction/Distance) SLD LN (Orientation / Direction/Distance) SCT ALL QUADS SLD ALL QUADS	Scattered through ... Solid ... at ..... Scattered Line ... To ..... Solid Line at ..... Scattered all Quadrants Solid all Quadrants	Optional Items	14	Character of Radar Echo Orientation Bearing and Distance	SCT LN NNW – SSE E 20	Scattered Line North Northwest to South Southeast East at Two Zero
15	PS or MS (Difference in Feet) or MSL Pressure (in Hecto-pascals or Inches)	Plus .....Minus ..... or ... hPa..... or .... inches		15	D-Value or Altimeter Setting	3016	Three Zero One Six Inches
16	PST or NPST or UNK	Persistent or Non-Persistent or Unknown		16	Contrails	PST	Persistent

17	FEW SCT BKN OVC CNS STF CUF TCU CB Base (Height in Feet) Top (Height in Feet)	Few Scattered Broken Overcast Continuous Stratiform Cumuliform Towering Cumulus Cumulonimbus Base..... Top .....

17	Clouds	SCT CUF	80 20	Scattered Cumuliform Base Two Thousand Top Eight Thousand
		OVC STF	120	Overcast Stratiform Base One Two Thousand

	Record	Voice			Items	Rec Example	Voice Example
18	GLS RPL WVL SLT MOD RUF VRUF HI VHI PNL (Direction of Swell) (Sea Ice)	Glassy Rippled Wavelets Slight Moderate Rough Very Rough High Very High Phenomenal ..... Concentration …Edge of Ice …Icebergs	Optional Items	18	State of Sea Direction of Swell Concentration & Edge of Sea Ice Icebergs	MOD NW 8/10 SEA ICE WITHIN 5 NM OF COAST	Moderate Northwest Eight Tenths within Five Nautical Miles of Coast

Annex B

Appendix B.5

MAWEC - Maritime Aircraft Weather Code

1. General This is a Standard NATO Meteorological Code for the transmission of meteorological reports for maritime patrol aircraft.

2. Mandatory Groups

MAWEC YYGGgg $Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$ $h_ah_ah_aTT$
$f_cw_mVI_mB_m$ ddfff

3. Optional Groups

$7C_eh_bh_bh_b$ $8C_eh_th_th_t$ $9DFSD_K$ $Oi_mP_oP_oP_o$

4. Specific Instructions

Code Figures		Code Table
MAWEC	Code Identifier	
YY	Day of the month	Note 2
GGgg	Time of observation in hours and minutes UTC	
Q_c	Quadrant of the globe	Note 3
$L_aL_aL_aL_a$	Latitude in degrees and minutes	
$L_oL_oL_oL_oL_o$	Longitude in degrees and minutes	
h_a h_a h_a	True altitude of aircraft in hundreds of feet	
TT	Corrected air temperature in whole degrees Celsius	Note 4
f_c	Flight conditions	Note 5
w_m	Present weather	Note 6
V	Horizontal visibility in yards (yd) and nautical miles (nm) or meters (m) and kilometers (km) respectively	Note 7
I_m	Aircraft icing	Note 8
B_m	Turbulence	Note 8
dd	True direction of wind in tens of degrees at	

	altitude h_a h_a h_a	
fff	Wind speed in knots (kt) at the altitude h_a h_a h_a	
7	Group indicator	Note 9
C_e	Character of cloud	Note 10
$h_bh_bh_b$	Altitude of base of cloud in hundreds of feet	
8	Group indicator	Note 9
C_e	Character of cloud	Note 10
$h_th_th_t$	Altitude of top cloud in hundreds of feet	
9	Group indicator	Note 11
D	Direction of surface wind	Note 12
F	Force of the surface wind (Beaufort Scale)	Note 13
S	State of the sea	Note 14
D_k	Direction of the swell	Note 12
0	Group indicator	Note 15
i_m	Method by which sea level pressure P_o P_o P_o	
	is reported	Note 16
P_o P_o P_o	Sea level pressure in hectopascals	

Note 1 Missing Data: Missing data shall be indicated by solidus (/).

Note 2 YY Day of the month (UTC): The first day of the month is coded as 01, the second as 02, etc.

Note 3 Q_C Quadrant of the globe (WMO Code Table 3333)

Code Figure	Latitude	Longitude
1	North	East
3	South	East
5	South	West
7	North	West

Note 4 TT Corrected Air Temperature in Whole Degrees Celsius: Temperature below 0°C are coded by adding 50 to numerical value, the hundreds figure, if any, being omitted: e.g. –6 °C is coded as 56, -12 °C as 62. If the air temperature is not measured, TT should be coded by solidi (//).

Note 5 f_c Flight Conditions

Code Figure

0	Sky clear
1	Below cloud
2	On top
3	Between layers
4	In and out of cloud
5	In cloud

Note 6 w_m Present Weather

Code Figure

0	No significant weather
1	Smoke, haze, or volcanic ash
2	Hail or shower with hail
3	Sandstorm, dust storm, or Blowing snow
4	Fog
5	Drizzle
6	Rain
7	Snow or rain and snow mixed
8	Shower
9	Thunderstorm

Note 7 V Horizontal Visibility

Code Figure	(WMO Code Table 4300 Equivalent)		(WMO Code Table 4300)
0	Less than 50 yd	or	Less than 50 m
1	50 to 200 yd	or	50 to 200 m
2	200 to 500 yd	or	200 to 500 m
3	500 to 1000 yd	or	500 to 1,000 m
4	1,000 yd to 1 nm	or	1 to 2 km
5	1 to 2 nm	or	2 to 4 km
6	2 to 5 nm	or	4 to 10 km
7	5 to 10 nm	or	10 to 20 km
8	10 to 25 nm	or	20 to 50 km
9	Over 25 nm	or	50 km or more

Note 8 I_m Aircraft Icing (Code as for turbulence)

B_m Turbulence

Code Figure

0	Nil
1	Light
2	Moderate
3	Severe

Note 9 7/8 Group Indicators: Groups $7C_eh_bh_bh_b$ and $8C_eh_th_th_t$ refer to clouds reported under f_c. These groups may be repeated to report more than one cloud layer. When $h_bh_bh_b$ or $h_th_th_t$ cannot be determined, forms $7c_e///$, $8C_e///$ will be used.

Note 10 C_e Character of Cloud

Code Figure

1	Mainly stratiform: scattered
2	Mainly stratiform: broken
3	Mainly stratiform: overcast
4	Mainly cumuliform: scattered
5	Mainly cumuliform: broken
6	Mainly cumuliform: overcast
7	Towering Cu and Cb: scattered
8	Towering Cu and Cb: broken
9	Towering Cu and Cb: overcast

Scattered applies when clear areas predominate.

Broken applies when cloud masses predominate.

Note 11 9 Group Indicator: When the direction and strength of the surface wind cannot be reasonably estimated, D is coded as 9, F as a solidus (/).

Note 12 D Direction of Surface Wind (Code as for Direction of Swell)

D_k Direction of Swell

(WMO Code Table 0700)

Code Figure		Code Figure	
0	Calm	5	SW
1	NE	6	W
2	E	7	NW
3	SE	8	N
4	S	9	Confused (swell); Variable (wind)

Note 13 F Force of Surface Wind (Beaufort Scale)

Code Figure		Code Figure	
0	Calm	5	17 to 21 kt
1	1 to 3 kt	6	22 to 27 kt
2	4 to 6 kt	7	28 to 33 kt
3	7 to 10 kt	8	34 to 40 kt
4	11 to 16 kt	9	41 kt or over

Note 14 S State of the Sea

Code Figure		Height (WMO Code Table 3700)	
0	Calm (glassy)	0 ft	0 m
1	Calm (rippled)	0 - 1/4 ft	0 - 0.1 m
2	Smooth (wavelets)	1/4 - 2 ft	0.1 - 0.5 m
3	Slight	2 - 4 ft	0.5 - 1.25 m
4	Moderate	4 - 8 ft	1.25 - 2.5 m
5	Rough	8 - 13 ft	2.5 - 4 m
6	Very Rough	13 - 20 ft	4 - 6 m
7	High	20 - 30 ft	6 - 9 m
8	Very High	30 - 45 ft	9 – 14 m
9	Phenomenal	Over 45 ft	Over 14 m

Note 15 O Group Indicator: $P_oP_oP_o$ sea level pressure should normally only be reported if the aircraft is flying at an altitude of 1500 ft or below.

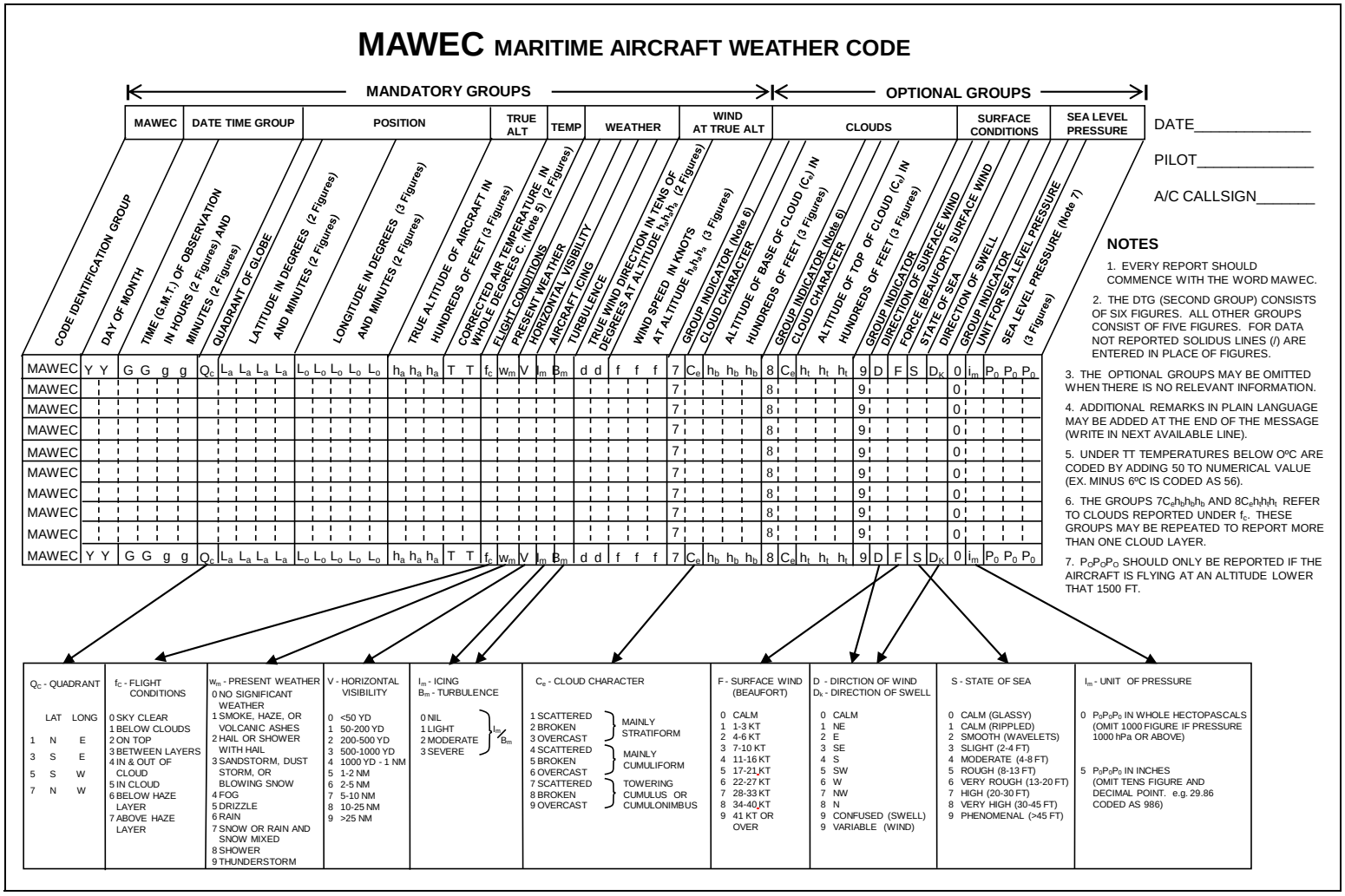
Note 16 i_m Method by which Sea Level Pressure $P_oP_oP_o$ is Reported

Code Figure

0 $P_oP_oP_o$ is reported in whole hectopascals (omitting thousands digit if pressure is 1000 hPa or above)

5 $P_oP_oP_o$ is reported in inches (omitting tenth digit and decimal point, e.g., 29.86 is coded as 986)

MAWEC MARITIME AIRCRAFT WEATHER CODE



NOTES

1. EVERY REPORT SHOULD COMMENCE WITH THE WORD MAWEC.
2. THE DTG (SECOND GROUP) CONSISTS OF SIX FIGURES. ALL OTHER GROUPS CONSIST OF FIVE FIGURES. FOR DATA NOT REPORTED SOLIDUS LINES (/) ARE ENTERED IN PLACE OF FIGURES.
3. THE OPTIONAL GROUPS MAY BE OMITTED WHEN THERE IS NO RELEVANT INFORMATION.
4. ADDITIONAL REMARKS IN PLAIN LANGUAGE MAY BE ADDED AT THE END OF THE MESSAGE (WRITE IN NEXT AVAILABLE LINE).
5. UNDER TT TEMPERATURES BELOW 0ºC ARE CODED BY ADDING 50 TO NUMERICAL VALUE (EX. MINUS 6ºC IS CODED AS 56).
6. THE GROUPS $7C_e h_b h_b h_b$ AND $8C_e h_t h_t h_t$ REFER TO CLOUDS REPORTED UNDER f_c. THESE GROUPS MAY BE REPEATED TO REPORT MORE THAN ONE CLOUD LAYER.
7. $P_0P_0P_0$ SHOULD ONLY BE REPORTED IF THE AIRCRAFT IS FLYING AT AN ALTITUDE LOWER THAT 1500 FT.

Q_c - QUADRANT

	LAT	LONG
1	N	E
3	S	E
5	S	W
7	N	W

f_c - FLIGHT CONDITIONS

0 SKY CLEAR
1 BELOW CLOUDS
2 ON TOP
3 BETWEEN LAYERS
4 IN & OUT OF CLOUD
5 IN CLOUD
6 BELOW HAZE LAYER
7 ABOVE HAZE LAYER

w_m - PRESENT WEATHER

0 NO SIGNIFICANT WEATHER
1 SMOKE, HAZE, OR VOLCANIC ASHES
2 HAIL OR SHOWER WITH HAIL
3 SANDSTORM, DUST STORM, OR BLOWING SNOW
4 FOG
5 DRIZZLE
6 RAIN
7 SNOW OR RAIN AND SNOW MIXED
8 SHOWER
9 THUNDERSTORM

V - HORIZONTAL VISIBILITY

0 <50 YD
1 50-200 YD
2 200-500 YD
3 500-1000 YD
4 1000 YD - 1 NM
5 1-2 NM
6 2-5 NM
7 5-10 NM
8 10-25 NM
9 >25 NM

I_m - ICING
B_m - TURBULENCE

0 NIL
1 LIGHT
2 MODERATE
3 SEVERE

(I_m / B_m)

C_e - CLOUD CHARACTER

1 SCATTERED
2 BROKEN
3 OVERCAST
} MAINLY STRATIFORM

4 SCATTERED
5 BROKEN
6 OVERCAST
} MAINLY CUMULIFORM

7 SCATTERED
8 BROKEN
9 OVERCAST
} TOWERING CUMULUS OR CUMULONIMBUS

F - SURFACE WIND (BEAUFORT)

0 CALM
1 1-3 KT
2 4-6 KT
3 7-10 KT
4 11-16 KT
5 17-21 KT
6 22-27 KT
7 28-33 KT
8 34-40 KT
9 41 KT OR OVER

D - DIRCTION OF WIND
D_K - DIRECTION OF SWELL

0 CALM
1 NE
2 E
3 SE
4 S
5 SW
6 W
7 NW
8 N
9 CONFUSED (SWELL)
9 VARIABLE (WIND)

S - STATE OF SEA

0 CALM (GLASSY)
1 CALM (RIPPLED)
2 SMOOTH (WAVELETS)
3 SLIGHT (2-4 FT)
4 MODERATE (4-8 FT)
5 ROUGH (8-13 FT)
6 VERY ROUGH (13-20 FT)
7 HIGH (20-30 FT)
8 VERY HIGH (30-45 FT)
9 PHENOMENAL (>45 FT)

I_m - UNIT OF PRESSURE

0 $P_0P_0P_0$ IN WHOLE HECTOPASCALS (OMIT 1000 FIGURE IF PRESSURE 1000 hPa OR ABOVE)

5 $P_0P_0P_0$ IN INCHES (OMIT TENS FIGURE AND DECIMAL POINT. e.g. 29.86 CODED AS 986)

Annex B

Appendix B.6

RECCO - Report from Meteorological Reconnaissance Aircraft Code

1. General This is a Standard NATO Meteorological Code for transmission of meteorological observations by weather reconnaissance aircraft.

2. Form of Code

RECCO

SECTION 1 (Mandatory)

9xxx9 GGggi$_d$ YQL$_a$L$_a$L$_a$ L$_o$L$_o$L$_o$Bf$_c$ h$_a$h$_a$h$_a$d$_t$d$_a$

ddfff TTT$_d$T$_d$w /jHHH

SECTION 2 (Optional)

1k$_n$N$_s$N$_s$N$_s$ Ch$_s$h$_s$H$_t$H$_t$ (Ch$_s$h$_s$H$_t$H$_t$) 4ddff 6W$_s$S$_s$W$_d$d$_w$

7I$_r$I$_t$S$_b$S$_e$ 7h$_i$h$_i$H$_i$H$_i$ 8d$_r$d$_r$S$_r$O$_e$ 8E$_w$E$_1$c$_e$i$_e$ 9V$_i$T$_w$Y$_w$T$_w$

SECTION 3 (Intermediate)

9xxx9 GGggi$_d$ YQL$_a$L$_a$L$_a$ L$_o$L$_o$L$_o$Bf$_c$ h$_a$h$_a$h$_a$d$_t$d$_a$

ddfff TTT$_d$T$_d$w /jHHH

3. Notes

a. The code name RECCO is used as a prefix to the report, indicating that it is a report from a meteorological reconnaissance flight.

b. The code form is divided into three sections as follows:

(1) Section 1 - The use of Section 1 is mandatory. All groups and elements shall always be included in the report. If datum is not available for an element, a solidus (/), or the appropriate code figure, shall be reported for the element to indicate missing. (Section 1 is sometimes referred to as the mandatory portion of the flight-level report.)

(2) Section 2 - The use of Section 2 is optional. If Section 2 is used, all the groups for which data are observed shall be included in the report. The groups in Section 2 are self-identifying; therefore, they can be omitted from, included in, or repeated (as required) in the

report without confusion. (Section 2 is sometimes referred to as the optional portion of the flight-level report.)

(3) Section 3 - The use of Section 3 is optional. If Section 3 is used, as with Section 1, all the groups and elements shall always be included in the report. If datum is not available for an element, a solidus (/), or the appropriate code figure, shall be reported for the element to indicate missing.

c. 9xxx9 is a key group indicating the dimensional unit being used and whether or not radar observations are being made. This group shall always be included in the report. If radar equipment is operational, this information shall be reported for symbol xxx even though no echoes are observed. The omission of the 8-groups from the report will indicate to the recipient that no echoes were observed. In this code group, xxx may be encoded as either 222 or 777 in Section 1, but only as 555 in Section 3 (see Code Table 22).

d. When icing occurs, both the 7-groups shall be included in the report. The 7-groups may be repeated as often as necessary to report the icing conditions encountered.

e. When radar data are observed, both the 8-groups shall be included in the report. The 8-groups may be repeated as often as necessary to report essential data.

f. When required, intermediate observations may be taken between complete flight level observations. Section 3 shall be used to report the intermediate data.

(1) The intermediate data are reported by attaching Section 3 to the next complete flight level report (i.e., at the end of Section 2 or Section 1, as appropriate).

(2) Unless otherwise indicated, it shall be assumed that a straight-line, constant-altitude flight has been made between the position of the last reported complete flight level observation and the present one. Any intermediate observations reported in the present complete flight level report shall be assumed to have been made on this flight path.

(3) If the altitude of the flight is altered between any two consecutive complete flight level observations, intermediate observations shall not be reported between those two flight level reporting positions.

g. The observation circle for observations shall be considered the cylindrical portion of the atmosphere approximately 30 nautical miles in radius with the aircraft at the centre at the time of observation.

h. Plain language remarks may be added at the end of the coded data, as appropriate.

i. Sounding data from reconnaissance aircraft are encoded in code from FM 37-VII TEMP DROP.

j. Sea ice, as observed by aircraft, are reported in SEA ICE data section (see paragraph 6 of this appendix).

4. Specification of Symbolic Letters, Words and Figure Groups

B Turbulence (Code Table 1).

C Genus of cloud predominating in the layer (Code Table 2).

c_e Character of echo (Code Table 3).

(1) The term "solid" is used when the individual echoes are not distinctly and widely separated.

d_a Reliability of wind at flight altitude (Code Table 5).

d_t Type of wind at flight altitude (Code Table 6).

d_w Bearing of distant weather (Code Table 4).

dd Direction, in tens of degrees, from which the wind is blowing at the level given by $h_ah_ah_a$. True direction, in tens of degrees from which the surface wind is blowing.

d_rd_r Bearing of echo centre from aircraft, in tens of degrees.

(1) See Note (1) under S_r.

E_1 Length of echo axis, in tens of nautical miles.

E_w Echo width or diameter, in tens of nautical miles.

f_c Flight conditions (Code Table 7).

(1) The average flight conditions within the observation circle are reported for f_c.

ff Wind speed in knots (kt) at the surface.

(1) Wind speeds of 100-199 kt inclusive are indicated by adding 50 to dd. When over 199 kt, dd is indicated without adding 50, ff is coded //, and plain language remark is used: e.g. WIND 240.

fff Wind speed in knots at the level given by $h_ah_ah_a$.

GGgg Time of observation, in hours and minutes UTC.

H_iH_i Altitude of the top of the layer in which icing occurred (Code Table 8).

(1) Level flight is indicated by //.

H_tH_t Altitude of tops of clouds reported by C (Code Table 8).

(1) The average altitude of cloud bases and tops is reported for h_sh_s and H_tH_t, respectively.

HHH Geopotential height reported in meters below 500 hPa and decameters at and above 500 hPa, D-value in decameters (500 added if negative), or sea-level pressure in whole hectopascals, as specified by Code Figure j.

h_ih_i Altitude of the base of the layer in which icing occurred (Code Table 8).

(1) In level flight, the height at which icing occurred is reported for h_ih_i.

h_sh_s Altitude of bases of clouds reported by C (Code Table 8).

(1) See Note (1) under H_tH_t.

$h_ah_ah_a$ Altitude of the aircraft, in decameters.

I_r Rate of icing (Code Table 9).

I_t Type of icing and type of contrails (Code Table 10).

i_d Dew point, aircraft altitude, and air temperature indicator (Code Table 11).

i_e Intensity of echo (Code Table 12).

j Index pertaining to HHH (Code Table 13).

k_n Number of cloud layers reported.

(1) When clouds are present in indefinite layers (chaotic sky), 9 is reported for k_n.

(2) If it is impossible to determine that clouds exist (due to darkness or for other reasons), a solidus (/) is reported for k_n.

(3) If the number of cloud layers reported exceeds three, k_n in the first 1-group reports the total number of cloud layers. The second 1-group reports the additional number of layers being reported exclusive of those previously reported.

$L_aL_aL_a$ Latitude, at time GGgg, to the nearest tenth of a degree.

$L_oL_oL_o$ Longitude, at time GGgg, to the nearest tenth of a degree. The hundreds digit is omitted for longitude 100° to 180°.

$N_sN_sN_s$ Amount of individual cloud layer or mass, of genus C, where s specifies sequential number of the cloud layer (Code Table 14).

(1) The amount of cloud layer reported for N_s is the amount in the individual layer as though no other cloud were present; i.e., the summation concept is not used.

(2) When code figure 9 (chaotic sky) is reported for k_n, the total amount of cloud covering the sky is reported by the first N_s and solidi (//) are reported for the remainder.

(3) When a solidus (/) is reported for k_n, 9 is reported for the first two N_s and 0 or 9 is reported for the last N_s, depending upon visibility of the celestial domain.

O_e Orientation of ellipse (Code Table 15).

Q Octant of the globe (Code Table 16).

S_b Distance to beginning of icing (Code Table 17).

S_e Distance to ending of icing (Code Table 17).

S_r Distance to echo centre, in tens of nautical miles.

(1) When the distance to the centre of the echo is 94 nautical miles or more, 100 is subtracted from the distance and the tens value of the remainder is reported for S_r and 50 is added to the value normally reported for d_rd_r.

(2) When a line of echoes is observed, S_r is the distance to the mid-point of the line.

S_s Distance of occurrence of W_s (Code Table 17).

TT Air temperature at flight level $h_ah_ah_a$, in whole degrees Celsius.

(1) For negative temperature, 50 is added to the absolute value of the temperature, with the hundreds figure, if any, being omitted. A temperature of -50 °C is given as 00, the distinction between -50 °C and 0 °C being made from the general weather situation and from comparison with the previous reports at the same level.

T_dT_d Dew point, in whole degrees Celsius.

(1) For negative values, see Note (1) under TT. A report of // for T_dT_d when i_d is coded as 4 through 7 indicates a relative humidity less than 10 percent or T_dT_d colder than -49 °C.

$T_wY_wT_w$ Sea surface temperature, in tenths of a degree Celsius.

V_i In-flight horizontal visibility (Code Table 18).

W_d Distant weather (Code Table 19).

(1) Weather conditions of importance observed at the observation position but outside the observation circle are reported for W_d.

W_s Significant weather changes (Code Table 20).

(1) Significant weather changes that have occurred since the last observation or in the preceding hour (whichever period is shorter) along the track are reported for W_s.

w Present weather (Code Table 21).

(1) Code Figure 2 is reported for w when the total amount of cloud above or below the aircraft is 7/8 or more and a higher code figure is not appropriate.

xxx Indicator specifying type of RECCO observation and presence or absence of radar data (Code Table 22).

Y Day of the week (Code Table 23).

(1) The day (UTC) on which the observation was taken as specified by GGgg.

1, 4, 6, 7, 8, and 9 Group indicator figures specifying the data reported by the remainder of the digits in the group.

9xxx9 Indicator group specifying RECCO observation.

5. Code Tables

Table 1

B Turbulence

Code Figure

0	None
1	Light turbulence
2	Moderate turbulence in clear air, infrequent
3	Moderate turbulence in clear air, frequent
4	Moderate turbulence in cloud, infrequent
5	Moderate turbulence in cloud, frequent
6	Severe turbulence in clear air, infrequent
7	Severe turbulence in clear air, frequent
8	Severe turbulence in cloud, infrequent
9	Severe turbulence in cloud, frequent

Table 2

C Genus of cloud predominating in the layer

Code Figure		Code Figure	
0	Cirrus (Ci)	5	Nimbostratus (N)
1	Cirrocumulus (Cc)	6	Stratocumulus (Sc)
2	Cirrostratus (Cs)	7	Stratus (St)
3	Altocumulus (Ac)	8	Cumulus (Cu)
4	Altostratus (As)	9	Cumulonimbus (Cb)
/	Cloud not visible owing to darkness, fog, dust storm, or other analogous phenomena (//)		

Table 3

c_e Character of echo

Code Figure		Code Figure	
0	Not reported/indeterminate	4	Solid line
1	Scattered	5	Scattered, all quadrants
2	Solid	6	Solid, all quadrants
3	Scattered line		

Table 4

d_w Bearing of distant wind

Code Figure		Code Figure	
0	No report	5	SW
1	NE	6	W
2	E	7	NW
3	SE	8	N
4	S	9	All directions

Table 5

d_a Reliability of wind at flight level

Code Figure

0 90% to 100% reliable; multiple drift with closed wind star, or small open star when winds are 50 kt or greater; short radar wind runs, wind obtained using Doppler radar or inertial omega systems

1 85% to 100% reliable; multiple drift with small open star, or double drift or single drift with average ground speed by timing; short radar wind runs

2 80% to 100% reliable; fix to fix winds using the following pin point visual fixes, radar fixes or accurate loran fixes using good ground waves

3 75% to 90% reliable; fix to fix winds using two or three lines of position (LOPs) either loran, celestial, radio, or sight bearings or any combination of the three above when all lines of position are considered reliable

4 60% to 80% reliable; winds obtained using single drift and single LOP (Speed Line), air-plot, etc.

5 50% to 75% reliable; fix to fix winds using two or three lines of position either loran, celestial, radio, or sight bearings or any combination of the above when one of the lines is not considered reliable

6 Less than 50% reliable; winds obtained by any of the above methods that the navigator believes to be inaccurate or of questionable accuracy

7 No reliability; assumed or estimated wind

8 No wind; navigator unable to determine a wind

Table 6

d_t Type of wind at flight level

Code Figure

0 Spot wind

1 Winds averaged over 100 nm preceding last fix; last fix 25 nm prior to the reported position

2 Winds averaged over 200 nm preceding last fix; last fix 25 nm prior to the reported position

3 Winds averaged over 300 nm preceding last fix; last fix 25 nm prior to the reported position

4 Winds averaged over 400 nm preceding last fix; last fix 25 nm prior to the reported position

5 Winds averaged over 100 nm preceding last fix; last fix 75 nm prior to the reported position

6 Winds averaged over 200 nm preceding last fix; last fix 75 nm prior to the reported position

7 Winds averaged over 300 nm preceding last fix; last fix 75 nm prior to the reported position

8 Winds averaged over 400 nm preceding last fix; last fix 75 nm prior to the reported position

9 Winds averaged over more than 400 nm

/ No wind reported

Table 7

f_c Flight conditions

Code Figure

0 Total cloud amount less than 1/8

1 Total cloud amount at least 1/8, with either 1/8 to 4/8 above or 1/8 to 4/8 below, or combinations thereof

2 Cloud amount more than 4/8 above and 0 to 4/8 below

3 Cloud amount 0 to 4/8 above and more than 4/8 below

4 Cloud amount more than 4/8 above and more than 4/8 below

5 Chaotic sky; many undefined layers

6 In and out of clouds, Instrument Meteorological Conditions 25% of the time

7 In and out of clouds, Instrument Meteorological Conditions 50% of the time

8 In and out of clouds, Instrument Meteorological Conditions 75% of the time

9 In clouds all the time, continuous Instrument Meteorological Conditions

/ Impossible to determine due to darkness or other cause

Table 8

H_iH_i Altitude of the top of the layer in which icing occurred

H_tH_t Altitude of the tops of the clouds reported by C

h_ih_i Altitude of the base of the layer in which icing occurred

h_sh_s Altitude of the bases of the clouds reported by C

Code Figure	Meters	Code Figure	Meters	Code Figure	Meters
00	< 30	34	1,020	68	5,400
01	30	35	1,050	69	5,700
02	60	36	1,080	79	6,000
03	90	37	1,110	71	6,300
04	120	38	1,140	72	6,600
05	150	39	1,170	73	6,900
06	180	40	1,200	74	7,200
07	210	41	1,230	75	7,500
08	240	42	1,260	76	7,800
09	270	43	1,290	77	8,100
10	300	44	1,320	78	8,400
11	330	45	1,350	79	8,700
12	360	46	1,380	80	9,000
13	390	47	1,410	81	10,500
14	420	48	1.440	82	12,000
15	450	49	1,470	83	13,500
16	480	50	1,500	84	15,000
17	510	51	Not Used	85	16,500
18	540	52	Not Used	86	18,000
19	570	53	Not Used	87	19,500
20	600	54	Not Used	88	21,000
21	630	55	Not Used	89	>21,000
22	660	56	1,800	90	Less than 50 m
23	690	57	2,100	91	50 to 100 m
24	720	58	2,400	92	100 to 200 m
25	750	59	2,700	93	200 to 300 m
26	780	60	3,000	94	300 to 600 m
27	810	61	3,300	95	600 to 1,000 m
28	840	62	3,600	96	1,000 to 1,500 m
29	870	63	3,900	97	1,500 to 2,000 m
30	900	64	4,200	98	2,000 to 2,500 m
31	930	65	4,500	99	2,500 m or more
32	960	66	4,800		or no clouds
33	990	67	5,100		

Note: If the observed value is between two of the heights, as given in the table, the code figure for the lower height shall be reported, except for Code Figures 90 through 99; in this decade, a value exactly equal to one of the heights at the ends of the ranges shall be coded in the higher range, e.g., a height of 600 m is reported by Code Figure 95.

Table 9

I_r Rate of icing

Code Figure

7	Light
8	Moderate
9	Severe
/	Unknown

Table 10

I_t Type of icing and type of contrails

Code Figure

0	None
1	Rime Ice in cloud
2	Clear ice in cloud
3	Combination rime and clear ice in cloud
4	Rime ice in precipitation
5	Clear ice in precipitation
6	Combination rime and clear ice in precipitation
7	Frost (icing in clear air)
8	Non-persistent contrails (less than 1/4 nm long)
9	Persistent contrails

Table 11

i_d Dew point, aircraft altitude, and air temperature indicator

Code Figure

0	Dew point not measured/aircraft below 10,000 m
1	Dew point not measured/aircraft at or above 10,000 m
2	Dew point not measured/aircraft below 10,000 m and flight level temperature -50 °C or colder
3	Dew point not measured/aircraft at or above 10,000 m and flight level temperature -50 °C or colder
4	Dew point not measured/aircraft below 10,000 m
5	Dew point not measured/aircraft at or above 10,000 m

6 Dew point not measured/aircraft below 10,000 m and flight level temperature -50 °C or colder

7 Dew point not measured/aircraft at or above 10,000 m and flight level temperature -50 °C or colder

Note: For Code Figures 4 through 7, see Note (1) under specification of T_dT_d.

Table 12

I_e Intensity of echo

Code Figure

0 No report, or unknown
2 Weak
5 Moderate
8 Strong

Table 13

j Index pertaining to HHH

Code Figure

0 Sea-level pressure in whole hectopascals; thousands figure omitted
1 Altitude of 200 hPa surface in geopotential decameters (thousands figure omitted)
2 Altitude of 850 hPa surface in geopotential decameters (thousands figure omitted)
3 Altitude of 700 hPa surface in geopotential decameters (thousands figure omitted)
4 Altitude of 500 hPa surface in geopotential decameters
5 Altitude of 400 hPa surface in geopotential decameters
6 Altitude of 300 hPa surface in geopotential decameters
7 Altitude of 250 hPa surface in geopotential decameters; tens of thousands figure omitted
8 D-value in geopotential decameters; if negative, 500 is added to HHH
9 No absolute altitude available or geopotential data inaccurate

Table 14

$N_sN_sN_s$ Amount of individual cloud layer or mass, of genus C, where s specifies sequential number of the cloud layer

Code Figure

0	0	0
1	1 okta or less, but not zero	1/10 or less, but not zero
2	2 oktas	2/10 - 3/10
3	3 oktas	4/10
4	4 oktas	5/10
5	5 oktas	6/10
6	6 oktas	7/10 - 8/10
7	7 oktas or more, but not 8 oktas	9/10 or more, but not 10/10
8	8 oktas	10/10
9	Sky obscured, or cloud amount cannot be estimated	

Table 15

O_e Orientation of ellipse

Code Figure		Code Figure	
0	No report	5	ESE - WNW
1	NNE - SSW	6	SE - NW
2	NE - SW	7	SSE - NNW
3	ENE - WSW	8	S - N
4	E - W	9	Uncertain

Table 16

Q Octant of the globe

Code Figure	Greenwich Longitude	Hemi-sphere	Code Figure	Greenwich Longitude	Hemi-sphere
0	0° - 90°W	North	5	0° - 90°W	South
1	90° - 180°W	North	6	90° - 180°W	South
2	180° - 90°E	North	7	180° - 90°E	South
3	90° - 0°E	North	8	90° - 0°E	South

Table 17

S_b Distance to beginning of icing
S_e Distance to ending of icing
S_s Distance to occurrence of W_s

Code Figure		Code Figure	
0	No report	6	120 nm
1	Previous position	7	150 nm
2	Present position	8	180 nm
3	30 nm	9	More than 180 nm
4	60 nm	/	Unknown
5	90 nm		

Table 18

V_i In-flight horizontal visibility

Code Figure

0	In-flight visibility 0 to and including 1 nm
1	In-flight visibility > 1 and ≤ 3 nm
2	In-flight visibility > 3 nm

Table 19

W_d Distant weather

Code Figure

0	No report
1	Signs of hurricane
2	Ugly, threatening sky
3	Dust storm or sandstorm
4	Fog or ice fog
5	Waterspout
6	Cirrostratus layer or bank
7	Altostratus or altocumulus layer or bank
8	Line of heavy cumulus
9	Cumulonimbus heads or thunderstorm

Table 20

W_s Significant weather changes

Code Figure

0	No change
1	Marked wind shift
2	Beginning or ending of marked turbulence
3	Marked temperature change (not with altitude)
4	Precipitation begins or ends
5	Change in cloud forms
6	Fog or ice fog bank begins or ends
7	Warm front
8	Cold front
9	Front, type not specified

Table 21

w Present weather

Code Figure

0	No significant weather
1	Smoke, haze, or volcanic ashes
2	Hail or shower with hail
3	Sandstorm, dust storm, or blowing snow
4	Fog
5	Drizzle
6	Rain
7	Snow, or rain and snow mixed
8	Shower
9	Thunderstorm

Table 22

xxx Indicator specifying type of RECCO observation and presence or absence of radar data

Code Figure

222	Basic observation without radar data capability
555	Intermediate observation with or without radar data capability
///	Basic observation with radar data capability

Table 23

Y Day of the week

Code Figure		Code Figure	
1	Sunday	5	Thursday
2	Monday	6	Friday
3	Tuesday	7	Saturday
4	Wednesday		

6. Sea-Ice Data Section

To report sea-ice conditions, the following supplementary section to the RECCO code form is used by the US:

ICE $9A_TA_1A_2A_3$ TPW_fOS_i 1BBDD 2BBDD $311w_dw_d$ $411w_dw_d$ $511w_dw_d$

The first two groups are mandatory. The remaining groups with indicator figures 1 through 5 are optional and are used to describe more fully the openings in the ice (W_f), when observed. These indicator figures mean:

1 = Drift ice boundary data follow

2 = Fast ice boundary data follow

3 = Lead data follow

4 = Polynya data follow

5 = Ice belt data follow

a. Specifications of symbolic letters

A_T Total concentration of ice -- the sum of A_1, A_2, A_3.

A_1 Amount of slush, brash and ice cakes (less than 30 ft in size). This is the ratio of the aerial extent of the type of ice present to the total extent of ice and water.

A_2 Amount of small and medium floes (30 to 3,000 ft in size). This is the ratio of the aerial extent of the type of ice present to the total extent of ice and water.

A_3 Amount of giant ice floes and ice fields (over 3,000 ft in size). This is the ratio of the aerial extent of the type of ice present to the total extent of ice and water.

BB Bearing to the nearest boundary in tens of degrees from the co-ordinates indicated in the forepart of the RECCO report. BB and DD are coded as 00 when the boundary is at the location indicated by these co-ordinates.

DD Distance to the nearest boundary, in nautical miles, from the co-ordinates indicated in the forepart of the RECCO report. BB and DD are coded as 00 when the boundary is at the location indicated by these co-ordinates.

11 Length of major axis of the openings in the ice (W_f) in nautical miles.

O Orientation of openings in the ice (W_f).

P Puddles (depressions on, or thawing holes in, sea-ice filled with melted water).

S_i Amount of fast-ice. Fast-ice is defined as any type of ice, either broken or unbroken, attached to the shore, stranded in shoal water, or attached to the bottom of shoal areas.

T Topography (i.e., the character of ice surface).

W_f Openings in the ice.

w_dw_d Width of the openings in the ice (W_f) in nautical miles.

b. Specification of code figures and code tables

A_T Total concentration of ice

A_1 Amount of slush, brash and ice cakes

A_2 Amount of small and medium floes

A_3 Amount of giant floes and ice fields

Code Figure		Code Figure	
0	No ice	5	7/10
1	<1/10 to 2/10	6	8/10
2	3/10 to 4/10	7	9/10
3	5/10	8	10/10
4	6/10	9	Not determined or unknown

DD Distance to the nearest boundary from the co-ordinates indicated in the forepart of the RECCO report

11 Length of major axis of the openings in the ice (W_f)

w_dw_d Width of the openings in the ice (W_f)

Code Figure

01	1 - 2 nm
02	2 - 3 nm
03	3 - 4 nm
04	4 - 5 nm
etc.	
89	89 - 90 nm
90	Less than 1/10 nm
91	1/10 nm
92	2/10 nm
93	3/10 nm
etc.	
99	9/10 nm

O Orientation of openings in the ice (W_f)

Code Figure		Code Figure	
0	No distinct orientation	5	Parallels shore at east
1	NE - SW	6	Parallels shore at south
2	E - W	7	Parallels shore at west
3	SE - NW	8	Parallels shore at north
4	N - S	9	Not determined or unknown

P Puddles

Code Figure

0	No puddles
1	Puddles joined, extensive cracking
2	Puddles melted through
3	Puddles cover 7 - 9 tenths of ice area
4	Puddles cover 4 - 6 tenths of ice area
5	Puddles cover 1 - 3 tenths of ice area
6	Puddles cover less than 1 tenth of ice area
7	Puddles frozen
8	Ice without puddles
9	Not determined or unknown

S_i Amount of fast-ice

Code Figure

0 Shore not observed
1 Shore extensively clear
2 Ice blocking less than half of the shore
3 Ice blocking more than half of the shore but some openings visible
4 Ice blocking entire shore
5 Not used
6 Not used
7 Not used
8 Radar indications of shore ice but extent of coverage undetermined
9 Not determined or unknown

T Topography

Code Figure

0 No sea-ice.

1 Slush or pancake ice. Slush is an accumulation of ice crystals which may or may not be frozen together. Pancake ice consists of pieces of newly formed ice usually between 1 and 6 ft in diameter.

2 Level ice (ice having a flat and level surface).

3 Rafted ice (a type of pressure ice formed by one cake overriding another).

4 Pressure ridge/ridged ice (pressure ice in the form of a ridge or many ridges).

5 Hummocks. Hummocked ice is ice piled haphazardly into mounds or hillocks. It is similar to rafted ice except that hummocked ice required a greater degree of pressure than rafted ice. A hummock or hillock is in reality an old pressure ridge, or rafted ice which due to snow and weather, has fused into on ice mass and rounded out.

6 Pressure ice. This includes ice having any readily observed roughness of the surface but the observer is unable to determine type. Rafted, ridged and hummocked types of pressure ice will be reported by one of the foregoing code figures.

7 Rotten, disintegrating ice -- old ice that has become honeycombed in the course of melting and is in an advanced stage of disintegration.

8 Not used.

9 Not determined or unknown.

W_f Openings in the ice

Code Figure

0	Open water
1	Ice in belts or patches
2	Ice evenly distributed
3	Polynya(s) in combination with leads or cracks
4	Lead(s) in combination with cracks
5	Single polynya
6	Single lead
7	No openings in the ice
9	Not determined or unknown

Annex B

Appendix B.7

TARWI - Target Weather Information Reporting Code

1. General This is a Standard NATO Meteorological Code for use by strike aircrews for providing in-flight reports of target weather information.

2. Form of Code

TARWI

$YQL_aL_aL_a$ $L_oL_oL_oG'G'$ CHVWR

or

$X_BX_BX_B$ $X_LX_LX_NX_NX_NX_N$ YYGGgg CHVWR

3. Specification of Symbolic Letters

TARWI	Code identification
Y	Day of week (as given in WMO Code Table 4900)
Q	Octant of globe (as given in WMO Code Table 3300)
$L_aL_aL_a$	Latitude in tenths of degrees
$L_oL_oL_o$	Longitude in tenths of degrees; the hundreds digit is omitted for longitude 100° to 180°
G'G'	Time of observation to the nearest hour UTC (24-hour clock) (Note 1)
$X_BX_BX_B$	Identification of Grid Zone Designation UTM
X_LX_L	100,000 meter square identification UTM
$X_NX_NX_NX_N$	Numerical grid co-ordinates UTM of the observation point given to the desired accuracy
YY	Day of month (UTC). The first day of the month is coded as 01, the second as 02, etc.
GGgg	Time of observation in hours and minutes UTC
C	Low cloud amount (Note 2)
H	Low cloud height (Note 3)
V	Visibility (Note 4)
W	Weather (Note 5)
R	Remarks (Note 6)

4. Notes

Note 1

G'G' Gives time to nearest quarter hour

Time 15 min past hour - add 25 to hour for GG
Time 30 min past hour - add 50 to hour for GG
Time 45 min past hour - add 75 to hour for GG

Note 2

C Low cloud amount

Code Figure		Code Figure	
0	No low cloud	5	5/8 low cloud cover
1	1/8 low cloud cover	6	6/8 low cloud cover
2	2/8 low cloud cover	7	7/8 low cloud cover
3	3/8 low cloud cover	8	overcast low clouds
4	4/8 low cloud cover	9	Not observed

Note 3

H Low cloud height

Code Figure		Code Figure	
0	No low cloud	5	2,500 ft
1	500 ft or less	6	3,000 ft
2	1,000 ft	7	3,500 ft
3	1,500 ft	8	4,000 ft
4	2,000 ft	9	Not observed

Note 4

V Visibility

Code Figure

	Kilometers	Nautical Miles
0	0 to less than 1	0 to less than 1/2
1	1 to less than 2	1/2 to less than 1
2	2 to less than 3	1 to less than 1 1/2
3	3 to less than 4	1 1/2 to less than 2
4	4 to less than 5	2 to less than 3
5	5 to less than 6	3
6	6 to less than 7	More than 3 to less than 4
7	7 to less than 8	4 to less than 5
8	8 or greater	5 or greater
9	Vis not reported	Vis not reported

Note 5

W Weather

Code Figure

0 No significant weather
1 Smoke, haze, or volcanic ashes
2 Hail or shower with hail
3 Sandstorm, dust storm, or blowing snow
4 Fog
5 Drizzle
6 Rain
7 Snow or rain and snow mixed
8 Shower
9 Thunderstorm

Note 6

R Remarks

Code Figure

A Encoded weather is simulated (for exercise use)
B Multiply cloud heights (Note 3) by 10
C No medium or scattered medium clouds
D Scattered variable broken medium clouds
E Broken variable overcast, medium clouds
F Contrails at flight level
G Enroute weather predominantly IFR
H Enroute weather predominantly VFR
I Gusty winds at surface
J Fog in valley
K Higher terrain obscured
L Surface conditions variable due to showers
M Thunderstorms occurring
N Thunderstorms enroute
O Icing at flight level or freezing precipitation
P Surface wind NE quadrant
Q Surface wind SE quadrant
R Surface wind SW quadrant
S Surface wind NW quadrant
T Weather better to north
U Weather better to east
V Weather better to south
W Weather better to west
X Weather suitable for mission
Y Weather marginal for mission
Z Weather unsuitable for mission

The remarks entry selected will be the one considered most significant for the mission

Annex B

Appendix B.8

RAFOR - Range Forecast Code

1. General RAFOR is a standard forecast code for selected military ranges in Belgium, Denmark, France, Germany, the Netherlands, Spain, and the United Kingdom. RAFORs are generally available 3 hours prior to range opening and are valid for 9 hours or until scheduled closure. RAFORs are issued every 3 hours.

2. Form of Code

FL--99 CCCC YYGGgg

RAFOR

XXXX or CCCC $YYG_1G_1G_2G_2$ (Text of forecast follows in the TAF format using national practices)

3. Specification of Symbolic Letters

FL--99 CCCC	Bulletin Header. The `--` identifies the nation supplying the forecast (NL = Netherlands, DN = Denmark, DL = Germany, UK = United Kingdom, BX = Belgium). The CCCC identifies the ICAO location indicator of the Met Office issuing the forecast or the overall responsible Met Centre (EBWM = Beauvechain, EGRR Bracknell, EHWX = Woensdrecht, EKMK = Karup, ETGG = Gluecksburg, ETGL = Muenster, ETUO = Guetersloh, ETUL = Laarbruch,).
YY	The date when the RAFOR is issued.
GGgg	The time when the RAFOR is issued in hours and minutes UTC.
RAFOR	Code identification.
XXXX or CCCC	Range location indicator or ICAO-indicator.
$YYG_1G_1G_2G_2$	The date and the valid time of the RAFOR (beginning/end of forecast period).

4. Amendment Criteria

Amendments are issued when there are changes in visibility through 3,700 m and 5,000 m, ceiling 1,000 ft and significant weather of thunderstorms and freezing precipitation, unless noted otherwise (see notes 1 and 2).

Note 1 Amendment criteria are 5 km (visibility) and 1,500 ft (ceiling), in addition to thunderstorms and freezing precipitation for the following ranges:

Baumholder
Grafenwoehr
Hammelburg
Heuberg
Hohenfels
Meppen
Muensingen
Schoenhagen
Siegenburg
Suippes

Note 2 Amendment criteria are 5 km (visibility) and 1,000 ft (ceiling), in addition to thunderstorms and freezing precipitation for Putlos range.

Note 3 RAFORs are amended in-line with UK TAF amendment citeria (see Annex C).

5. Ranges that have RAFORs

Range	Bulletin Header (FL--99 CCCC)	Location Indicator (XXX) Pseudo-Indicator
Belgium		
Helchteren	FLBX99 EBWM	EBP5
Denmark		
Roemoe	FLDN99 EKMK	EKRX
France		
Suippes	FLDL99 LFxx	LFFS (see Note 1)
Germany		
Baumholder	FLDL99 ETGL	BAUM (see Note 1)
Bergen-Hohne	FLDL99 ETUO	ETGB (see Note 3)
Grafenwoehr	FLDL99 ETGL	GRAF (see Note 1)
Hammelburg	FLDL99 ETGL	HBUR (see Note 1)
Heuberg	FLDL99 ETGL	HEUB (see Note 1)
Hohenfels	FLDL99 ETGL	HOFE (see Note 1)
Meppen	FLDL99 ETGG	ETWM (see Note 1)
Muensingen	FLDL99 ETGL	MUEN (see Note 1)
Nordhorn	FLDL99 ETGL	ETUN
Putlos	FLDL99 ETGG	PULO (see Note 2)
Schoenhagen	FLDL99 ETGG	SHAG (see Note 2)
Sennelager	FLDL99 ETUO	SENN (see Note 3)
Siegenburg	FLDL99 ETGL	ETAV (see Note 1)

Netherlands		
Vlieland	FLNL99 EHWX	EHVL
Spain		
Bardenas Reales	FLSP99 LEZM	LEBR
United Kingdom		
Donna Nook	FLUK99 EGRR	EGXX
Garvie Island	FLUK99 EGRR	EGQC
Holbeach	FLUK99 EGRR	EGYH
Otterburn	FLUK99 EGRR	EGOT
Spade-Adam	FLUK99 EGRR	EGOM
Tain	FLUK99 EGRR	EGQA
Wainfleet	FLUK99 EGRR	EGYW

Note 1 RAFORS for these ranges are issued on request only. Forward requests to:

DEU Air Force Air Operations Command
GeoInfoCenter Muenster
Flight Weather Forecast Center Air Force
Manfred-von-Richthofen-Str. 8-20
D-48145 Muenster

E-Mail: ZentrLuftOpGeoInfoZentrLwII2WxBer@Bundeswehr.org
Telephone: +49 251 936 4771

Note 2 RAFORS for these ranges are issued on request only. Forward requests to:

DEU NAVY HQ GeoInfo Division
METOC Forecasting Section (Flight Weather Oceanographic Center (FWOC), Gluecksburg)
Uferstrasse
D-24956 Gluecksburg

E-Mail: MarKdoEinsGeoAnforderung@Bundeswehr.org
Telephone: +49 4631 666 3911
Telephone: +49 4631 666 3912

Note 3 RAFORS for these ranges are issued on request only. From 2200 hours local time Sunday to 1700 hours local time Friday forward requests to:

S Met O Guetersloh

c/o 1 Regt AAC
Princess Royal Kaserne
Marienfelder Strasse
D-33330 Guetersloh

Telephone:	+49 5241 842515	- Senior Met Officer
	+49 5241 842497	- Forecaster
Fax:	+49 5241 842975	
E-mail:	nimbusgut@metoffice.com	

If Guetersloh is closed, the request can be made to the Defence Met Centre (DMC) which is open continuously 24 hours, 7 days a week:

Met Ops
Met Office
HQSTC
RAF High Wycombe
Buckinghamshire
HP14 4UE
U.K.

Telephone:	+44 1494 461461 3748	DMC Chief Forecaster
Fax:	+44 1494 461461 2416	
E-mail:	dmc@metoffice.gov.uk	

Anyone requesting one of these RAFORs should provide the following information:

- name
- organisation
- telephone contact number
- fax and/or e-mail contact if they wish the RAFOR to be sent directly:

- which RAFOR is required
- period of validity of the RAFOR
- number of times each day the RAFOR is required (usually every 3 hours until the range closes)
- the days the RAFOR is required

Note 4 RAFORs for Garvie Island are issued on request only. Forward requests to:

S Met O
RAF Lossiemouth
Morayshire

IV31 6SD
U.K.

Telephone: +44(0)1343 817408 – Senior Met Officer
+44(0)1343 816898 – Forecaster
+44(0)1343 817799 – Fax
Email: nimbuslos@metoffice.gov.uk

Annexes C

NATO METOC Codes for Artillery

Annex C

Appendix C.1

Standard Ballistic Meteorological Message

1. General The purpose of this agreement is to define weighted ballistic meteorological messages (METB2 or METB3) and to standardize the number of information digits and their meanings for use by any artillery service of any country. The METB2 message is defined for use by anti-aircraft artillery, whilst the METB3 is for surface-to-surface-firing against targets on the ground or at sea. Both forms of the message provide ballistically weighted values of wind direction in hundreds of mils, wind speed in knots and virtual temperature and air density which are both reported in tenths of percent of the standard values (see Annex E.1). These data are given for the surface and for each of up to 21 standard zones above the surface up to a maximum altitude of 30 km, as required by the operational situation. The ballistic weighting provides a set of meteorological parameters for each zone, which are applicable for the entire trajectory of the projectile below this zone (Edition 4 dated 03 Oct 2000).

2. Appendices:
   - C.1.1: Message Structure and Standards
   - C.1.2: Q Code for Octant of Globe
   - C.1.3: Line Number - Standard Height of Target or Vertex Height above Meteorological Datum Plane
   - C.1.4: Definition of Meteorological Datum Plane, Zones and Standard Values, and Determination of Ballistic Elements
   - C.1.5: Specimens and Decoded Messages
   - C.1.6: Tables of Weighting Factors for Anti-Aircraft Fire (Message 2)
   - C.1.7: Tables of Weighting Factors for Surface-to-Surface Fire (Message 3)
   - C.1.8: Derivation of Ballistic Density

3. Related Documents:

STANAG 2211	IGEO – Geodetic Datums, Ellipsoids, Grids and Grid References Appendix E.1 MET - Adoption of a Standard Atmosphere
Appendix E.3	MET - Adoption of a Standard Artillery Computer Meteorological Message
Appendix E.4	MET - Format of Requests for Meteorological Messages for Ballistic and Special Purposes

4. Aim The aim of this agreement is to define a ballistic meteorological message and to standardize the number of its information digits and their meanings for use by any artillery service of any country. This will make it possible for all armed forces to understand and be able to use ballistic meteorological information issued by any service of any country.

5. Agreement: Participating nations agree to adopt the following:

   a. In connection with message construction two basic definitions as follows:

      (1) Message Structure: Which defines the "format" of the message and covers the overall size of the message, the ancillary signals necessary for transmission and reception, and the number of information digits but not their meaning nor the number of different operational messages that the system is capable of transmitting.

      (2) Message Standards: Which define the actual operational meaning of the information digits.

   b. The message structure shown at Appendix C.1.1 as far as the number of information digits is concerned.

   c. The message standards as set out at Appendix C.1.1.

Appendix C.1.1 - Message Structure (Standard Ballistic Meteorological Message)

The number of information digits (or letters) shall be as follows:

GROUP 1	METBKQ		
GROUP 2	$L_aL_aL_aL_oL_oL_o$	or	XXXXXX
GROUP 3	$YYG_oG_oG_oG$		
GROUP 4	hhhPPP		
GROUP 5	ZZddFF		
GROUP 6	TTT)))		

Groups 5 and 6 are repeated for each line of the message. Only those lines of the message which are required by the recipients need be included.

MESSAGE STANDARDS

GROUP 1

MET	Meteorological Message.
B	Ballistic.
K	Type of Message K = 2 for anti-aircraft fire K = 3 for surface-to-surface fire
Q	Code for the Octant of the Globe (See Appendix C.1.2).

GROUP 2

If Q = 0 to 3 or Q = 5 to 8 then

$L_aL_aL_aL_oL_oL_o$

$L_aL_aL_a$	Latitude of the centre of the area of applicability in tens, units and tenths of a degree.
$L_oL_oL_o$	Longitude of the centre of the area of applicability in tens, units and tenths of a degree. The hundreds digit is omitted for longitudes 100° to 180° inclusive.

If Q = 9 then

XXXXXX

XXXXXX	Location of the centre of the area of applicability, in clear or in code (alphanumeric), using NATO Grid Reference Systems (as defined in STANAG 2211), e.g., a 6 figure grid reference. This enables the location to be specified to a higher precision than can be done using geographical coordinates (latitude and longitude). Alternatively, XXXXXX may be used to define location names in clear text or in code.

GROUP 3

YY	Day of the month on which the period of validity of the message commences.
$G_oG_oG_o$	Time (GMT) of the commencement of the period of validity in tens, units and tenths of an hour, using the 24-hour clock from 000 to 239.

G	Duration of the period of validity, in hours from 1 to 8; code figure 9 indicates 12 hours.
GROUP 4	
hhh	Height of the Meteorological Datum Plane (MDP) above Mean Sea Level in decameters. See Appendix C.1.4 for definition of MDP.
PPP	Pressure at the MDP expressed as a percentage, to the nearest 0.1%, of the standard pressure. The initial figure is omitted if the pressure is standard or above. See Appendix C.1.4 for definition of standard pressure.
GROUP 5	
ZZ	Line number identifying a line in the message (two consecutive groups). The content of the corresponding line refers to trajectories for which the height above MDP of the vertex (surface-to-surface fire) or of the target (surface-to-air fire) has the value standardized for ZZ in Annex C.
dd	Direction from which the ballistic wind for the zone is blowing, measured clockwise from geographic North and expressed in thousands and hundreds of mils. Encode from 01 to 64. Encode 00 when wind is zero.
FF	Speed of the ballistic wind for the zone, expressed in tens and units of knots. See Appendix C.1.4 for definition of ballistic wind.
GROUP 6	
TTT	Ballistic air temperature in percent to the nearest 0.1%. The initial figure is omitted when the ballistic air temperature is standard or above. See Appendix C.1.4 for definition of ballistic air temperature.
)))	Ballistic air density in percent to the nearest 0.1%. The initial figure is omitted when the ballistic air density is standard or above. See Appendix C.1.4 for definition of ballistic air temperature.

Appendix C.1.2 - Q – Code For Octant Of The Globe

Q Code Figure	Greenwich Longitude	Hemisphere
0	0° to 90° W	
1	90° to 180° W	Northern
2	180° to 90° E	
3	90° to 0° E	
5	0° to 90° W	Southern
6	90° to 180° W	
7	180° to 90° E	
8	90° to 0° E	
9	To be used when the area of applicability is not indicated by latitude and longitude	

Appendix C.1.3 - Line Number – Standard Height Of Target Or Vertex (Height Above Meteorological Datum Plane)

ZZ	Meters
00	0
01	200
02	500
03	1000
04	1500
05	2000
06	3000
07	4000
08	5000
09	6000
10	8000
11	10000
12	12000
13	14000
14	16000
15	18000
16	20000
17	22000
18	24000
19	26000
20	28000
21	30000

Appendix C.1.4 - Definition of Meteorological Datum Plane, Zones and Standard Values, and Determination of Ballistic Elements

DEFINITION OF METEOROLOGICAL DATUM PLANE

The Meteorological Datum Plane (MDP) is the level surface to which the heights of the zones (layers) and the ballistic elements are related.

For Army use, the MDP is normally at the height of the Meteorological Station above mean sea level; for Navy use, the MDP is normally at mean sea level.

DEFINITION OF ZONES

Zones to be used for the determination of ballistic elements from aerological measured or forecast elements, are limited by heights above the MDP, given

in column 2 of the Table in Annex C.

The number of each zone is that of the line corresponding to its upper limit. For instance, zone 4 extends from 1500 meters down to 1000 meters.

DEFINITION OF STANDARD VALUES

The value of the standard pressure is 1013.25 hPa.

The standard values of temperature and density in each zone are as follows:

	ZONE	STANDARD VALUES	
CODE	Height of Limits (meters above MDP)	Temperature (Degrees K)	Density (g/m^3)
00	surface	288.150	1225.0
01	0 - 200	287.500	1213.3
02	200 - 500	285.875	1184.4
03	500 - 1000	283.275	1139.2
04	1000 - 1500	280.025	1084.6
05	1500 - 2000	276.775	1032.0
06	2000 - 3000	271.900	956.86
07	3000 - 4000	265.400	863.23
08	4000 - 5000	258.900	776.77
09	5000 - 6000	252.400	697.11
10	6000 - 8000	242.650	589.50
11	8000 - 10000	229.650	466.35

	ZONE	STANDARD VALUES	
CODE	Height of Limits (meters above MDP)	Temperature (Degrees K)	Density (g/m^3)
12	10000 - 12000	218.275	363.39
13	12000 - 14000	216.650	265.48
14	14000 - 16000	216.650	193.67
15	16000 - 18000	216.650	141.29
16	18000 - 20000	216.650	103.07
17	20000 - 22000	217.650	74.874
18	22000 - 24000	219.650	54.280
19	24000 - 26000	221.650	39.466
20	26000 - 28000	223.536	28.777
21	28000 - 30000	225.518	21.042

These standard values are taken from the1976 ICAO Atmosphere in accordance with Annex A.1, using geopotential heights. Because only very

small differences are involved, for purposes of this agreement geopotential and geometric heights may be used interchangeably to suit national ballistic purposes.

DETERMINATION OF BALLISTIC ELEMENTS

Ballistic temperature is obtained by computing the weighted* average of the relative values in the various zones, the relative value in each zone being the measured or forecast mean value of virtual temperature in absolute units expressed as a percentage of the standard temperature for that zone.

Ballistic density is obtained in a similar manner, i.e., by computing the weighted* average of the relative values in the various zones, the relative value in each zone being obtained by first computing the zone density from the mean virtual zone temperature and the pressure at the midpoint of the zone, and then expressing this zone density as a percentage of the standard density for the zone. Alternatively, ballistic density may be derived from weighted temperature and surface pressure by the method given in Appendix C.1.8.

Ballistic wind is obtained by computing the weighted* mean of the average winds in the various zones.

Appendix C.1.5 - Specimen Of Ballistic Meteorological Message

METB30	512018	070954	013992		
000000	971021	015702	971021	025906	972021
036009	972022	045810	975022	055711	975023
065813	977018	076115	981013	086319	987006
096321	991002	106429	991002	110136	991999
120137	991997	130132	991992	140129	991992
150127	991992				

This means:

INTRODUCTION

GROUP 1	Ballistic meteorological message for surface fire applicable to the Northern Hemisphere between 0° and 90° West.
GROUP 2	51°12'N; 01°48'W is the centre of the area of applicability.
GROUP 3	Day of month in the 7th; valid time is from 0930 to 1330 hours GMT.

* The weighting factors are given in Appendices E.2.6 and E.2.7. The use of the weighting functions on which the weighting factors are based is standardized, but the calculating technique is optional.

GROUP 4 Height of MDP above mean sea level is 130 m. Pressure at MDP is 99.2% of standard.

BODY OF MESSAGE

Line 00 of message:

GROUP 5	Ballistic wind:	calm.
GROUP 6	Ballistic air temperature:	97.1%
	Ballistic air density:	102.1%

Line 01 of message:

GROUP 7	Ballistic wind:	direction 5,700 mils. speed 2 kt.
GROUP 8	Ballistic air temperature:	97.1%
	Ballistic air density:	102.1%

Etc.

Appendix C.1.6 - Tables Of Weighting Factors For Anti-Aircraft Fire (Message 2)

Line No. - Lgne No.	STANDARD HEIGHT ABOVE HDP HAUTEUR STANDARD AU-DESSUS DU MDP (M)	ZONE NO. - ZONE NO.																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		0 to 200	200 to 500	500 to 1000	1000 to 1500	1500 to 2000	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 8000	8000 to 10000	10000 to 12000	12000 to 14000	14000 to 16000	16000 to 18000	18000 to 20000	20000 to 22000	22000 to 24000	24000 to 26000	26000 to 28000	28000 to 30000
1	200	1.00																				
2	500	0.50	0.50																			
3	1000	0.29	0.33	0.38																		
4	1500	0.16	0.25	0.39	0.20																	
5	2000	0.13	0.18	0.31	0.27	0.11																
6	3000	0.08	0.12	0.22	0.20	0.19	0.19															
7	4000	0.07	0.08	0.16	0.15	0.16	0.27	0.11														
8	5000	0.04	0.08	0.13	0.12	0.13	0.24	0.18	0.08													
9	6000	0.04	0.06	0.11	0.10	0.10	0.21	0.20	0.12	0.06												
10	8000	0.03	0.04	0.08	0.08	0.08	0.16	0.15	0.14	0.13	0.11											
11	10000	0.02	0.04	0.06	0.07	0.06	0.13	0.13	0.12	0.11	0.18	0.08										
12	12000	0.03	0.04	0.07	0.07	0.07	0.12	0.11	0.10	0.08	0.15	0.10	0.06									
13	14000	0.02	0.04	0.05	0.06	0.06	0.11	0.10	0.09	0.08	0.14	0.11	0.09	0.05								
14	16000	0.02	0.04	0.05	0.06	0.04	0.09	0.09	0.09	0.08	0.13	0.11	0.09	0.06	0.05							
15	18000	0.01	0.03	0.05	0.04	0.05	0.09	0.09	0.08	0.07	0.12	0.10	0.09	0.08	0.06	0.04						
16	20000		0.03	0.05	0.04	0.04	0.08	0.08	0.08	0.07	0.12	0.10	0.09	0.08	0.07	0.05	0.04					
17	22000		0.02	0.04	0.04	0.03	0.08	0.07	0.07	0.07	0.11	0.09	0.08	0.07	0.07	0.06	0.04	0.03				
18	24000		0.02	0.04	0.03	0.03	0.07	0.07	0.07	0.06	0.11	0.09	0.08	0.07	0.07	0.06	0.05	0.04	0.03			
19	26000		0.02	0.04	0.03	0.03	0.07	0.06	0.06	0.06	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.04	0.03	0.03		
20	28000		0.02	0.03	0.03	0.03	0.06	0.06	0.06	0.06	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.05	0.04	0.03	0.02	

21	30000		0.02	0.03	0.03	0.03	0.05	0.06	0.05	0.05	0.10	0.09	0.07	0.07	0.06	0.06	0.05	0.05	0.04	0.04	0.03	0.02

Wind Weighting Factors

Temperature Weighting Factors

Line No. - Lgne No.	STANDARD HEIGHT ABOVE HDP HAUTEUR STANDARD AU-DESSUS DU MDP (M)		ZONE NO. - ZONE NO.																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		0 to 200	200 to 500	500 to 1000	1000 to 1500	1500 to 2000	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 8000	8000 to 10000	10000 to 12000	12000 to 14000	14000 to 16000	16000 to 18000	18000 to 20000	20000 to 22000	22000 to 24000	24000 to 26000	26000 to 28000	28000 to 30000
1	200	1.00																				
2	500	0.63	0.37																			
3	1000	0.37	0.37	0.26																		
4	1500	0.25	0.30	0.35	0.10																	
5	2000	0.20	0.24	0.30	0.18	0.08																
6	3000	0.13	0.19	0.24	0.18	0.14	0.12															
7	4000	0.10	0.14	0.20	0.16	0.14	0.19	0.07														
8	5000	0.09	0.10	0.17	0.15	0.13	0.20	0.12	0.04													
9	6000	0.07	0.09	0.14	0.13	0.12	0.19	0.15	0.08	0.03												
10	8000	0.05	0.08	0.12	0.10	0.10	0.17	0.14	0.10	0.08	0.06											
11	10000	0.05	0.06	0.10	0.09	0.08	0.15	0.13	0.12	0.10	0.12	0.00										
12	12000	0.04	0.06	0.10	0.08	0.08	0.14	0.13	0.11	0.10	0.16	0.00	0.00									
13	14000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00								
14	16000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00							

15	18000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00	0.00					
16	20000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00	0.00					
17	22000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00	0.00					
18	24000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00	0.00					
19	26000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00	0.00					
20	28000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00	0.00					
21	30000	0.05	0.06	0.10	0.09	0.08	0.16	0.12	0.13	0.11	0.10	0.00	0.00	0.00	0.00	0.00					

Density Weighting Factors

Line No. - Lgne No.	STANDARD HEIGHT ABOVE HDP HAUTEUR STANDARD AU-DESSUS DU MDP (M)	ZONE NO. - ZONE NO.																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		0 to 200	200 to 500	500 to 1000	1000 to 1500	1500 to 2000	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 8000	8000 to 10000	10000 to 12000	12000 to 14000	14000 to 16000	16000 to 18000	18000 to 20000	20000 to 22000	22000 to 24000	24000 to 26000	26000 to 28000	28000 to 30000
1	200	1.00																				
2	500	0.63	0.37																			
3	1000	0.37	0.37	0.26																		
4	1500	0.25	0.30	0.35	0.10																	
5	2000	0.20	0.24	0.30	0.18	0.08																
6	3000	0.13	0.19	0.24	0.18	0.14	0.12															
7	4000	0.10	0.14	0.20	0.16	0.14	0.19	0.07														
8	5000	0.09	0.10	0.17	0.15	0.13	0.20	0.12	0.04													
9	6000	0.07	0.09	0.14	0.13	0.12	0.19	0.15	0.08	0.03												
10	8000	0.05	0.08	0.12	0.10	0.10	0.17	0.14	0.10	0.08	0.06											
11	10000	0.04	0.06	0.10	0.08	0.08	0.15	0.13	0.10	0.10	0.12	0.04										

12	12000	0.04	0.06	0.09	0.08	0.08	0.13	0.12	0.10	0.08	0.13	0.07	0.02									
13	14000	0.03	0.05	0.08	0.08	0.06	0.12	0.11	0.10	0.08	0.13	0.09	0.05	0.02								
14	16000	0.03	0.05	0.06	0.07	0.07	0.11	0.10	0.09	0.08	0.13	0.10	0.06	0.04	0.01							
15	18000	0.02	0.05	0.06	0.07	0.05	0.11	0.10	0.08	0.08	0.13	0.10	0.07	0.05	0.03							
16	20000	0.00	0.05	0.05	0.06	0.05	0.09	0.10	0.08	0.07	0.13	0.10	0.08	0.06	0.04	0.02						
17	22000	0.00	0.04	0.05	0.05	0.05	0.08	0.09	0.08	0.07	0.13	0.10	0.08	0.06	0.05	0.03	0.02					
18	24000	0.00	0.04	0.05	0.05	0.05	0.08	0.08	0.08	0.06	0.12	0.10	0.08	0.07	0.05	0.04	0.03	0.02				
19	26000	0.00	0.04	0.05	0.04	0.05	0.07	0.08	0.08	0.06	0.11	0.10	0.08	0.07	0.05	0.04	0.03	0.02	0.01			
20	28000	0.00	0.04	0.04	0.04	0.05	0.07	0.07	0.07	0.06	0.10	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01		
21	30000	0.00	0.04	0.04	0.03	0.04	0.07	0.06	0.07	0.06	0.10	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.01	

Appendix C.1.7 - Tables Of Weighting Factors For Surface-To-Surface Fire (Message 3)

Wind Weighting Factors

	STANDARD HEIGHT ABOVE HDP HAUTEUR STANDARD AU-DESSUS DU MDP (M)	ZONE NO. - ZONE NO.																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		0 to 200	200 to 500	500 to 1000	1000 to 1500	1500 to 2000	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 8000	8000 to 10000	10000 to 12000	12000 to 14000	14000 to 16000	16000 to 18000	18000 to 20000	20000 to 22000	22000 to 24000	24000 to 26000	26000 to 28000	28000 to 30000
1	200	1.00																				
2	500	0.20	0.80																			
3	1000	0.09	0.19	0.72																		
4	1500	0.06	0.12	0.26	0.56																	
5	2000	0.04	0.08	0.15	0.20	0.53																

6	3000	0.03	0.05	0.08	0.09	0.12	0.63															
7	4000	0.02	0.03	0.07	0.07	0.08	0.20	0.53														
8	5000	0.02	0.02	0.06	0.06	0.06	0.14	0.19	0.45													
9	6000	0.02	0.02	0.05	0.05	0.05	0.12	0.13	0.20	0.36												
10	8000	0.01	0.02	0.02	0.04	0.03	0.07	0.08	0.09	0.09	0.55											
11	10000	0.00	0.00	0.01	0.04	0.03	0.08	0.08	0.09	0.09	0.20	0.38										
12	12000	0.00	0.01	0.01	0.02	0.04	0.07	0.07	0.07	0.08	0.17	0.16	0.30									
13	14000	0.00	0.01	0.01	0.01	0.03	0.07	0.07	0.07	0.07	0.15	0.14	0.13	0.24								
14	16000	0.00	0.01	0.01	0.01	0.02	0.07	0.07	0.07	0.07	0.13	0.13	0.13	0.10	0.18							
15	18000	0.00	0.01	0.01	0.01	0.02	0.07	0.07	0.07	0.07	0.12	0.12	0.11	0.10	0.08	0.14						
16	20000	0.00	0.01	0.01	0.01	0.01	0.06	0.07	0.06	0.06	0.12	0.11	0.11	0.10	0.08	0.07	0.13					
17	22000	0.00	0.01	0.01	0.01	0.01	0.04	0.06	0.06	0.06	0.11	0.10	0.10	0.09	0.09	0.07	0.07	0.12				
18	24000	0.00	0.01	0.01	0.01	0.01	0.03	0.06	0.05	0.05	0.11	0.09	0.09	0.09	0.08	0.08	0.06	0.07	0.11			
19	26000	0.00	0.01	0.01	0.01	0.01	0.03	0.05	0.05	0.05	0.10	0.09	0.08	0.08	0.08	0.07	0.07	0.05	0.06	0.11		
20	28000	0.00	0.01	0.01	0.01	0.01	0.02	0.04	0.05	0.04	0.09	0.09	0.08	0.08	0.08	0.07	0.07	0.06	0.05	0.06	0.10	
21	30000	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.04	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.06	0.05	0.05	0.06	0.10

Temperature Weighting Factors

Line No. - Lgne No.	STANDARD HEIGHT ABOVE HDP HAUTEUR STANDARD AU-DESSUS DU MDP (M)	ZONE NO. - ZONE NO.									
		1	2	3	4	5	6	7	8	9	10 - 21
		0 to 200	200 to 500	500 to 1000	1000 to 1500	1500 to 2000	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 30000 (2km layers)
1	200	1.00									
2	500	0.27	0.73								
3	1000	0.13	0.20	0.67							
4	1500	0.08	0.12	0.25	0.55						
5	2000	0.05	0.10	0.20	0.21	0.44					
6	3000	0.04	0.04	0.09	0.11	0.13	0.59				
7	4000	0.02	0.04	0.07	0.09	0.11	0.26	0.41			
8	5000	0.01	0.03	0.05	0.04	0.10	0.19	0.23	0.35		
9 to 21	6000 to 30000 (2km layers)	0.01	0.01	0.02	0.03	0.03	0.09	0.13	0.24	0.44	0.00

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Density Weighting Factors

	STANDARD HEIGHT ABOVE HDP HAUTEUR STANDARD AU-DESSUS DU MDP (M)	ZONE NO. - ZONE NO.																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		0 to 200	200 to 500	500 to 1000	1000 to 1500	1500 to 2000	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 8000	8000 to 10000	10000 to 12000	12000 to 14000	14000 to 16000	16000 to 18000	18000 to 20000	20000 to 22000	22000 to 24000	24000 to 26000	26000 to 28000	28000 to 30000
1	200	1.00																				
2	500	0.43	0.57																			
3	1000	0.22	0.31	0.47																		
4	1500	0.15	0.21	0.32	0.32																	
5	2000	0.11	0.17	0.25	0.22	0.25																
6	3000	0.08	0.11	0.17	0.17	0.15	0.32															
7	4000	0.06	0.08	0.14	0.13	0.12	0.22	0.25														
8	5000	0.05	0.06	0.11	0.11	0.10	0.19	0.17	0.21													
9	6000	0.04	0.06	0.09	0.09	0.08	0.17	0.15	0.14	0.18												
10	8000	0.03	0.04	0.07	0.07	0.07	0.13	0.12	0.11	0.11	0.25											
11	10000	0.01	0.03	0.05	0.05	0.06	0.12	0.11	0.09	0.09	0.16	0.23										
12	12000	0.02	0.03	0.05	0.05	0.05	0.11	0.10	0.09	0.08	0.14	0.12	0.16									
13	14000	0.02	0.02	0.04	0.05	0.05	0.11	0.09	0.09	0.08	0.14	0.10	0.09	0.12								
14	16000	0.02	0.03	0.05	0.05	0.05	0.10	0.09	0.08	0.07	0.13	0.11	0.08	0.06	0.08							
15	18000	0.02	0.04	0.05	0.05	0.05	0.10	0.09	0.08	0.07	0.12	0.09	0.08	0.05	0.05	0.06						
16	20000	0.00	0.04	0.05	0.04	0.05	0.09	0.08	0.08	0.07	0.12	0.09	0.08	0.06	0.04	0.05	0.05					
17	22000	0.00	0.03	0.04	0.04	0.04	0.08	0.08	0.07	0.07	0.11	0.09	0.07	0.07	0.05	0.04	0.04	0.05				
18	24000	0.00	0.03	0.04	0.04	0.04	0.08	0.07	0.07	0.06	0.11	0.09	0.07	0.06	0.06	0.04	0.03	0.04	0.05			

19	26000	0.00	0.03	0.04	0.03	0.03	0.07	0.07	0.07	0.06	0.11	0.09	0.08	0.06	0.06	0.05	0.03	0.03	0.04	0.04		
20	28000	0.00	0.03	0.04	0.03	0.03	0.06	0.06	0.06	0.06	0.10	0.09	0.08	0.06	0.06	0.05	0.04	0.03	0.03	0.04	0.04	
21	30000	0.00	0.03	0.04	0.03	0.03	0.06	0.06	0.06	0.06	0.10	0.09	0.08	0.06	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.04

Appendix C.1.8 - Derivation Of Ballistic Density

Ballistic density may be obtained by using the appropriate weighting factors given in Appendix C.1.6 for Message 2 and Appendix C.1.7 for Message 3. Alternatively ballistic density may be derived from the surface pressure and a weighted temperature using the formula:

$$D_B = P - (T-1{,}000) \cdot f(Y_s)$$

where D_B = ballistic density in tenths per cent

P = pressure at the MDP in tenths per cent

T = weighted temperature in tenths per cent

and $f(Y_s)$ = the conversion factor for height Y_s.

The values of the conversion factor, $f(Y_s)$, to be used are tabulated below.

Line No.	Standard Altitudes: Y_s (m)	Conversion Factor: $f(Y_s)$	
		Message 2	Message 3
0	0	1.00	1.00
1	200	0.99	0.99
2	500	0.98	0.97
3	1,000	0.96	0.94
4	1,500	0.94	0.91
5	2,000	0.92	0.88
6	3,000	0.88	0.82
7	4,000	0.83	0.76
8	5,000	0.79	0.70
9	6,000	0.75	0.63
10	8,000	0.67	0.50
11	10,000	0.59	0.35
12	12,000	0.52	0.28
13	14,000	0.43	0.20
14	16,000	0.36	0.17
15	18,000	0.30	0.13

For Message 2 the values of the weighted temperature, T, are the values of the ballistic temperature obtained by using the weighting factors given in Appendix C.1.7. For message 3 the values of the weighted temperature for lines 1 to 9 are the corresponding ballistic temperatures obtained by using the weighting

factors given in Appendix C.1.7 and for lines 10 to 15 the weighted temperatures obtained by using the following weighting factors

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Line No. - Ligne No.	STANDARD HEIGHT ABOVE MDP HAUTEUR AU-DESSUS DU MDP (M)	ZONE NO. - ZONE NO.													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		0 to 200	200 to 500	500 to 1000	1000 to 1500	1500 to 2000	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 8000	8000 to 10000	10000 to 12000	12000 to 14000	14000 to 16000	16000 to 18000
10	8000	0.01	0.01	0.03	0.04	0.05	0.09	0.10	0.11	0.14	0.42					
11	10000	-0.04	-0.01	-0.02	-0.01	0.02	0.08	0.08	0.06	0.09	0.20	0.55				
12	12000	-0.01	-0.01	-0.02	-0.01	0.00	0.06	0.06	0.06	0.06	0.14	0.19	0.48			
13	14000	-0.02	-0.07	-0.08	-0.02	-0.01	0.05	0.03	0.07	0.09	0.16	0.11	0.19	0.50		
14	16000	-0.02	-0.02	-0.03	-0.02	-0.01	0.03	0.04	0.03	0.02	0.11	0.17	0.14	0.15	0.41	
15	18000	0.00	0.00	-0.03	-0.02	0.00	0.05	0.05	0.05	0.03	0.08	0.04	0.13	0.05	0.18	0.39

Annex C

Appendix C.2

Adoption of a Standard Artillery Computer Meteorological Message (METCM)

1. General: The purpose of this agreement is to define an unweighted computer meteorological message (METCM) and to standardize the number of information digits and their meanings for use by any artillery service of any country. This will make it possible for all armed forces to understand and be able to use an unweighted artillery meteorological message that is compatible with fire control computers. The METCM message provides meteorological input to the ballistic trajectory computations and gives wind direction in tens of mils, wind speed in knots, virtual temperature in tenths of degrees Kelvin and pressure in hectopascals. These data are given for the surface and for each of up to 31 standard zones above the surface up to a maximum altitude of 30 km, as required by the operational situation (Edition 2 dated 26 May 2001).

2. Appendices:

C.2.1. Message Format
C.2.2. Explanation of Symbolic Code
C.2.3. Specimens and Decoded Messages

3. Related Documents:

STANAG 2211	Geodetic Datums, Projections, Grids and Grid References
Appendix A.1	Adoption of a Standard Atmosphere
Appendix C.1	Adoption of a Standard Ballistic Meteorological Message
Appendix C.3	Format of Requests for Meteorological Messages for Ballistic and Special Purposes
Appendix C.5	Adoption of a Standard Target Acquisition Meteorological Message

4. Aim: The aim of this agreement is to define a computer meteorological message and to standardize the number of its information digits and their meanings for use by any artillery service of any country. This will make it possible for all armed forces to understand and be able to use an unweighted artillery meteorological message which is compatible with computers.

5. Agreement: Participating nations agree to adopt the message format for a Standard Artillery Computer Meteorological Message as shown at Appendix C.2.1, with explanation of symbolic code as shown at Appendix C.2.2 and specimen and decoded message as detailed in Appendix C.2.3.

APPENDIX C.2.1 - Message Format

1. The Standard Artillery Computer Meteorological Message shall consist of a number of groups which are represented in symbolic code as follows:

METCMQ•$L_aL_aL_aL_oL_oL_o$•YY$G_oG_oG_oG$•hhh$P_dP_dP_d$
$z_nz_n$dddFFF•TTTTPPPP
$z_nz_n$dddFFF•TTTTPPPP
$z_nz_n$dddFFF•TTTTPPPP

$z_nz_n$dddFFF•TTTTPPPP
99999

The message contains a single column holding several lines. Each line contains one or several fields separated by a single blank space (illustrated above with the • symbol which does not appear in the message). Message shall not contain blank or empty lines. End of message is given by a line with 99999.

Note: Characters $L_aL_aL_aL_oL_oL_o$ may, in certain cases, be replaced by 6 other characters: XXXXXX (see §2), however this is not recommended because latitude and longitude are frequently needed by message processing algorithms.

2. The first four groups of the Standard Artillery Computer Meteorological Message, i.e., METCMQ $L_aL_aL_aL_oL_oL_o$ YY$G_oG_oG_oG$ hhh$P_dP_dP_d$, comprise the introduction which contains identification information primarily. The second group $L_aL_aL_aL_oL_oL_o$ which contains position information in geographical coordinates (latitude and longitude) based on WGS 84, can be replaced by position information using NATO Grid Reference System (as defined in STANAG 2211 IGEO) in clear or in code in the form XXXXXX. Alternatively, XXXXXX may be used to define location names in clear text or in code.

3. Following the introduction, the body of the message contains meteorological information for use with artillery computers presented in pairs of eight-figure groups separated by a single blank space ($z_nz_n$dddFFF TTTTPPPP) which are called Lines. Each Line, except Line 00, contains mean wind direction and speed and mean virtual temperature for a specific layer in the atmosphere (called a Zone); also air pressure at the mid-height of the Zone.

4. For Line number 00, the values will be the actual values of the Meteorological Datum Plane (MDP). This Line must strictly be filled with accurate values for wind direction and windspeed, virtual temperature and pressure because it is used to initialize an automatic quality control process for upper layers. The upper and lower height limits (called Standard Heights) for zones are defined in Appendix C.2.2 in the definition of Line number (z_nz_n).

5. A complete message consists of the introduction and up to 32 Lines at maximum. It is not necessary that all 32 Lines be included in every message; only those Lines from the MDP to that Line(s) required by the artillery unit(s) initiating the request need to be included. Intermediate missing lines are not allowed. End of message is a line built with the following 5 characters: 99999.

Appendix C.2.2 - Explanation Of Symbolic Code

METCMQ

MET Meteorological Message

CM Artillery Computer

Q (0-3, 5-8) Code for the Octant of the Globe
(9) Use of position information

Q Code Figure	Greenwich Longitude	Hemisphere
0	0 to 90° W	Northern
1	90° to 180° W	
2	180°to 90° E	
3	90° to 0° E	
5	0° to 90° W	Southern
6	90° to 180° W	
7	180° to 90° E	
8	90° to 0° E	
9	Use of position information	

If Q = 0 to 3 or Q = 5 to 8, then

$L_aL_aL_aL_oL_oL_o$

$L_aL_aL_a$ Latitude of the centre of the area of applicability in tens, units and tenths of a degree.

$L_oL_oL_o$ Longitude of the centre of the area of applicability in tens, units and tenths of a degree. The hundreds digit is omitted for longitudes 100° to 180° inclusive.

If Q = 9, then

XXXXXX

XXXXXX Location of the centre of the area of applicability, in clear or in code (alphanumeric), using NATO Grid Reference Systems (as defined in

STANAG 2211 IGEO), e.g. a 6 figure grid reference. This enables the location to be specified to a higher precision than can be done using geographical co-ordinates (latitude and longitude). Alternatively, XXXXXX may be used to define location names in clear text or in code.$\underline{YYG_oG_oG_oG}$

YY Day of the month on which the period of validity of the message commences.

$G_oG_oG_o$ Time (UTC) of the commencement of the period of validity in tens, units and tenths of an hour, using the 24-hour clock from 000 to 239.

G Duration of the period of validity, in hours from 1 to 8; code figure 9 indicates 12 hours.

$\underline{hhhP_dP_dP_d}$

hhh Height of the Meteorological Datum Plane (MDP) above Mean Sea Level in decameters. The MDP is the horizontal surface to which heights of the zones and meteorological elements are referred. On land the MDP is normally at the height of the meteorological station above Mean Sea Level; at sea the MDP is normally at Mean Sea Level.

$P_dP_dP_d$ Pressure at the MDP expressed in hundreds, tens and units of hectopascals. When the value of air pressure is 1000 hPa or more, the thousand digit is omitted.

$\underline{Z_nZ_n}$dddFFF

Z_nZ_n Zone Number corresponding to a Line Number in the message. Zone Number 04 refers to a zone extending from 1000 meters to 1500 meters above the MDP. Zone Number 00 indicates zero height at the MDP.

ddd Direction from which the mean vector wind for the Zone is blowing, measured clockwise from geographic North and expressed in thousands, hundreds and tens of mils. Encode from 001 to 640, as 000 when the wind speed is zero. For Zone Number 00, the value will be the wind direction measured at the MDP.

FFF Speed of the mean vector wind for the zone, expressed in hundreds, tens and units of knots. For Zone Number 00, the value will be the wind speed measured at the MDP.

TTTTPPPP

TTTT Mean virtual temperature for the zone in hundreds, tens, units and tenths of a degree Kelvin. For Zone Number 00, the value will be the temperature measured at the MDP.

PPPP Air pressure at the mid-point of the zone, in thousands, hundreds, tens and units of hectopascals. For Zone Number 00, the value will be the pressure measured at the MDP.

ZONE NUMBER CODE

(All heights are above the Meteorological Datum Plane)

ZONE NUMBER CODE		
Z_nZ_n	Height above MDP of mid-point of zone (meters)	Height above MDP from base to top of zone (meters)
00	0	0
01	100	0 to 200
02	350	200 to 500
03	750	500 to 1000
04	1250	1000 to 1500
05	1750	1500 to 2000
06	2250	2000 to 2500
07	2750	2500 to 3000
08	3250	3000 to 3500
09	3750	3500 to 4000
10	4250	4000 to 4500
11	4750	4500 to 5000
12	5500	5000 to 6000
13	6500	6000 to 7000
14	7500	7000 to 8000
15	8500	8000 to 9000
16	9500	9000 to 10000
17	10500	10000 to 11000
18	11500	11000 to 12000
19	12500	12000 to13000
20	13500	13000 to 14000
21	14500	14000 to 15000
22	15500	15000 to 16000
23	16500	16000 to 17000
24	17500	17000 to 18000
25	18500	18000 to 19000
26	19500	19000 to 20000
27	21000	20000 to 22000
28	23000	22000 to 24000

29	25000	24000 to 26000
30	27000	26000 to 28000
31	29000	28000 to 30000

Appendix C.2.3 - Specimens And Decoded Messages

Example 1

METCM0 512018 070952 013972
00310004 29770972
01290013 29560961
02306014 29040933
03357014 28340890
04396007 28090837
05502008 28040787
06450015 27810742
07475013 27440696
08520013 27050653
09582018 26730613
10575017 26430575
11566016 26100538
12571015 25620487
13588009 25000427
14611011 24270372
15354012 23570323
16395016 22980278
17384014 22320240
18379028 21950206
19394021 21340175
20423017 20800149
21625016 20480126
22003019 20330107
23634025 20490091
24074023 20660077
25106026 20950066
26156029 21180056
27201030 21270043
28224030 21570032
29266035 21860016
30291036 21960016
31321040 22060013
99999

This decodes as follows:

Introduction

METCM0	MET	Meteorological Message
	CM	Computer
	0	Octant 0: Northern Hemisphere, 0° to 90° West.
512018	512	Latitude of the centre of the area of applicability is 51.2° North
	18	Longitude of the centre of the area of applicability is 1.8° West
070952	07	Period of validity commences on the 7th day of the month
	095	Start of the period of validity is at 09.5 hours, i.e. 09:30 hours UTC
	2	Valid period lasts for 2 hours, i.e. until 11:30 hours UTC
013972	013	Height of the MDP above Mean Sea level is 13 decameters
	972	Pressure at the MDP is 972 hPa

Body of the Message

00310004	00	Zone Number 00 denoting 0 meters above the MDP
	310	Wind direction at MDP is 3100 mils
	004	Wind speed at MDP is 4 knots
29770972	2977	Virtual air temperature at MDP is 297.7 K
	0972	Air pressure at MDP is 972 hPa
01290013	01	Zone Number 01, denoting zone 1 with upper limit 200 meters above the MDP
	290	Mean wind direction in the zone from 0 to 200 meters is 2900 mils
	013	Mean wind speed in the zone from 0 to 200 meters is 13 knots
29560961	2956	Mean virtual temperature for the zone from 0 to 200 meters is 295.6 K
	0961	Air pressure at the mid-height of the zone, i.e. at 100 meters, is 961 hPa
02306014	02	Zone Number 02, denoting zone 2 with upper limit 500 meters and lower limit 200 meters above the MDP

	306	Mean wind direction in the zone from 200 to 500 meters is 3060 mils
	014	Mean wind speed in the zone from 200 to 500 meters is 14 knots
29040933	2904	Mean virtual temperature for the zone from 200 to 500 meters is 290.4 K
	0933	Air pressure at the mid-height of the zone, i.e. at 350 meters, is 933 hPa

The remaining lines for zones 03 up to (a maximum) zone 31 are decoded in like manner.

99999 End of message line

Example 2

METCM9 WB8373 070952 013972
00000000 29770972
01290013 29560961
02306014 29040933
03350010 28340890
04396007 28090837
05502008 28040787
06450015 27700742
07475013 27440696
08520013 27050651
09582018 26730613
10575017 26430575
11566016 26100538
12571015 25620487
13588009 25000427
14611011 24270372
15354012 23570323
16395016 22980278
17384014 22320240
18379028 21950206
19394021 21340175
20423017 20800149
21625016 20480126
22003019 20330107
23634025 20490091
24074023 20660077
25106026 20950066
26156029 21180056
27201030 21270043
28224030 21570032

29266035 21860016
30291036 21960016
31321040 22060013
99999

This decodes as follows:

METCM9	MET	Meteorological Message
	CM	Computer
	9	Indicates use of NATO Grid Reference Systems, in clear or in code, for position information WB8373. Location of the centre of the area of applicability in Military Grid Reference System (MGRS) coordinates, given to an accuracy within 1 km. (Full coordinates are 30UWB834728 to an accuracy of within 100 m.)

The remaining lines are decoded in like manner to Example 1.
Note that wind speed is null for Zone Number 00 (MDP) therefore wind direction is also 000.

Annex C

Appendix C.3

Format for Requests for Meteorological Messages for Ballistic Purposes

1. General The purpose of this agreement is to define the format of a request (METR) for standard ballistic meteorological messages as adopted in Appendix C.1 (METB2 or METB3), for standard artillery computer meteorological messages as adopted in Appendix C.2 (METCM), and for standard target acquisition meteorological messages as adopted in Appendix C.5 (METTA) for use by any artillery service of any country. The METR specifies the type of message and the location and times for which it is required (Edition 4 dated 28 May 2001).

2. Appendices:
   - C.3.1: Message Structure and Message Standards
   - C.3.2: Q Code for Octant of the Globe
   - C.3.3: Target or Vertex Height (METB)
   - C.3.4: Zone Number Code (METCM)
   - C.3.5: Zone Number Code (METTA)
   - C.3.6: Specimen of Request for Meteorological Message for Ballistic and Special Purposes

3. Related Documents:

STANAG 2211	IGEO - Geodetic Datums, Projections, Grids and Grid References
Appendix A.1	MET - Adoption of a Standard Atmosphere
Appendix C.1	MET - Adoption of a Standard Ballistic Meteorological Message
Appendix C.2	MET - Adoption of a Standard Artillery Computer Meteorological Message
Appendix C.4	MET - Adoption of a Standard Target Acquisition Meteorological Message

4. Aim: The aim of this agreement is to define the format of a request for meteorological messages for ballistic and special purposes.

5. Agreement: Participating nations agree to adopt a standard format of requests for meteorological messages for ballistic and special purposes as presented by Appendices C.3.1 to C.3.6.

Appendix C.3.1 - Message Structure And Message Standards

APPENDIX 3 TO
ANNEX C TO
AMETOCP-4 VOL I

1. MESSAGE STRUCTURE

The number of information digits (or letters) shall be as follows:

GROUP 1 METRKQ

GROUP 2 $L_aL_aL_aL_oL_oL_o$ or XXXXXX

GROUP 3 $Y_0Y_0G_0G_0G_1G_1$

GROUP 4 $Z_0Z_0Z_1Z_1J_0J_1$

2. MESSAGE STANDARDS

GROUP 1

MET Meteorological Message

R Request

K Type of message:

2 Appendix C.1 (METB, anti-aircraft)

3 Appendix C.1 (METB, surface-to-surface)

6 Appendix C.4 (METTA, target acquisition)

9 Appendix C.2 (METCM, computer message)

Q Code for the octant of the Globe

GROUP 2

LaLaLa Latitude of the centre of the area of applicability in tens, units and tenths of degree

LoLoLo Longitude of the area of applicability in tens, units and tenths of degrees. For longitudes 100° or greater the hundreds digit is omitted.

or

XXXXXX Location of the centre of the area of applicability, in clear or in code (alphanumeric), using NATO Grid Reference Systems (as defined in STANAG 2211), e.g. a 6 figure grid reference. This

enables the location to be specified to a higher precision than can be done using geographical coordinates (latitude and longitude). Alternatively, XXXXXX may be used to define location names in clear text or in code.

GROUP 3

Y_0Y_0 Day of month (GMT) on which delivery of the first message is required.

G_0G_0 GMT time to the nearest hour of the day Y_0Y_0 at which delivery of the first message of the series is required.

G_1G_1 GMT time to the nearest hour of the day at which delivery of the last message of the series is required. This day Y_1Y_1 can be determined by using J_0 (in Group 4).

GROUP 4

Z_0Z_0 Lowest line of message required (see Annex C).

Z_1Z_1 Highest line of message required (see Annex C).

J_0 The number of days from 0 to 9, which must be added to Y_0Y_0 to find the last day for which support is required.

J_1 A number from 1 to 8 to designate a time interval in hours between successive MET messages and the number 9 to designate a twelve-hour interval, when more than one message is required. When only one message is required, (G_1G_1 is the same as G_0G_0 and Jo is 0) then J_1 from 1 to 8 designates the period in hours for which the message should be valid; the number 9 designates a twelve-hour period of validity. Where no period of validity is specified, J_1 is 0.

Appendix C.3.2 - Q Code For Octant Of The Globe

Q Code Figure	Greenwich Longitude	Hemisphere
0	0° to 90° W	
1	90° to 180° W	Northern
2	180° to 90° E	
3	90° to 0° E	
5	0° to 90° W	Southern
6	90° to 180° W	
7	180° to 90° E	
8	90° to 0° E	
9	Use when latitude and longitude are not used	

Appendix C.3.3 - Target Or Vertex Height (METB)
(Above Meteorological Datum Plane)

ZZ	Meters
00	0
01	200
02	500
03	1000
04	1500
05	2000
06	3000
07	4000
08	5000
09	6000
10	8000
11	10000
12	12000
13	14000
14	16000
15	18000
16	20000
17	22000
18	24000
19	26000
20	28000
21	30000

Appendix C.3.4 - Zone Number Code (METCM)
(All heights are above the Meteorological Datum Plane)

Z_nZ_n	Height above MDP of mid-point of zone (metres)	Height above MDP from base to top of zone (metres)
00	0	0
01	100	0 to 200
02	350	200 to 500
03	750	500 to 1000
04	1250	1000 to 1500
05	1750	1500 to 2000
06	2250	2000 to 2500
07	2750	2500 to 3000
08	3250	3000 to 3500
09	3750	3500 to 4000
10	4250	4000 to 4500
11	4750	4500 to 5000
12	5500	5000 to 6000
13	6500	6000 to 7000
14	7500	7000 to 8000
15	8500	8000 to 9000
16	9500	9000 to 10000
17	10500	10000 to 11000
18	11500	11000 to 12000
19	12500	12000 to 13000
20	13500	13000 to 14000
21	14500	14000 to 15000
22	15500	15000 to 16000
23	16500	16000 to 17000
24	17500	17000 to 18000
25	18500	18000 to 19000
26	19500	19000 to 20000
27	21000	20000 to 22000
28	23000	22000 to 24000
29	25000	24000 to 26000
30	27000	26000 to 28000
31	29000	28000 to 30000

Appendix C.3.5 Zone Number Code (METTA)
(All heights are above the Meteorological Datum Plane)

Z_tZ_t	Height above MDP of mid-point of zone (metres)	Height above MDP of Zone (metres)	
		Base	Top
00	0	0	0

01	25	0	50
02	75	50	100
03	150	100	200
04	250	200	300
05	350	300	400
06	450	400	500
07	550	500	600
08	650	600	700
09	750	700	800
10	850	800	900
11	950	900	1,000
12	1,050	1,000	1,100
13	1,150	1,100	1,200
14	1,250	1,200	1,300
15	1,350	1,300	1,400
16	1,450	1,400	1,500
17	1,550	1,500	1,600
18	1,650	1,600	1,700
19	1,750	1,700	1,800
20	1,850	1,800	1,900
21	1,950	1,900	2,000
22	2,050	2,000	2,100
23	2,150	2,100	2,200
24	2,250	2,200	2,300
25	2,350	2,300	2,400
26	2,450	2,400	2,500
27	2,550	2,500	2,600

Appendix C.3.6 - Specimens Of Request For Meteorological Message For Ballistic And Special Purposes

METR31
345983
050816
000624

This means:

GROUP 1

Ballistic meteorological message is requested for surface fire northern hemisphere between 90°W and 180°W.

GROUP 2

34°30’N; 98°18’W are latitude and longitude of the centre of the area of applicability.

GROUP 3

Delivery of the first message is required on the fifth day of the month at 08020 GMT. Delivery of the last message of the series is required at 1600 GMT on the seventh day of the month (for determination of the seventh day, see Group 4).

GROUP 4

00 is the lowest line of code and 06 is the highest line of code of the messages required.

Messages are required for two successive days following the day of delivery of the first message. In this specimen, messages are required on the fifth, sixth and seventh days of the month.

The time interval between successive messages is four hours.

Annex C

Appendix C.4

Adoption of a Standard Target Acquisition Meteorological Message (METTA)

1. General The purpose of this agreement is to (1) define a target acquisition meteorological message (METTA) for use by RPV, drone, weapon locating radar, and sound ranging systems, and (2) to standardize the number of information digits and their meanings for use by any artillery service of any country. This will make it possible for all armed forces to produce the message either by conventional or computer-based methods as well as to understand and use the message with conventional or computer based target acquisition systems. The METTA provides wind direction in tens of mils, wind speed in knots, temperature in tenths of degrees Kelvin and relative humidity in percent. These data are given for the surface and for each of up to 27 standard zones above the surface up to a maximum altitude of 2600 meters as required by the operational situation. Additionally, the METTA provides the height of the base of the lowest cloud at the point of observation in tens of meters and the refractive index at the surface (Edition 2 dated 28 May 2001).

2. Appendices:
   - C.4.1: Message Structure and Message Standards
   - C.4.2: Zone Number Code
   - C.4.3: Cloud Code
   - C.4.4: Specimen of a Standard Target Acquisition Meteorological Message

3. Related Documents:

STANAG 2211	IGEO - Geodetic Datums, Projections, Grids and Grid References
Appendix A.1	MET - Adoption of a Standard Atmosphere
Appendix C.1	MET - Adoption of a Standard Ballistic Meteorological Message
Appendix C.2	MET - Adoption of a Standard Artillery Computer Meteorological Message
Appendix C.3	MET - Format of Requests for Meteorological Messages for Ballistic and Special Purposes

4. Aim: The aim of this agreement is to define a target acquisition meteorological message for remotely-piloted vehicle, drone, weapon locating radar and sound ranging systems, and to standardize the number of its information digits and their meanings for use by any service of any country. This will make it possible for all armed forces to

   a. Produce the message either by conventional or automatic data processing (ADP) methods;

b. Understand and use the message with either conventional or ADP based drone, weapon locating radar and sound ranging systems.

5. Agreement: The armed forces of the NATO countries agree to adopt the message format for a standard target acquisition meteorological message, as shown at Appendix C.4.1, the zone number codes as detailed at Appendix C.4.2, the cloud code as detailed at Appendix C.4.3 and the specimen message as detailed at Appendix C.4.4.

Appendix C.4.1 - Message Structure And Message Standards

1. MESSAGE STRUCTURE
(Standard Target Acquisition Meteorological Message)

The number of information digits (or letters) shall be as follows:

GROUP 1 METTAQ

GROUP 2 $L_aL_aL_aL_oL_oL_o$ or XXXXXX

GROUP 3 $Y_0Y_0G_0G_0G_0G$

GROUP 4 $hhhP_dP_dP_d$

GROUP 5 CCCNNN

GROUP 6 $Z_tZ_t$dddFFF

GROUP 7 ttttUU

NOTES

(a) GROUPS 6 and GROUP 7 will be repeated for each zone number of the message. Only those zones of the message that are required by the recipient need be included.

(b) If any data is not available, the missing data will be indicated with a slash (/) for each missing digit. This note applies also to optional groups such as NNN in GROUP 5.

2. MESSAGE STANDARDS

GROUP 1

MET Meteorological Message

TA A Target Acquisition Message

Q Octant of the Globe as defined in Table 1 (page A-3)

GROUP 2

LaLaLa Latitude of the centre of the area of applicability in tens, units and tenths of degree.

LoLoLo Longitude of the area of applicability in tens, units and tenths of degrees. For longitudes 100° or greater the hundreds digit is omitted.

or

XXXXXX Location of the centre of the area of applicability, in clear or in code (alphanumeric), using NATO Grid Reference Systems (as defined in STANAG 2211), e.g. a 6 figure grid reference. This enables the location to be specified to a higher precision than can be done using geographical coordinates (latitude and longitude). Alternatively, XXXXXX may be used to define location names in clear text or in code.

GROUP 3

YY Day of month (GMT) of the commencement of the period of validity of the message.

$G_0G_0G_0$ Time of the commencement of the period of validity in tens, units and tenths of an hour (GMT) using the 24-hour clock from 000 to 239.

G The duration of the period of validity in hours from 1 to 8, code figure 9 indicating 12 hours.

GROUP 4

hhh Height of the meteorological datum plan (MDP) above Mean Sea Level in decametres. The MDP is the horizontal surface to which heights of the zones and meteorological elements are referred. On land the MDP is normally the height of the meteorological station above Mean Sea Level; at sea the MDP is normally at Mean Sea Level.

$P_dP_dP_d$ Pressure at the MDP expressed in hundreds, tens and units of hectoPascals. When the value of the air pressure is 1000 hPa or more the thousand digit is omitted.

GROUP 5

CCC The height above the MDP of the base of the lowest cloud at the point of observation, given in tens of metres above the MDP, in accordance with the Cloud Code at Appendix C.5.3.

NNN (Optional) The mean refractive index at the surface in "N" units. If NNN is not to be included in the message, the missing data will be indicated by three slashes - ///.

GROUP 6

Z_tZ_t Zone number code (see Appendix C.5.2).

ddd Mean wind direction for the zone given in thousands, hundreds and tens of mills (true). For zone number 00 the value will be the wind direction at the MDP.

FFF Mean wind speed of the zone in hundreds, tens and units of knots. For zone number 00 the value will be the wind speed at the MDP.

GROUP 7

tttt Mean air temperature of the zone in hundreds, tens, units and tenths Kelvin. For zone number 100 the value will be the air temperature at the MDP.

UU Mean relative humidity of the zone expressed as percentage in tens and units. 100% is denoted by 00. For zone 00 the value is to be the relative humidity at the MDP.

Q Code Figure	Greenwich Longitude	Hemisphere
0	0° to 90° W	Northern
1	90° to 180° W	
2	180° to 90° E	
3	90° to 0° E	
5	0° to 90° W	Southern
6	90° to 180° W	
7	180° to 90° E	
8	90° to 0° E	
9	Use when latitude and longitude are not used	

TABLE 1. Q Code for Octant of the Globe

Appendix C.5.2 - Zone Number Code

Z_tZ_t	Height of mid-point of Zone above MDP (metres)	Height above MDP of Zone (metres)	
		Base	Top
00	0	0	0
01	25	0	50
02	75	50	100
03	150	100	200
04	250	200	300
05	350	300	400
06	450	400	500
07	550	500	600
08	650	600	700
09	750	700	800
10	850	800	900
11	950	900	1,000
12	1,050	1,000	1,100
13	1,150	1,100	1,200
14	1,250	1,200	1,300
15	1,350	1,300	1,400
16	1,450	1,400	1,500
17	1,550	1,500	1,600
18	1,650	1,600	1,700
19	1,750	1,700	1,800
20	1,850	1,800	1,900
21	1,950	1,900	2,000
22	2,050	2,000	2,100
23	2,150	2,100	2,200
24	2,250	2,200	2,300
25	2,350	2,300	2,400
26	2,450	2,400	2,500
27	2,550	2,500	2,600

Appendix C.4.3 - Cloud Code

000	Sky obscured by fog.
001-160	Visual estimate of base of lowest cloud in tens of metres, if below 1,600 m.
166	Visual estimate is that base of lowest cloud is above 1,600 m.
199	Sky clear.

301-460	Subtract 300 to obtain base of lowest cloud observed by searchlight or laser in tens of metres if below 1,600 m.
466	Base of lowest cloud observed by searchlight or laser is above 1,600 m.
499	No cloud detected by searchlight or laser.
501-660	Subtract 500 to obtain height at which a balloon begins to disappear in cloud in tens of metres if below 1,600 m.
666	Balloon lost above 1,600 m.

NOTE: Each service will use that portion of the code appropriate to its own procedures.

Appendix C.4.4 - Specimen Of A Target Acquisition Meteorological Message

RAW DATA

1. The meteorological station location is UK (Lulworth), where:

    a. Time is GMT.

    b. The centre of the area of applicability is 50° 36’ N (50.6° N), 02° 14’ W (2.2° W).

    c. Octant of the globe is Northern Hemisphere 0° to 90° West.

2. Details of balloon launch are:

    a. Launch was at 1200 hrs on 3rd April (GMT).

    b. Period of validity is 2 hours.

    c. Height of MDP above mean sea level is 20 m.

    d. Pressure at MDP is 1,010 hPa.

    e. Measured surface temperature is 17.6C, (290.8° Kelvin).

    f. Height at which balloon was lost in cloud is 1,200 m.

    g. Mean relative humidity is 80% at MDP.

    h. Surface Refractive Index is not required in this message.

3. Message requested to zone number 02.

Actual conditions are:

Zone No.	Wind Direction	Wind Speed (Knots)	Temperature (°C)	Humidity (%)
00	270° (4,800 mils)	08	17.6 (290.8 Kelvin)	80
01	282° (5,013 mils)	10	16.8 (290.0 Kelvin)	84
02	307° (5,458 mils)	15	15.7 (288.9 Kelvin)	88

CODED MESSAGE

METTAO 506022 031202 002010
620 / / /
00480008 290880
01501010 290084
02546015 288988

ANNEX D

NATO METOC Codes for CBRN

Appendix D.1

Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas (Operators Manual, ATP-45)

1. General The purpose of this publication is to prescribe the chemical, biological, radiological and nuclear (CBRN) procedures to be followed by the Land, Air and Naval Forces for the reporting of all nuclear detonations and of enemy biological or chemical attacks and resulting contamination, reporting of CBRN releases other than attack (ROTA), predicting and warning of hazard areas from CBRN attacks and from ROTA, evaluation of CBRN information and the influence of CBRN incidents on operations, and interchange of reports, quoted above, between NATO forces and national military and civil authorities and agencies.

Current meteorological data are a vital prerequisite for radiological fallout and biological, chemical and ROTA downwind hazard prediction.

Meteorological services will distribute the messages described below.

(1) CBRN Basic Wind Report (CBRN BWR)
These are messages containing information on wind directions (from which the wind is blowing) and wind speeds in a number of layers from the surface of the earth to 30000 m altitude to be used for detailed fallout prediction. Additionally, the zone of validity and time of measuring are stated.

(2) CBRN Effective Downwind Report (CBRN EDR).
These are messages containing information on downwind speed and downwind direction (towards which the wind is blowing) for each of seven pre-selected weapon yields. The CBRN EDR is used to calculate simplified fallout hazard prediction areas.

(3) CBRN Chemical Downwind Report (CBRN CDR).
These are messages containing basic meteorological information for predicting chemical vapour hazard areas, biological aerosol and radioactive particles.

2. Related Documents:

STANAG 2047 CBRN	Emergency alarms of hazard or attack (CBRN and air attack only)

STANAG 2083 CBRN	Commander's guide on nuclear radiation exposure of groups during war
STANAG 2104 CBRN	Friendly nuclear strike warning (STRIKWARN)
AEP-45	Programmers manual for reporting nuclear detonations, biological and chemical attacks, and predicting and warning of associated hazards and hazard areas

3. Aim: The aim of this agreement is to register national acceptance of ATP-45 in its currently valid version.

4. Agreement: Participating nations agree to use ATP-45 in its currently valid version.

Changes to ATP-45 will be incorporated into the publication and will be accepted as part of it provided they have been formally offered by the Military Committee Joint Standardization Board (MCJSB), NSA, to national authorities concerned and have been agreed by them.

ANNEXES E

NATO Maritime METOC Codes

Overview

Appendix E.1 VELO code

Appendix E.2 Noise Measurement Code

Appendix E.3 Standard Format for Oceanographic Forecasts

Appendix E.4 OPTASK METOC

Appendix E.5 OPTASK REA

Appendix E.6 MIHUSOFOR Forecast Format

Appendix E.7 Marine Mammal Sighting Report Format

Appendix E.8 BATHY Code

Appendix E.9 Additional Military Layers (AML)

Appendix E.10 BOWWAVE Acronym

Annex E

Appendix E.1

VELO code

See AMETOCP-4 Vol II.

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Appendix E.2

Noise Measurement Code

See AMETOCP-4 Vol II.

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Appendix E.3

Standard Format for Oceanographic Forecasts

See AMETOCP-4 Vol II.

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Appendix E.4

OPTASK METOC

See AMETOCP-4 Vol II.

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Appendix E.5

OPTASK REA

See AMETOCP-4 Vol II.

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Appendix E.6

MIHUSOFOR Forecast Format

See AMETOCP-4 Vol II.

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Appendix E.7

NATO UNDERSEA RESEARCH CENTRE – Marine Mammal Sighting Report Format

See AMETOCP-4 Vol II.

Annex E

Appendix E.8

BATHY Code

A report of bathythermal information is compiled with the BATHY code. The code form and regulations are described in the WMO manual on codes, chapter **FM 63–XI Ext. BATHY.**

Annex E

Appendix E.9

Additional Military Layers (AML) – Digital Geospatial Data Products

1. Appendices:

E.9.1	Additional Military Layers
E.9.2	Glossary

2. Related Documents:

International Hydrographic Organisation (IHO) Special Publication 57, 3.1 Edition 2000	Transfer Standard for Digital Hydrographic Data
AGeoP-3	Digital Geographic Information Exchange Standard (DIGEST)
STANAG 4564	Standard for Warship Electronic Chart Display and Information System (WECDIS)
STANAG 1116 MW	Specifications for Naval Mine Warfare Information and for Data Transfer AMP-11
STANAG 3715 IGEO	Specifications for filing and charting of Non-Sub Contacts (NSC) Information
NATO Geospatial Policy	MC296/1, February 2006

3. Aim: The aim of this agreement is to define a set of geospatial data products for the publication and exchange of all of types of:

a. hydrographic information beyond that necessary solely for maritime navigation as defined by International Convention for the Safety of Life at Sea (SOLAS), 1974, Chapter V.
b. oceanographic climatological information
c. meteorological climatological information

4. Agreement: Participating nations agree that:

a. The terms “Additional Military Layers” and “AML” shall not be used except to describe the concept and products identified in this agreement.
b. AML is defined as: “AML is a unified range of digital geospatial data products designed to satisfy the totality of NATO non-navigational maritime defence requirements.”
c. AML Product Specifications utilise the Common Product Specification Framework defined by STANAG 4564.

d. All AML products will be constructed using the WGS84 horizontal datum.
e. The Content Model developed for AML products will be designed for compatibility with the relevant elements of the content models of associated products such as ENC and DNC.
f. This STANAG covers the nature and scope of AML.
g. Product specifications and their maintenance are managed by a routine procedure. Details of the product specifications can be found in Annex E.9.1, Paragraphs 12 – 15.
h. The AML concept allows for the use of different exchange standards (e.g. S-57). The product specification separates the generic definition of the content of each AML product (held in the main body of the specification), from exchange standards (defined in annexes of the specification). This approach ensures interoperability at the information (content model) level, while allowing flexibility in the format of the data.
i. Subject to design of user systems, AML products provided in different exchange standards can be combined in a single display. AML products also may be displayed with backdrop navigational chart data in raster or vector form.
j. A single product specification may result in a number of data products for the same geographic area. These data products may vary because of scale, security classification or be different subsets of the data content defined in the specification. These content and scale of these different products will be dictated by the intended use of that product.
k. This agreement does not mandate the use of any particular symbolization standard for AML Products. It is expected that any implementation would conform to the relevant standards pertaining to its own operation. For example IHO S-52 – Colours and Symbols Specifications for ECDIS; Mil-Std 2525C Common Warfighting Symbology /APP-6B Joint Symbology; Mil-Prf-89045 Geospatial Symbols for Digital Displays (GEOSYM).

5. General: The agreement contains two annexes. Their contents are described below:
d. Appendix E.9.1 provides an overview of the AML concept and product;
e. Appendix E.9.2 provides a Glossary.

6. Details of Agreement: The details of the agreement are given in Appendix E.9.1.

Appendix E.9.1 - Additional Military Layers

INTRODUCTION:

1. This annex provides an overview of the concept and development of AML.

OVERVIEW:

2. AML is defined in Para 2.b of this agreement.
3. It is designed to provide the defence maritime user with digital vector and gridded data to support situational awareness across the full range of warfare scenarios at every operating level from strategic planning to tactical operation.
4. It is designed to be deployable within a wide range of systems including headquarters planning, command and control, navigational (WECDIS) – in conjunction maritime navigational products such as ENC – weapon systems and sensors (e.g. SONAR).

ORIGIN AND HISTORY:

5. The AML initiative has defined maritime digital products for the defence user. The original concept paper for AML was presented to the GeoRWG in 1996 (GeoRWG, London, April 1996: “Additional Information Layers for Military Hydrographic Use”, R. Carpenter, UKHO).
6. Version 1.0 of AML was published in November 2001. This consisted of six logical layers of information, the content of each being defined within their own product specification. These six layers defined digital vector information and covered the following areas:
   - Contour Line Bathymetry (CLB)
   - Large Bottom Objects (LBO, wrecks and items on the seabed of more than 5 metres long)
   - Small Bottom Objects (SBO, mine-like contacts and items on the seabed of less than 5 metres long)
   - Environment, Seabed and Beach (ESB)
   - Routes, Areas and Limits (RAL)
   - Maritime Foundation and Facilities (MFF)
7. Version 2.1 of AML was published in November 2005. This version extended the features contained within the six vector product specifications, changed some features between product specifications and re-modelled some features within the SBO product specification. However it retained the six separate vector specifications as defined in V1.0.
8. In addition three gridded product specifications have been added to the AML concept:
   - Integrated Water Column (IWC) – Version 2.1, Jun 2006
   - Atmospheric and Meteorological Climatology (AMC) – Version 1.0, Nov 2004
   - Gridded Sediment – Environment Seabed and Beach (GS-ESB) – Draft Version 1.0, Jul 2005
9. Version 3.0 of AML was published in July 2008. This version has only affected the six vector specifications. The gridded specifications remain unchanged. Version 3.0 has combined the six vector product specifications into a single product specification. It has also extended the features described within AML.

GOVERNANCE OF AML:

10. AML development is directed by the Geospatial Maritime Working Group (GMWG) and all versions of AML endorsed by them.
11. The GMWG is tasked by the NATO Geospatial Board (NGB to whom it reports once a year and as required. For oceanographic and meteorological contents GMWG will liaise with the Military Committee Meteorology and Oceanography Group (MC METOC Group).

PRODUCT SPECIFICATIONS:

12. The NATO endorsed Product Specifications for the three concurrent versions of AML are the authority for AML products.
13. The Product Specifications define the data content, format and structure of all AML products.
14. These specifications must be referred and adhered to by any AML production or receiving system.
15. The endorsed AML Product Specifications may be accessed via the AML web page hosted on the United Kingdom Hydrographic Office website (www.ukho.gov.uk).

PRODUCT FORMAT:

16. The AML product specification has been written in two parts. The main part of the product specification describes the content of the product without specifying any particular format. Annexes to the product specification describe how that content should be encoded in a particular format. (e.g. Annex A of the vector product specification describes the S-57 format encoding.)
17. Currently the only NATO endorsed format for the vector product specifications is S-57.
18. The format for the gridded IWC and GS-ESB products is netCDF. The format for the gridded AMC product is GRIB.

IMPLEMENTATION:

19. As described above there are currently three concurrent versions of the AML vector product specifications.
20. As of the date of STANAG 7170, Ed. 2, all three versions are current. This is because of the need to support legacy systems still requiring earlier versions of the specification.
21. The version of AML a NATO nation chooses to adopt will be dictated by the capability of their AML receiving systems and the requirements for interoperability across warfare disciplines and between NATO nations and NATO commands.

22. Further information should be sought from the GMWG with respect to the implementation strategy for AML and the timeline for migrating to later versions of AML.

NATO STATUS:

23. AML as defined by this agreement is a mandated product for WECDIS as defined in STANAG 4564.
24. AML is recognised as a core requirement for NATO maritime geospatial requirements (Geospatial Maritime Information Requirements in Support to NATO, version1.2, Mar 2008).

ENCRYPTION:

25. In the interests of international interoperability, AML products will not be encrypted.

FUTURE DEVELOPMENTS:

26. Under the direction of GMWG a further gridded specification is being developed: Network Model Bathymetry (NMB). This will provide a regular gridded model of bathymetric data.
27. It is likely that further formats for AML products will be defined, including GML.
28. The emergence of international standards for geospatial information, namely the ISO 191XX series of standards, will dictate the future development of AML products. The IHO S-100 Geospatial Standard for Marine Data and Information, is an example of a maritime standard conformant to the ISO standards. It is anticipated that GMWG will conform to, and where necessary extend, the S-100 standard for future defence maritime geospatial data.
29. Information with respect to these developments should be obtained from the GMWG.

Appendix E.9.2 - Glossary for AML

Acronym	Definition
AHHWG	Ad Hoc Hydrographic Working Group - established by NGC in 1998 as forum of maritime experts to consider hydrographic aspects of the NGP. Replaced by GMWG.
CPSF	Common Product Specification Framework - template for writing of product specifications defined in Annex B of STANAG 4564.
DGIWG	Defence Geospatial Information Working Group - Non NATO body of (mainly) land and air mapping bodies.
DIGEST	Digital Geographic Exchange Standard - produced by DGIWG
DNC	Digital Nautical Chart (US vector chart in VPF).
ECDIS	Electronic Chart Display and Information System - when used

	with an ENC becomes a legal replacement for a paper chart for maritime navigation
ENC	Electronic Navigational Chart
GeoRWG	Geographic Requirements Working Group - subordinate group to NGC
GMWG	Geospatial Maritime Working Group. Succeeded AHHWG.
GRIB	WMO bit-oriented data exchange format (GRIdded Binary)
IHO	International Hydrographic Organisation
MC METOC GROUP	Military Committee Meteorology and Oceanography Group
METOC	Meteorological Oceanographic
NetCDF	Network Common Data Format
NGC	NATO Geospatial Conference
NGP	NATO Geospatial Policy
NGA	National Geospatial-Intelligence Agency - US defence agency
S-57	IHO Transfer Standard for Digital Hydrographic Data
VPF	Vector Product Format - a NGA developed variant of one of the standard DIGEST formats (NATO STANAG 7074)
WECDIS	Warship ECDIS
WMO	World Meteorological Organisation

Annex E

Appendix E.10

BOWWAVE Acronym

BOWWAVE is an acronym for the elements of a long form weather report. The meaning of the letters is described in STANAG 1401 (APP-7).

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