S-412

Weather Warnings Data Classification and Encoding Guide

Edition 1.2.0 – February 2026

IHO

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Document History

Changes to the Product Specification S-412 are coordinated by the SERCOM, formely JCOMM.

Table 1

Version Number	Date	Approved By	Purpose
1.2.0	January 2026	WMO	Initial document creation by IIC Technologies. Version number in line with the PS.

1 Overview

1.1 Preface

The “Data Classification and Encoding Guide” has been developed to provide consistent, standardized instructions for encoding S-412 data.

The purpose of the Data Classification and Encoding Guide is to facilitate S-412 encoding to meet WMO SERCOM standards for the proper display of Marine Weather Warning information in an ECDIS. The document describes how to encode marine weather information considered relevant to be displayed on an ECDIS.

The content of a Marine Weather Warning product is at the discretion of the producing authority, provided that the conventions described within this document are followed. A “producing authority” is a Hydrographic Office (HO) or an organization authorized by a government, HO or other relevant government institution to produce Marine Weather Warning product.

1.2 S-412 Annex A — Data Classification and Encoding Guide — Metadata

NOTE This information uniquely identifies this Annex to the Product Specification and provides information about its creation and maintenance.

Title	The World Meteorological Organization Marine Weather Warning Product Specification, Annex A – Data Classification and Encoding Guide
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Identifier	S-412 Annex A
Maintenance	Changes to S-412 Annex A; Data Classification and Encoding Guide are coordinated by the SERCOM, formely JCOMM and must be made available via the IHO web site.

1.3 Terms, definitions and abbreviations

1.3.1 Terms and definition

See S-412 Product Specification main document, clause 1.4.

1.3.2 Abbreviated terms

For a list of abbreviations, see S-412 Product Specification main document, Clause 1.6.1.

1.4 Use of language

Within this document: • “Must” indicates a mandatory requirement.
• “Should” indicates an optional requirement, that is the recommended process to be followed, but is not mandatory.
• “May” means “allowed to” or “could possibly” and is not mandatory.

1.5 Maintenance

Changes to the Data Classification and Encoding Guide must occur in accordance with the S-412 Marine Weather Warning Product Specification clause 1.9.

2 General

2.1 Introduction

This S-412 Data Classification and Encoding Guide (DCEG) contains rules and guidance for converting data describing the real world into data products that conform to the S-412 specification.

The S-412 specification contains an application schema (UML model) describing the conceptual domain model in terms of classes and a Feature Catalogue that specifies the data model, i.e., specifies the data model types corresponding to the various classes in the application schema.

To simplify the DCEG text, the various data model types will be provided without the suffixes “class”, “type” or “instance”; e.g. the term “feature” should be understood as “feature class” or “feature type” or “feature instance” as best fits the immediate context in which it is used (and where there might be confusion, it is written out in full as feature class/type/instance). The model defines real world entities as a combination of descriptive and spatial characteristics (S-412 Product Specification — section 4).

This clause of the DCEG contains general information needed to understand the encoding rules and describes fundamental common rules and constraints. It also describes datasets and metadata. The data model object types used within S-412 and their encoding rules and guidelines are defined in detail in subsequent clauses of this document.

Within this document the features and attributes appear in bold text or italic text, to distinguish them from surrounding words.

2.2 Multiple Datasets

In order to facilitate the efficient processing and exchange of S-412 data, S-412 data files will be split by the time and date in which the file data is valid.

Guidance to be enhanced by WMO.

2.3 Descriptive characteristics

2.3.1 Feature

A feature contains descriptive attributes that characterize real world entities.

The word ‘feature’ as used in the ISO 191xx series and in S-100 based product specifications has two distinct but related senses – ‘feature type’ and ‘feature instance’. A feature instance is a single occurrence of the feature and is represented as an object in a dataset.

The location of a feature instance on the Earth’s surface is indicated by a relationship to one or more spatial primitive instances.

S-412 makes use of the Geographic (Geo) feature type which carries the descriptive characteristics of a real-world entity and of the Information type feature which carries information associated to on or more geo feature.

2.3.2 Geographic feature class

Geographic (Geo) feature types carry the descriptive characteristics of a real world entity which is provided by a spatial primitive instance.

2.3.3 Meta feature class

S-412 does not make use of meta features.

2.3.4 Charted background feature

The data product is primarily distributed to be visualized as an overlay of an S-101 ENC on an ECDIS or other GIS applications. Consequently, all necessary descriptive and spatial characteristics to provide a charted background should be provided by the underlying application.

2.4 Spatial characteristics

2.4.1 Spatial primitives

The allowable geometric primitive for each feature type is defined in the Feature Catalogue. The only allowable geometric primitive in an S-412 data product is surface.

Each spatial value must be referenced by at least one feature instance.

2.4.2 Time

S-412 datasets can represent real-world phenomena in the present or future. Because of the unique nature of atmospheric and oceanographic concepts and their geographical changes in time, a variety of time attributes are included in S-412 to ensure instances of features are attributed correctly through time. Features or information types outside of the temporal range of a dataset shall not be included in a dataset. Time shall always be provided in Coordinated Universal Time (UTC).

The dateTimeRange is a complex attribute consisting of simple attributes, dateTimeStart and dateTimeEnd, to allow certain features to define a specific temporal range. The dateTimeRange attribute is mandatory for each feature. This attribute provides data producers the flexibility to manage the temporal resolution of their datasets at the feature level and to concatenate data files in a manner which best suits their workflow and customer's needs. In order for features to be portrayed, the user's system must clearly indicate the dateTimeRange of a feature or a group of features if the values are the same. Instances of this attribute may be used for data validation and to ensure temporal quality.

Three other simple dateTime attributes (issuedDateTime, nextUpdateDateTime, and cancellationDate) are mandatory for each WeatherWarning and inherited into the sub-feature types. The issuedDateTime attribute provides a timestamp for when the WeatherWarning has been issued. The nextUpdateDateTime attribute provides the time information for the next expected WeatherWarning to be issued. The cancellationDate {is used to mark when a WeatherWarning is set to expire, or be cancelled}.

3 Geo Features

3.1 Convergent Boundary

3.2 IceAccretionWarning

Table 3-1

IHO Definition : A product issued by a national authority when ice accumulation rates pose a hazard to vessels.
S-412 Geo Feature: IceAccretionWarning
Primitives: surface

Table 3-2

S-412Attribute	Acronym	Allowable Encoding Value	Type	Multiplicity
iceAccretionRate	()		EN	1,1
sourceOfIcing	()		EN	0,1

fixedDateRange	()		C	1,1
weatherWarningMessage	()		C	0,1
issueDate	()		DT	1,1
weatherWarningNumber	()		TE	1,1
cancellationDate	()		DT	1,1
nextUpdateDateTime	()		DT	1,1
interoperabilityIdentifier	()		URN	0,1

3.3 RestrictedVisibilityWarning

Table 3-3

IHO Definition : A product issued by a national authority when horizontal visibility is degraded to less than 0.5 nautical miles by fog, smoke, dust, haze, heavy precipitation, or any other phenomena.
S-412 Geo Feature: RestrictedVisibilityWarning
Primitives: surface

Table 3-4

S-412Attribute	Acronym	Allowable Encoding Value	Type	Multiplicity
fixedDateRange	()		C	1,1
weatherWarningMessage	()		C	0,1
issueDate	()		DT	1,1
weatherWarningNumber	()		TE	1,1
cancellationDate	()		DT	1,1
nextUpdateDateTime	()		DT	1,1
interoperabilityIdentifier	()		URN	0,1

3.4 SignificantWaveHeightWarning

Table 3-5

IHO Definition : A product issued by a national authority when sea state conditions pose a hazard or are life-threatening.
S-412 Geo Feature: SignificantWaveHeightWarning
Primitives: surface

Table 3-6

S-412Attribute	Acronym	Allowable Encoding Value	Type	Multiplicity
significantWaveHeightWarningThreshold	()		EN	1,1
fixedDateRange	()		C	1,1

weatherWarningMessage	()		C	0,1
issueDate	()		DT	1,1
weatherWarningNumber	()		TE	1,1
cancellationDate	()		DT	1,1
nextUpdateDateTime	()		DT	1,1
interoperabilityIdentifier	()		URN	0,1

3.5 ThunderstormWarning

Table 3-7

IHO Definition : A product issued by a national authority when an area of thunderstorms or squalls poses a hazard. Conditions could include strong winds, locally higher waves, potentially heavy precipitation, hail, and dangerous lightning strikes.
S-412 Geo Feature: ThunderstormWarning
Primitives: surface

Table 3-8

S-412Attribute	Acronym	Allowable Encoding Value	Type	Multiplicity
fixedDateRange	()		C	1,1
weatherWarningMessage	()		C	0,1
issueDate	()		DT	1,1
weatherWarningNumber	()		TE	1,1
cancellationDate	()		DT	1,1
nextUpdateDateTime	()		DT	1,1
interoperabilityIdentifier	()		URN	0,1

4 Attributes and Enumerates Descriptions

4.1 beaufortForce

Table 4-1

IHO Definition : Wind force scale, originally based on the state of the sea, expressed in numbers from 0 to 12, as defined by WMO (WMO 306 Manual on Codes, Volume I.1 — International Codes). **Attribute Type :** enumeration 99) calm **IHO Definition** :Absence of air motion or wind with a speed of less than 1 knot (Beaufort scale wind force 0). 1) light air **IHO Definition** :Wind with a speed between 1 and 3 knots (Beaufort scale wind force 1) 2) ligth breeze **IHO Definition** :Wind with a speed between 4 and 6 knots (Beaufort scale wind force 2). 3) gentle breeze **IHO Definition** :Wind with a speed between 7 and 10 knots (Beaufort scale wind force 3). 4) moderate breeze **IHO Definition** :Wind with a speed between 11 and 16 knots (Beaufort scale wind force 4). 5) fresh breeze

IHO Definition :Wind with a speed between 17 and 21 knots (Beaufort scale wind force 5).
6) strong breeze
IHO Definition :Wind with a speed between 22 and 27 knots (Beaufort scale wind force 6).
7) near gale
IHO Definition :Wind with a speed between 28 and 33 knots (Beaufort scale wind force 7).
8) gale
IHO Definition :Wind with a speed between 34 and 40 knots (Beaufort scale wind force 8).
9) strong glae
IHO Definition :Wind with a speed between 41 and 47 knots (Beaufort scale wind force 9).
10) storm
IHO Definition :Wind with a speed between 48 and 55 knots (Beaufort scale wind force 10).
11) violent storm
IHO Definition :Wind with a speed between 56 and 63 knots (Beaufort scale wind force 11).
12) hurricane
IHO Definition :(1) Term, derived from a Caribbean word, first applied to tropical cyclones of the Caribbean Sea. (2) Wind with a speed 64 knots or higher (Beaufort scale wind force 12).

Remarks : Note: for S-412, we will limit the attribute to enumeration values 7-12.

4.2 iceAccretionRate

Table 4-2

IHO Definition : Represents the ice accretion warning that has been exceeded or forecast to be exceeded based on ice accumulation rates.
Attribute Type : enumeration
1) moderateIcing
IHO Definition :Ice accumulation rates between 0.7 and 2 centimeters per hour are forecast or occurring.
2) severeIcing
IHO Definition :Ice accumulation rates greater than or equal to 2 centimeters per hour are forecast or occurring.

Remarks :

4.3 metareaName

Table 4-3

IHO Definition : A name referencing a defined geographical area of the ocean used to coordinate the transmission of meteorological information and services to mariners.
Attribute Type : enumeration
1) METAREA I
IHO Definition :METAREA 1.
2) METAREA II
IHO Definition :METAREA 2.
3) METAREA III
IHO Definition :METAREA 3.
4) METAREA IV
IHO Definition :METAREA 4.
5) METAREA V
IHO Definition :METAREA 5.
6) METAREA VI
IHO Definition :METAREA 6.
7) METAREA VII
IHO Definition :METAREA 7.
8) METAREA VIII
IHO Definition :METAREA 8.
9) METAREA IX
IHO Definition :METAREA 9.
10) METAREA X
IHO Definition :METAREA 10.
11) METAREA XI
IHO Definition :METAREA 11.

12) METAREA XII
IHO Definition :METAREA 12.
13) METAREA XIII
IHO Definition :METAREA 13.
14) METAREA XIV
IHO Definition :METAREA 14.
15) METAREA XV
IHO Definition :METAREA 15.
16) METAREA XVI
IHO Definition :METAREA 16.
17) METAREA XVII
IHO Definition :METAREA 17.
18) METAREA XVIII
IHO Definition :METAREA 18.
19) METAREA XIX
IHO Definition :METAREA 19.
20) METAREA XX
IHO Definition :METAREA 20.
21) METAREA XXI
IHO Definition :METAREA 21.

Remarks :

4.4 significantWaveHeightWarningThreshold

Table 4-4

IHO Definition : Represents the significant wave height warning that has been exceeded or is forecast to be exceeded based on predetermined bins of significant wave height values.
Attribute Type : enumeration
1) two and a half to four metres
IHO Definition :Significant wave heights between 2.5 and 4 metres (8-13 feet) are forecast or occurring.
2) four to six metres
IHO Definition :Significant wave heights between 4 and 6 metres (13-20 feet) are forecast or occurring.
3) six to nine metres
IHO Definition :Significant wave heights between 6 and 9 metres (20-30 feet) are forecast or occurring.
4) nine to fourteen metres
IHO Definition :Significant wave heights between 9 and 14 metres (30-45 feet) are forecast or occurring.
5) greater than fourteen metres
IHO Definition :Significant wave heights greater than 14 metres (>45 feet) are forecast or occurring.

Remarks :

4.5 text

Table 4-5

IHO Definition : A non-formatted digital text string.
Attribute Type : text

Remarks : Should be used, for example, to hold the information that is for short cautionary or explanatory notes. Therefore, text populated in text must not exceed 300 characters. Text may be in English, or in a national language. No formatting of text is possible within text. If formatted text, or text strings exceeding 300 characters, is required, then an alternate concept should be used.

4.6 language

Table 4-6

IHO Definition : The method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way.
Attribute Type : text

Remarks : The language is encoded by a 3 character code following ISO 639-2/T.

4.7 agencyName

Table 4-7

IHO Definition : The name of an agency, entity or organization.
Attribute Type : text

Remarks :

4.8 mailingAddress

Table 4-8

IHO Definition : The physical address a parcel may be sent to.
Attribute Type : text

Remarks :

4.9 telephoneNumber

Table 4-9

IHO Definition : The telephone number of an entity.
Attribute Type : text

Remarks :

4.10 emailAddress

Table 4-10

IHO Definition : Identifies an email box to which email messages are delivered.
Attribute Type : text

Remarks :

4.11 webAddress

Table 4-11

IHO Definition : A reference to a web resource that specifies its location on a computer network and a mechanism for retrieving it.
Attribute Type : text

Remarks :

4.12 countryName

Table 4-12

IHO Definition : The name of a nation.
Attribute Type : text

Remarks :

4.13 dateStart

Table 4-13

IHO Definition : dateStart
Attribute Type : S100_TruncatedDate

Remarks :

4.14 dateEnd

Table 4-14

IHO Definition : dateEnd
Attribute Type : S100_TruncatedDate

Remarks :

4.15 issueDate

Table 4-15

IHO Definition : The time, expressed in Universal Time Coordinated (UTC) at which an object and its attributes are issued from an agency.
Attribute Type : dateTime

Remarks : 19850412T183059 denotes 18 hours, 30 minutes, and 59 seconds on 12 April 1985.

4.16 weatherWarningNumber

Table 4-16

IHO Definition : Identification number given to a specifc weather warning.
Attribute Type : text

Remarks :

4.17 cancellationDate

Table 4-17

IHO Definition : Date and time of cancelling a notice or warning.
Attribute Type : dateTime

Remarks :

4.18 nextUpdateDateTime

Table 4-18

IHO Definition : The time, expressed in Universal Time Coordinated (UTC) an object and its attributes are scheduled to be updated.
Attribute Type : dateTime

Remarks : Unit: Years, months, days, hours, minutes, secondsResolution:1 secondFormat: YYYYMMDDTHHMMSS, where Y is year, M is month, D is day, H is hour, M is minute, and S is secondExample: 19850412T183059 denotes 18 hours, 30 minutes, 59 seconds on 12 April 1985.

4.19 interoperabilityIdentifier

Table 4-19

IHO Definition : interoperabilityIdentifier **Attribute Type :** URN **Remarks :**

4.20 timeOfDayStart

Table 4-20

IHO Definition : timeOfDayStart **Attribute Type :** dateTime **Remarks :**

4.21 timeOfDayEnd

Table 4-21

IHO Definition : timeOfDayEnd **Attribute Type :** dateTime **Remarks :**

4.22 fileReference

Table 4-22

IHO Definition : fileReference **Attribute Type :** text **Remarks :**

4.23 sourceOfIcing

Table 4-23

IHO Definition : The type of weather phenomenon causing hazardous ice accretion. **Attribute Type :** enumeration 1) freezingSpray **IHO Definition** :Sea spray transported through air at temperatures below 0C. 2) freezingRain **IHO Definition** :Precipitation drops freezing on impact to form a coating of clear ice (glaze) on the ground and on exposed objects. 3) freezingFog **IHO Definition** :Tiny, supercooled liquid water droplets in fog can freeze instantly on exposed surfaces when surface temperatures are at or below freezing. 4) otherIcingSource **IHO Definition** :Source of icing is unknown or is different from other types of icing sources. **Remarks :**

4.24 windWarningThreshold

Table 4-24

IHO Definition : Represents the wind warning that has been exceeded or forecast to be exceeded.
Attribute Type : enumeration
1) near gale force
IHO Definition :Wind speeds between 28 and 33 knots (Beaufort scale wind force 7) are forecast or occurring.
2) gale force
IHO Definition :Wind speeds between 34 and 47 knots (Beaufort scale wind force 8 and 9) are forecast or occurring.
3) storm force
IHO Definition :Wind speeds between 48 and 63 knots (Beaufort scale wind force 10 or 11) are forecast or occurring.
4) hurricane force
IHO Definition :Sustained wind speeds 64 knots or higher (Beaufort scale wind force 12) are forecast or occurring.

Remarks :

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