1 Environmental Message Version: 3

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DAC: 367 FI: 33

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Future variant: NUID instead of message linking ID – at least 18 bits and also include ability to link multiple GN's together for even bigger areas.

Summary of changes:

Release Version 3

- Revised message version parameter definition to limit it to 15 versions in accordance with RTCM recommendation.
- Added new sensor owners.
- Added over/under range indications for dew point.
- Added better description of Beaufort scale.
- Added new version of Wind report that allows for other than 10min averaging window.
- Updated usage notes and reordered.
- Set version to 3.

Release Version 2c

- Corrected some typos in the description parameters, no change to message format.

Release Version 2b

- Corrected some typos in the description parameters, no change to message format.

Release Version 2

- Added Sensor Data Description to end of horizontal current report and air gap report.

- Set version to 2.

Release Version 1b:

- Changed usage notes to reflect Linked Text message vs Text Description message.

Release Version 1a:

- Changed some verbiage in the usage notes – no changes to message.

Release Version 1:

- Changed DAC to 367 to reflect final message. Set version to 1.

- Added message version parameter to Site Location Report (SR0). Also modified altitude parameter to allow for negative altitudes (relative to MSL).

- Added some clarifying text about direction and datum

- Deleted vertical reference point in Horizontal Current report and made reports relative to water surface to be consistent with other reports

- Added text to Air Gap report to handle the case of no gap (water above the sensor level)

Previous changes to drafts:

- Added precision parameter to Site Location Report

- Corrected Vertical Current Profile (3D) Report (negative rates needed)

- Corrected text in Air Gap Report description parameters

1.1 Introduction

The Environmental message is intended for a wide variety of environmental data, including: current flow, water level, water temperature, visibility, and air gap. The message has the ability to provide both real-time and forecast data. A message version number is includes in the SR0 parameter to indicate which version of the message is being used.

In order to maximize flexibility, this message can be used to transmit from 1 to 8 sensor reports (a 1 sensor report uses 1 slot while a message with 8 sensor reports requires 5 slots). These sensor reports can be data from one location or from multiple locations. In addition, the data does not need to be sent at the same update rate allowing data that changes more rapidly to be sent more often than slowly changing data. Static data such as sensor position can be sent even less frequently.

The framework for the Environmental message is shown in Table 1. Each Environmental message has 56 bits of standard header and from 1 to 8 sensor reports (112 bits each). Each sensor report has 27 bits of common data leaving 85 bits for sensor data. The framework for the sensor report is shown in Table 3. There are a variety of sensor types that can be transmitted using this message; 4 bits gives 16 possible values, these are listed in Table 4. Details for the 85 bits of information for each sensor report type are detailed in Tables 5 – 15. All possibilities for each data parameter are described. In each case *Sensor Not available* means that the specific reading is not ever possible from that sensor

location. *Data Not available* means that the reading is possible, but is not available for the current report (sensor could be malfunctioning).

All directions are relative to True North, all positions are WGS-84 Datum.

1.2 Usage notes

1. The Site ID is used to link the site location, identification, and sensor data. A single location may have multiple physical sensors at that location, generating a variety of data elements, allowing for the creation of multiple sensor reports from that location.
2. From 1 to 8 sensor reports can be assembled into a message; these can be from the same site or multiple sites. The number of reports assembled into a message is an operational decision based upon the maximum number of slots that are desired to be used for a single message. A single slot message can be created by using just one sensor report while it takes 5 slots to send a message with 8 sensor reports.
3. Up to 5-slot messages can be created, but messages with more than 3 slots should be avoided as messages with more slots are less likely to be received due to RF noise or packet collision.
4. The transmission schedule of the message should be based upon the latency of the data and the maximum time that a new user should expect to wait to receive the data. For example, NOAA PORTS® data is updated every 6 minutes, so it would be prudent to broadcast it every 3 minutes, thus ensuring at least two opportunities to receive the data in the sensor's epoch. In cases where data is updated infrequently (such as daily or hourly) the transmission schedule should be on the order of every 5 to 10 minutes to ensure that a new user does not have to wait overly long to receiver the message.
5. The sensor reports are a combination of dynamic and static information; the static information such as location and identification should be transmitted less often than the dynamic information (sensor readings).
6. The competent authority should always transmit the most recent data (based upon the timestamp of the data) available; older versions of the same data elements should not be transmitted. Data should also not be transmitted past the data expiration time.
7. Portrayal systems should automatically update upon receiving new data. Users should be able to retrieve the time of the data and the last data received.
8. Presentation software should automatically remove the data from the display once it is past the expiration date/time.
9. Since a Sensor Report 0 (Site Location) must be received before the relevant sensor data can be used, the EM version number is part of this report. If the received version number is different than what the display system has been programmed for, a message should be displayed to the operator indicating the mismatch in the version.

10. The Site ID can also be used to link additional text (e.g., a separate text message). However, the same source MMSI needs to send both the Environmental Message and additional Linked Text message (See Linked Text Message).
11. Some of the sensor reports include provisions for short-term forecasts or NowCasts. These are intended to be limited to only a few hours in the future and are only valid for a maximum of 255 minutes from the start of the forecast. The UTC day is included as part of the start time of the forecast to allow for the cases when it is near the end of the current day and a forecast a few hours in the future would fall on the next UTC day.

1.3 Message Format

Table 1: Environmental Message Framework – Broadcast

Parameter			# of bits	Description
Standard Message Header		Message ID	6	Identifier for Message 8; **always 8**.
		Repeat Indicator	2	Used by the repeater to indicate how many times a message has been repeated. (See ITU-R M.1371-3, Annex 2, § 4.6.1). 0 – 3; 0 = default; 3 = do not repeat any more. **Set to 0** (default).
		Source MMSI	30	MMSI number of source station. This varies according to the transmitter ID.
		Spare	2	Not to be used. **Set to zero.**
Binary Data		Designated Area Code	10	Designated area code (DAC). (See Rec. ITU-R M.1371-3 § 2.1, Annex 5). **Set to 367** (US).
		Function Identifier	6	Function identifier. **Set to 33.**
	Application Data	Sensor Report 1	112	Sensor report, structured as in Table 14. 1-slot message.
		Sensor Report 2	112	Optional additional sensor report, structured as in Table 14. 2-slot message.
		Sensor Report 3	112	Optional additional sensor report, structured as in Table 14. 3-slot message.
		Sensor Report 4	112	Optional additional sensor report, structured as in Table 14. 3-slot message.
		Sensor Report 5	112	Optional additional sensor report, structured as in Table 14. 4-slot message.
		Sensor Report 6	112	Optional additional sensor report, structured as in Table 14. 4-slot message.
		Sensor Report 7	112	Optional additional sensor report, structured as in Table 14. 5-slot message.
		Sensor Report 8	112	Optional additional sensor report, structured as in Table 14. 5-slot message.
Total bits			**168 - 952**	**1 – 5 slot message**

Table 2: Environmental Message – Number of Slots

Number of sensor reports transmitted in one message	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Number of bits used for a broadcast message	168	280	392	504	616	728	840	952
Number of slots used for a broadcast message	1	2	3	3	4	4	5	5

Table 3: Environmental Message Sensor Report Framework

Parameter		**# of bits**	**Description**
Report Type		4	Environmental Report Type as per Table 4.
Time of Data	UTC day	5	UTC day of the time of the data. 1 – 31; 0 = UTC day not available = default.
	UTC hour	5	UTC hour of the time of the data. 0 – 23; 24 = UTC hour not available = default; 25 - 31 (reserved for future use).
	UTC minute	6	UTC minute of the time of the data. 0 – 59; 60 = UTC minute not available = default; 61 - 63 (reserved for future use).
Site ID		7	Binary identifier of sensor site– combined with transmitter MMSI to fully identify sensor site (i.e., there can be more than one physical sensors, each reporting different data types at a sensor site).
Sensor Data		85	Remaining 85 bits are according to the sensor type – see Tables 5-15.
Total bits		**112**	

Table 4: Sensor Report Types

Value	Description	Table
0	Site Location	5
1	Station ID	6
2	Wind	8
3	Tide/river stage (water level)	9
4	Vertical Current Profile (2D)	10
5	Vertical Current Profile (3D)	11
6	Horizontal Current Profile	12
7	Sea state	13
8	Salinity	15
9	Weather	16
10	Air gap / Air draft	17
11	Wind v2	18
12	(reserved for future use)	N/A
13	(reserved for future use)	N/A
14	(reserved for future use)	N/A
15	(reserved for future use)	N/A

Table 5: Sensor Site Location

Parameter	# of bits	Description
Message Version	6	Sequential number used to indicate the message version in steps of 1. 0 = test message = default; 1 – 15 = message version; 16 – 63 = not to be used. **Set to 3**.
Longitude	28	Longitude of the center in 1/10,000 minute (±180°) in WGS-84 datum. East = positive, West = negative (as per 2's complement); 181° (6791AC0h) = not available = default.
Latitude	27	Latitude of the center in 1/10,000 minute (±90°) in WGS-84 datum. North = positive, South = negative (as per 2's complement); 91° (3412140h) = not available = default.
Precision	3	Precision of the Lat/Long. Data to be truncated to the number of decimal places specified in this parameter. 0-4 decimal places. Default = 5 (unknown); 5-6 = reserved; 7 = Do not use.
Altitude	12	Altitude of the sensor relative to MSL in 0.1 meter steps. Range of -200 – 200 m; Negative values in 2's complement. 2,001 = altitude 200 m or greater; 2,002 = data unavailable = default; 2,003 – 2,046 = reserved; 2,047 = not to be used.
Sensor Owner	4	Owner of the sensor/responsible for the sensor data. 0 = unknown = default; 1 = U.S. NOAA National Ocean Service (hydrographic office); 2 = U.S. Army Corps of Engineers (inland waterway authority); 3 = coastal directorate; 4 = NOAA National Weather Service (meteorological service); 5 = State or Port Authority; 6 = U.S. Coast Guard; 7 = U.S. Navy; 8 = Energy or Environmental Agency; 9 = Transportation Agency; 10 = Academic or Research Institution; 11 = Private or Commercial Service; 12 = Marine Exchange or Port Service; 13 = US Geologic Survey 14 = Other; 15 = not to be used.

Parameter	# of bits	Description
Data Timeout	3	Length of time that data is valid (i.e., should not be used after timeout period). 0 = no timeout period = default; 1 = 10 min; 2 = 1 hr; 3 = 6 hrs; 4 = 12 hrs; 5 = 24 hrs; 6 = 5 min; 7 = reserved.
Spare	2	Not used. Set to zero.
Total bits	**85**	

Table 6: Station ID

Parameter	# of bits	Description
Name	84	Maximum 14 characters 6-bit ASCII as defined in ITU 1371-5, Table 47. "@@@@@@@@@@@@@@" = not available = default. If less than 14 characters, the remainder of the parameter should be filled with "@" characters (set bits to 0); but, not shown on the presentation.
Spare	1	Not to be used. Set to zero.
Total bits	**85**	

Table 7: Sensor Data Parameter Descriptions

0	no data = default
1	raw real time;
2	real time with Quality Control;
3	predicted (based historical statistics);
4	forecast (predicted, refined with real-time information);
5	Nowcast (a continuous forecast);
6	reserved;
7	sensor not available.

Table 8: Wind Report.

Parameter		# of bits	Description
Wind Speed		7	Average of wind speed values over the last 10 minutes in 1 knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = data unavailable = default; 123 – 126 = reserved; 127 = not to be used.
Wind Gust		7	Max wind speed reading during the last 10 minutes in 1 knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = data unavailable = default; 123 – 126 = reserved; 127 = not to be used.
Wind Direction		9	Direction of the average wind over the last 10 minutes in 1 degree increments. 0 – 359 degrees; 360 = not available = default; 361 - 510 = reserved; 511 = not to be used.
Wind Gust Direction		9	Direction of the max wind over the last 10 minutes in 1 degree increments. 0 – 359 degrees; 360 = not available = default; 361 - 510 = reserved; 511 = not to be used.
Sensor Data Description		3	Type of data from Wind sensor. See Table 7.
Forecast Wind Speed		7	Predicted average wind speed in 1 knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = not available = default; 123 - 126 (reserved for future use); 127 = not to be used.
Forecast Wind Gust		7	Predicted maximum wind speed in 1 knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = not available = default; 123 - 126 = reserved; 127 = not to be used.
Forecast Wind Direction		9	Predicted direction of the average wind in 1 degree steps. 0 – 359 degrees; 360 = not available = default; 361 - 510 = reserved; 511 = not to be used.
Valid Time of Forecast	UTC day	5	UTC day of the forecast. 1 – 31; 0 = UTC day not available = default.
	UTC hour	5	UTC hour of the forecast. 0 – 23; 24 = UTC hour not available = default; 25 - 31 = reserved.
	UTC minute	6	UTC minute of the forecast. 0 – 59; 60 = UTC minute not available = default; 61 - 63 = reserved.
Duration of Forecast		8	Duration of the validity of the forecast from the time of the forecast, in one minute steps. 1 - 255 minutes; 0 = cancel forecast = default.
Spare		3	Not to be used. Set to 0.
Total bits		**85**	

Table 9: Tide/River Stage (Water Level) Report

Parameter		# of bits	Description	
Water Level Type		1	Type of water level. 0 = relative to reference datum; 1 = water depth.	
Water Level		16	Water level in centimeters. -327.67 to +327.67 m; -32,767 = -327.67 m or less (as per 2's complement); +32,767 = +327.67 m or greater (as per 2's complement); -32,768 = data unavailable = default.	
Water Level Trend		2	Trend in water level. 0 = increasing; 1 = decreasing; 2 = steady; 3 = unknown / data unavailable = default.	
Vertical Reference Datum		5	Defines type of datum used.	
			0 = Mean Lower Low Water (MLLW); 1 = International Great Lakes Datum (IGLD-85); 2 = local river datum; 3 = Station Datum (STND); 4 = Mean Higher High Water (MHHW); 5 = Mean High Water (MHW); 6 = Mean Sea Level (MSL); 7 = Mean Low Water (MLW); 8 = National Geodetic Vertical Datum (NGVD-29)	9 = North American Vertical Datum (NAVD-88); 10 = World Geodetic System (WGS-84); 11 = Lowest Astronomical Tide (LAT); 12 = Pool; 13 = Gauge; 14 = unknown/unavailable = default; 15 - 30 = reserved; 31 = not to be used.
Sensor Data Description		3	Type of data from Water Level sensor. See Table 7.	
Forecast Water Level Type		1	Type of water level for forecast. 0 = relative to reference datum; 1 = water depth.	
Forecast Water Level		16	Forecast water level in centimeters; range of -327.66 to +327.66 meters. -327.66 to +327.66 m; -32,767 = -327.67 m or less (as per 2's complement); +32,767 = +327.67 m or greater (as per 2's complement); -32,768 = data unavailable = default.	
Valid Time of Forecast	UTC day	5	UTC day of the forecast. 1 – 31; 0 = UTC day not available = default.	
	UTC hour	5	UTC hour of the forecast. 0 – 23; 24 = UTC hour not available = default; 25 - 31 = reserved.	
	UTC minute	6	UTC minute of the forecast. 0 – 59; 60 = UTC minute not available = default; 61 - 63 = reserved.	

Parameter	# of bits	Description
Duration of Forecast	8	Duration of the validity of the forecast from the time of the forecast, in one minute steps. 1 - 255 minutes; 0 = cancel forecast = default.
Spare	17	Not to be used. Set to 0.
Total bits	**85**	

Table 10: Two-Dimensional (x & y) Vertical Current Profile Report

Parameter	# of bits	Description
Current 1 Speed	8	Speed of current 1 measured at a chosen level below the water surface in 0.1 knot increments. 0.0 – 24.5 knots; 246 = speed 24.6 knots or greater; 247 = data unavailable = default; 248 - 254 = reserved; 255 = not to be used.
Current 1 Direction	9	Direction of current, in 1 degree increments. 0 – 359 degrees; 360 = data unavailable = default; 361-510 = reserved; 511 = not to be used.
Current 1 Measuring level	9	Measurement level of current 1 below water surface in 1 meter steps. 0 – 360 m; 361 = 361 m or greater; 362 = data unavailable = default; 363-510 = reserved; 511 = not to be used.
Current 2 Speed	8	Speed of current 2 measured at a chosen level below the water surface in 0.1 knot increments. (same as Current Speed 1)
Current 2 Direction	9	Direction of current 2 in 1 degree steps. (same as Current Direction 1)
Current 2 Measuring level	9	Measurement level of current 2 in meters below water surface in 1 meter increments. (same as Current Measuring level 1)
Current 3 Speed	8	Speed of current 3 measured at a chosen level below the water surface in 0.1 knot increments. (same as Current Speed 1)
Current 3 Direction	9	Direction of current 3 in 1 degree increments. (same as Current Direction 1)
Current 3 Measuring Level	9	Measurement level of current 3 in meters below water surface in 1 meter increments. (same as Current Measuring Level 1)
Sensor Data Description	3	Type of data from Current Sensor. See Table 7.
Spare	4	Not to be used. Set to 0.
Total bits	**85**	

Table 11: Three-Dimensional (x, y, & z) Vertical Current Profile

Parameter	# of bits	Description
Current 1: vector component North	9	Speed of North component of current 1 measured at a chosen level below the water surface in 0.1 knot increments, negative values in 2's complement. -25.0 – 25.0 knots; -25.1 = speed less than -25 kts; 25.1 = speed greater than 25 kts; -25.6 = data unavailable = default.
Current 1: vector component East	9	Speed of East component of current 1 measured at a chosen level below the water surface in 0.1 knot increments, negative values in 2's complement. -25.0 – 25.0 knots; -25.1 = speed less than -25 kts; 25.1 = speed greater than 25 kts; -25.6 = data unavailable = default.
Current 1: vector component Up	9	Speed of Up component of current 1 measured at a chosen level below the water surface in 0.1 knot increments, negative values in 2's complement. -25.0 – 25.0 knots; -25.1 = speed less than -25 kts; 25.1 = speed greater than 25 kts; -25.6 = data unavailable = default.
Current 1 measuring level	9	Measurement level of current 1 in meters below water surface in 1 meter increments. 0 – 360 m; 361 = 361 m or greater; 362 = data unavailable = default; 361-511 = reserved; 511 = not to be used.
Current 2: vector component North	9	Speed of North component of current 2 measured at a chosen level below the water surface in 0.1 knot steps. (same as for current 1)
Current 2: vector component East	9	Speed of East component of current 2 measured at a chosen level below the water surface in 0.1 knot steps. (same as for current 1)
Current 2: vector component Up	9	Speed of Up component of current 2 measured at a chosen level below the water surface in 0.1 knot steps. (same as for current 1)
Current 2 measuring level	9	Measurement level of current 2 in meters below water surface in 1 m steps. (same as for current 1)
Sensor Data Description	3	Type of data from Current sensor. See Table 7.
Spare	10	Not to be used. Set to 0.
Total bits	**85**	

Table 12: Horizontal Current Profile

Parameter	# of bits	Description
Current Reading Bearing	9	Bearing of current readings from the sensor position, in 1 degree increments (all current readings are along the same bearing line from the sensor). 0 – 359 degrees; 360 = data unavailable = default; 361-510 = reserved; 511 = not to be used.
Current 1 Distance	9	Distance of current 1 reading from sensor position, in 1 meter steps. 0 – 360 m; 361 = 361 m or greater; 362 = data unavailable = default; 363-510 = reserved; 511 = not to be used.
Current 1 Speed	8	Speed of current 1 measured at a chosen level below the water surface, in 0.1 knot steps. 0.0 – 24.5 knots; 246 = speed 24.6 knots or greater; 247 = data unavailable = default; 248 - 254 = reserved; 255 = not to be used.
Current 1 Direction	9	Direction of current 1 in 1 degree steps. 0 – 359 degrees; 360 = data unavailable = default; 361-510 = reserved; 511 = not to be used.
Current 1 Measuring level	9	Measurement level of current 1 in meters below the water surface in 0.1 knot steps. 0 – 360 m; 361 = 361 m or greater; 362 = data unavailable = default; 363-510 = reserved; 511 = not to be used.
Current 2 Distance	9	Distance of current 2 reading from sensor position, in 1 meter steps. (same as for current 1 distance)
Current 2 Speed	8	Speed of current 2 measured at a chosen level below the water surface in 0.1 knot steps. (same as for current 1 speed)
Current 2 Direction	9	Direction of current 2 in 1 degree steps. (same as for current 1 direction)
Current 2 Measuring Level	9	Measurement level of current 1 in meters below the water surface in 1 meter steps. (same as for current 1 level).
Sensor Data Description	3	Type of data from Current sensor. See Table 7.
Spare	3	Not to be used. Set to 0.
Total bits	**85**	

Table 13: Sea State

Parameter	# of bits	Description
Swell height	8	Height of the swell, 0.1 meter increments. 0.0 – 24.5m; 246 = height of 24.6m or greater; 247 = data unavailable = default; 248 - 254 = reserved; 255 = not to be used.
Swell period	6	Swell period in seconds, in 1 second increments. 0 – 60 seconds; 61 = data unavailable = default; 62 - 63 = reserved.
Swell direction	9	Direction of swells, 1 degree increments. 0 – 359 degrees; 360 = data unavailable = default; 361-510 = reserved; 511 = not to be used.
Sea state	4	Sea state according to Beaufort scale. 0 – 12 See Table 14; 13 = Data unavailable = default; 14-15 = reserved.
Swell Sensor Data Description	3	Type of data from Swell sensor. See Table 7.
Water temperature	10	Temperature of the water in degrees Celsius, in 0.1 degree increments: -10.0C to + 50.0C degrees Celsius. temp = decimal value /10 – 10 for decimal = 0 – 600; 601 = data not available = default; 602 – 1023 = reserved
Water temperature depth	7	Depth of water temperature sensor relative to water surface, 0.1 meter steps. 0 – 12m; 121 = depth of 12.1 meters or greater; 122 = data unavailable = default; 123 - 126 = reserved; 127 = not to be used.
Water Temp Sensor Data Description	3	Type of data from Water Temperature sensor. See Table 7.
Significant wave height	8	Height of the waves, 0.1 meter steps. 0.0 – 24.5m; 246 = height of 24.6m or greater; 247 = data unavailable = default; 248 - 254 = reserved; 255 = not to be used.
Wave period	6	Wave period, 1 second steps 0 – 60 seconds; 61 = data unavailable = default; 62 - 63 = reserved.
Wave direction	9	Direction of waves, 1 degree steps. 0 – 359 degrees; 360 = data unavailable = default; 361-510 = reserved; 511 = not to be used.

Parameter	# of bits	Description
Wave Sensor Data Description	3	Type of data from Wave sensor. See Table 7.
Salinity	9	Salinity in 0.1‰ (ppt) steps. 0.0 – 50.0 ‰; 501 = salinity 50.1‰ or greater; 502 = data not available = default; 503 = sensor not available; 504 - 510 = reserved; 511 = not to be used.
Total bits	**85**	

Table 14: Beaufort Scale.

Beaufort number	Description	Wind Speed	Wave Height	Sea Conditions
0	Calm	< 0.6 knot	0 m	Flat
1	Light air	0.6 – 3 knots	0 – 0.2m	Ripples without crests
2	Light breeze	3 – 6.4 knots	0.2 – 0.5m	Small wavelets. Crests of glassy appearance, not breaking
3	Gentle breeze	6.4 – 10.6 knots	0.5 – 1m	Large wavelets. Crests begin to break; scattered whitecaps
4	Moderate breeze	10.6 – 15.5 knots	1 – 2 m	Small waves with breaking crests. Fairly frequent whitecaps.
5	Fresh breeze	15.5 – 21 knots	2 – 3m	Moderate waves of some length. Many whitecaps. Small amounts of spray.
6	Strong breeze	21 – 26.9 knots	3 – 4m	Long waves begin to form. White foam crests are very frequent. Some airborne spray is present.
7	High wind, moderate gale, near gale	26.9 – 33.4 knots	4 – 5.5m	Sea heaps up. Some foam from breaking waves is blown into streaks along wind direction. Moderate amounts of airborne spray.
8	Gale, fresh gale	33.4 – 40.3 knots	5.5 – 7.5m	Moderately high waves with breaking crests forming spindrift. Well-marked streaks of foam are blown along wind direction. Considerable airborne spray.

Beaufort number	Description	Wind Speed	Wave Height	Sea Conditions
9	Strong gale	40.3 – 47.6 knots	7 – 10m	High waves whose crests sometimes roll over. Dense foam is blown along wind direction. Large amounts of airborne spray may begin to reduce visibility.
10	Storm, whole gale	47.6 – 55.3 knots	9 – 12.5m	Very high waves with overhanging crests. Large patches of foam from wave crests give the sea a white appearance. Considerable tumbling of waves with heavy impact. Large amounts of airborne spray reduce visibility.
11	Violent storm	55.3 – 63.4 knots	11.5 – 16m	Exceptionally high waves. Very large patches of foam, driven before the wind, cover much of the sea surface. Very large amounts of airborne spray severely reduce visibility.
12	Hurricane force	≥ 63.4 knots	≥ 14m	Huge waves. Sea is completely white with foam and spray. Air is filled with driving spray, greatly reducing visibility

Table 15: Salinity

Parameter	# of bits	Description
Water temperature	10	Temperature of water in degrees Celsius, 0.1 degree steps -10.0C to + 50.0C degrees Celsius; temp = decimal value /10 – 10 for decimal = 0 – 600; 601 = data unavailable; 602 = sensor unavailable = default; 603 – 1022 = reserved; 1023 = not to be used.
Conductivity	10	Water conductivity in Siemens/meter, in steps of 0.01 S/m. 0.0 - 7.00 Siemens/meter; 701 = conductivity >7.00; 702 = data unavailable; 703 = sensor not available = default; 704 – 1,022 = reserved; 1023 = not to be used.
Water pressure	16	Pressure of water in decibars, in steps of 0.1 decibars. 0.0 to 6000.0; 60001 = pressure >6000.1; 60002 = data unavailable; 60003 = sensor not available = default; 60004 – 65534 = reserved; 65535 = not to be used.
Salinity	9	Salinity in 0.1‰ (ppt) steps. 0.0 – 50.0 ‰; 501 = salinity 50.1‰ or greater; 502 = data unavailable; 503 = sensor not available (default); 504 - 510 = reserved; 511 = not to be used.
Salinity type	2	0 = measured; 1 = calculated using PSS-78; 2 = calculated using other method; 3 = = reserved
Salinity Sensor Data Description	3	Type of data from Salinity sensor. See Table 7.
Spare	35	Not to be used. Set to 0.
Total bits	**85**	

Table 16: Weather

Parameter	# of bits	Description
Air Temperature	11	Dry bulb temperature in degrees Celsius, in 0.1 degree steps. -60.0 to +60.0 degrees Celsius(as per 2's complement); -1024 = data unavailable = default; -1023 to -601 = reserved; 601 – 1023 = reserved.
Air Temp Sensor Data Description	3	Type of data from Air Temperature sensor. See Table 7.
Precipitation (type)	2	According to WMO. 0 = Rain; 1 = Snow; 2 = Rain and snow; 3 = none = default
Horizontal visibility	8	Visibility in nautical miles, 0.1 nautical mile (NM) steps. 0.0 – 24.0 NM; 241 = visibility 24.1 NM or greater; 242 = data unavailable; 243 = sensor not available = default; 244 - 254 = reserved; 255 = not to be used.
Dew Point	10	Dew point temperature in degrees Celsius, in 0.1 degree steps. -20.0 to +50.0 C; temp = Decimal value /10 – 20 for Decimal = 0 – 700; 701 = data unavailable=default; 702 = Dew point< -20°; 703 = Dew point > 50° 704 – 1022 = reserved; 1023 = not to be used.
Dew Point Sensor Data Description	3	Type of data from Dew Point sensor. See Table 7.
Air Pressure	9	Air pressure, defined as pressure reduced to sea level, in 1 hPa increments. 0 = pressure <800 hPa; 1 - 401 = 800 – 1200 hPa; 402 = pressure of 1201 hPa or greater; 403 = data unavailable = default; 404-510 = reserved; 511 = not to be used.
Air Pressure Trend	2	Air pressure trend. 0 = steady; 1 = decreasing; 2 = increasing; 3 = undefined/unknown = default.
Air Pressure Sensor Data Description	3	Type of data from air pressure sensor. See Table 7.
Salinity	9	Salinity in 0.1‰ (ppt) steps. 0.0 – 50.0 ‰; 501 = salinity 50.1‰ or greater; 502 = data unavailable; 503 = sensor not available (default); 504 - 510 = reserved; 511 = not to be used.
Spare	25	Not to be used. Set to 0.
Total bits	**85**	

Table 17: Air Gap

Parameter		# of bits	Description
Air Draught		13	The vertical distance measured from the ship's waterline to the highest point on the ship in 1-centimeter increments. 1 - 8,190 cm (81.9 m); 8,191 = distance 81.91m or greater; 0 = data unavailable = default.
Air Gap		13	The vertical distance measured from the surface of the water to the sensor in 1-centimeter increments. Negative values (water above the sensor should be encoded as 0). 1 - 8,190 cm (81.9 m); 8,191 = distance 81.91m or greater; 0 = data unavailable = default.
Air Gap Trend		2	Trend of the air gap measurement. 0 = steady; 1 = increasing gap measurement 2 = decreasing gap measurement; 3 = unknown.
Predicted Air Gap		13	The predicted vertical distance measured from the surface of the water to the sensor in 1-centimeter steps. This is the measurement for the time of the prediction. 1 - 8,190 cm (81.9 m); 8,191 = distance 81.91m or greater; 0 = data unavailable = default.
Time of Predicted Air Gap	UTC day	5	UTC day of the prediction. 1 – 31; 0 = UTC day not available = default.
	UTC hour	5	UTC hour of the prediction. 0 – 23; 24 = UTC hour not available = default; 25 - 31 = reserved.
	UTC minute	6	UTC minute of the prediction. 0 – 59; 60 = UTC minute not available = default; 61 - 63 = reserved.
Air Gap Sensor Data Description		3	Type of data from air gap sensor. See Table 7.
Spare		25	Not to be used. Set to. 0.
Total bits		**85**	

Table 18: Wind Report.

Parameter		# of bits	Description
Wind Speed		7	Average of wind speed values over the last N minutes in 1-knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = data unavailable = default; 123 – 126 = reserved; 127 = not to be used.
Wind Gust		7	Maximum wind speed during the last N minutes in 1-knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = data unavailable = default; 123 – 126 = reserved; 127 = not to be used.
Wind Direction		9	Direction of the average wind over the last N minutes in 1-degree increments. 0 – 359 degrees; 360 = not available = default; 361 - 510 = reserved; 511 = not to be used.
Averaging Time		6	Number of minutes used for average and time interval for maximum (value of N in parameters Wind Speed, Wind Gust, and Wind Direction) 0 = unknown = default; 1 – 60 minutes; 61 = more than 60 minutes; 62-63 = reserved.
Sensor Data Description		3	Type of data from Wind sensor. See Table 7.
Forecast Wind Speed		7	Predicted average wind speed in 1-knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = not available = default; 123 - 126 (reserved for future use); 127 = not to be used.
Forecast Wind Gust		7	Predicted maximum wind speed in 1-knot increments. 0 - 120 knots; 121 = wind 121 knots or greater; 122 = not available = default; 123 - 126 = reserved; 127 = not to be used.
Forecast Wind Direction		9	Predicted direction of the average wind in 1-degree steps. 0 – 359 degrees; 360 = not available = default; 361 - 510 = reserved; 511 = not to be used.
Start Time of Forecast	UTC hour	5	UTC hour of the forecast. (start of forecast is limited to within 24 hrs of current time 0 – 23; 24 = UTC hour not available = default; 25 - 31 = reserved.
	UTC minute	6	UTC minute of the forecast. 0 – 59; 60 = UTC minute not available = default; 61 - 63 = reserved.
Duration of Forecast		8	Duration of the validity of the forecast from the time of the forecast, in one minute steps. 1 - 255 minutes; 0 = cancel forecast = default.
Spare		11	Not to be used. Set to 0.
Total bits		**85**	