## BUFR TEMPLATE FOR AMDAR, 3 11 010, version 7 (14 October 2011)

| | | | | |
|---|---|---|---|---|
| 0 | 01 | 008 | | Aircraft identification [1] |
| 0 | 01 | 023 | | Sequence number [2] |
| 0 | 01 | 006 | | Flight number [3] |
| 0 | 01 | 110 | | Aircraft tail number [1] [4] |
| 0 | 01 | 111 | | Origination airport [4] |
| 0 | 01 | 112 | | Destination airport [4] |
| 2 | 04 | 002 | | Add associated field (of 2 bits) [19] [20] |
| 0 | 31 | 021 | | Associated field significance [19] [20] (= 8 Two bits quality information) |
| 3 | 01 | 011 | | Year, month and day |
| 3 | 01 | 013 | | Hour, minute and second |
| 3 | 01 | 021 | | Latitude and longitude (high accuracy) |
| 0 | 07 | 010 | | Pressure Altitude ( Flight Level )[5] |
| 0 | 10 | 053 | | GNSS Altitude [4] |
| 0 | 08 | 009 | | Detailed phase of flight [6] |
| 0 | 11 | 001 | | Wind direction |
| 0 | 11 | 002 | | Wind speed |
| 0 | 02 | 064 | | Aircraft roll angle quality [25] |
| 0 | 11 | 100 | Optional | Aircraft true airspeed [7] |
| 0 | 11 | 101 | Optional | Aircraft ground speed (u-component) [4] |
| 0 | 11 | 102 | Optional | Aircraft ground speed (v-component) [4] |
| 0 | 11 | 103 | Optional | Aircraft ground speed (w-component) [4] |
| 0 | 11 | 104 | Optional | Aircraft true heading [4] |
| 0 | 12 | 101 | | Temperature/air temperature [8] |
| 0 | 02 | 170 | | Aircraft humidity sensors [4] [24] |
| 2 | 01 | 144 | | Change data width [26] |
| 2 | 02 | 133 | | Change scale [26] |
| 0 | 13 | 002 | | Mixing ratio [22] |
| 2 | 02 | 000 | | Cancel change scale [26] |
| 2 | 01 | 000 | | Cancel change data width [26] |
| 2 | 01 | 135 | | Change data width [27] |
| 2 | 02 | 130 | | Change scale [27] |
| 0 | 13 | 003 | | Relative humidity |
| 2 | 02 | 000 | | Cancel change scale [27] |
| 2 | 01 | 000 | | Cancel change data width [27] |
| 1 | 01 | 000 | | Delayed replication of 1 descriptor |
| 0 | 31 | 000 | | Short delayed descriptor replication factor |
| 0 | 12 | 103 | Optional | Dew-point temperature [9] |
| 0 | 33 | 026 | | Moisture quality [23] |
| 1 | 01 | 000 | | Delayed replication of 1 descriptor |
| 0 | 31 | 000 | | Short delayed descriptor replication factor |
| 0 | 20 | 042 | Optional | Airframe icing [10] |
| 1 | 03 | 000 | | Delayed replication of 3 descriptors |
| 0 | 31 | 000 | | Short delayed descriptor replication factor |
| 0 | 20 | 043 | Optional | Peak liquid water content [11] |
| 0 | 20 | 044 | Optional | Average liquid water content [11] |
| 0 | 20 | 045 | Optional | Supercooled large droplet (SLD) conditions [11] |
| 1 | 01 | 000 | | Delayed replication of 1 descriptor |
| 0 | 31 | 000 | | Short delayed descriptor replication factor |
| 0 | 33 | 025 | Optional | ACARS interpolated values indicator [12] |
| 1 | 03 | 000 | | Delayed replication of 3 descriptors [13] |
| 0 | 31 | 001 | | Delayed descriptor replication factor [14] |

| | | | | |
|---|---|---|---|---|
| 0 | 11 | 075 | Optional | Mean turbulence intensity (EDR) |
| 0 | 11 | 076 | Optional | Peak turbulence intensity (EDR) |
| 0 | 11 | 039 | Optional | Extended time of occurrence of peak EDR [15] |
| 1 | 02 | 000 | | Delayed replication of 2 descriptors |
| 0 | 31 | 000 | | Short delayed descriptor replication factor |
| 0 | 11 | 037 | Optional | Turbulence index (EDR) |
| 0 | 11 | 077 | Optional | Reporting interval or averaging time for EDR [16] |
| 1 | 03 | 000 | | Delayed replication of 3 descriptors |
| 0 | 31 | 000 | | Short delayed descriptor replication factor |
| 0 | 11 | 034 | Optional | Vertical gust velocity [17] |
| 0 | 11 | 035 | Optional | Vertical gust acceleration [17] |
| 0 | 11 | 036 | Optional | Maximum derived equivalent vertical gust speed [17] |
| 2 | 04 | 000 | | Cancel add associated field [19] [20] |
| 1 | 19 | 000 | | Delayed replication of 19 descriptors [18] |
| 0 | 31 | 001 | | Delayed descriptor replication factor [18] |
| 3 | 01 | 011 | | Year, month and day |
| 3 | 01 | 013 | | Hour, minute and second |
| 3 | 01 | 021 | | Latitude and longitude (high accuracy) |
| 0 | 07 | 007 | | Height |
| 0 | 11 | 105 | Optional | EDR algorithm version [4] |
| 2 | 04 | 007 | | Add associated field (of 7 bits) [21] |
| 0 | 31 | 021 | | Associated field significance [21] (= 7 Percentage confidence) |
| 0 | 11 | 076 | Optional | Peak turbulence intensity (EDR) |
| 0 | 11 | 075 | Optional | Mean turbulence intensity (EDR) |
| 2 | 04 | 000 | | Cancel add associated field [21] |
| 0 | 11 | 106 | Optional | Running minimum confidence [4] |
| 0 | 11 | 107 | Optional | Maximum number bad inputs [4] |
| 0 | 11 | 108 | Optional | Peak Location [4] |
| 0 | 11 | 109 | Optional | Number of good EDR [4] |
| 0 | 12 | 101 | Optional | Temperature/air temperature |
| 0 | 11 | 001 | Optional | Wind direction |
| 2 | 01 | 130 | Optional | Change data width |
| 0 | 11 | 084 | Optional | Wind speed |
| 2 | 01 | 000 | Optional | Cancel change data width |

**Notes for Standardized BUFR Template for AMDAR data 3 11 010, version 7:**

(1)    Aircraft identifier 0 01 008 can cope with ASDAR, ADS and other AMDAR identities. ADS reports use a 24-bit ICAO airframe identifier, equating to an 8-character BCD number. Look at developing a standard naming convention for the various AMDAR regions and/or programmes. The WIGOS meeting agreed that additional information such aircraft type and navigation systems would be part of the Meta data, not part of the Standardized BUFR Template for AMDAR. It was noted that AMDAR Meta data would be addressed by the WIGOS Pilot Project for AMDAR. This identifier is used for masking the identity of the aircraft. For the real identification, 0 01 110 can be used and is therefore classed as optional.

(2)    The sequence number is a simple observation count to be included in the down-linked message.  It should be reset at 0000 UTC each day and can be useful for quality control, data management and archiving purposes. The WIGOS meeting has made the recommendation that if this parameter is not used by an operational AMDAR programme or NWP Centre then this parameter be removed from the new Standardized BUFR Template for AMDAR.

(3)    0 01 006 (Flight number) will assist with the quality control of aircraft track data, by providing information on the route the aircraft is expected to take, including information on the departure airport and the expected arrival airports. Presently 8 characters has been used as an estimate as the maximum length for any given flight number.

(4)    Refer to the following table for the required BUFR descriptors including the units, scale, reference value and data width.

| Table reference | | BUFR | | | |
|---|---|---|---|---|---|
| F X Y | Element name | Unit | Scale | Reference value | Data width |
| 0 11 100 | Aircraft true airspeed | m s$^{-1}$ | 1 | 0 | 12 |
| 0 11 101 | Aircraft ground speed u-component | m s$^{-1}$ | 1 | –4096 | 13 |
| 0 11 102 | Aircraft ground speed v-component | m s$^{-1}$ | 1 | –4096 | 13 |
| 0 11 103 | Aircraft ground speed w-component | m s$^{-1}$ | 1 | –512 | 10 |
| 0 11 104 | Aircraft true heading | Degree true | 0 | 0 | 9 |
| 0 10 053 | Global Navigation Satellite System Altitude | m | 0 | -1000 | 17 |
| 0 01 110 | Aircraft tail number | CCITT IA5 | 0 | 0 | 48 |
| 0 01 111 | Origination airport | CCITT IA5 | 0 | 0 | 24 |
| 0 01 112 | Destination airport | CCITT IA5 | 0 | 0 | 24 |
| 0 11 105 | EDR algorithm version | Numeric | 0 | 0 | 6 |
| 0 11 106 | Running minimum confidence | Numeric | 1 | 0 | 4 |
| 0 11 107 | Maximum number bad inputs | Numeric | 0 | 0 | 5 |
| 0 11 108 | Peak Location | Numeric | 1 | 0 | 4 |
| 0 11 109 | Number of good EDR | Numeric | 0 | 0 | 4 |
| 0 02 170 | Aircraft humidity sensors | Code table | 0 | 0 | 6 |

*Proposal for new AMDAR descriptors in 3 11 010, version 5.*

*(These descriptors were proposed for version 5 and no change has been done with version 6 and 7)*

(5)      Following advice from the airline industry it was recommended that Pressure (0 07 004) not be included as the primary height field and that Pressure Altitude (PALT) (0 07 010) replace this field. Note: PALT should be identical to that of the previously used AMDAR primary height field Flight Level (0 07 010),

it is recommended that the definition of Flight Level include definition for PALT (h_lh_lh_l as per the FM42 definition) to remove confusion (it refers to Pressure Altitude as a measure of height relative to standard datum plane of 1013.2 hPa).

(6)      This phase of flight table is expanded to indicate wind quality from roll angle, or roll and pitch combined and also to indicate the method of ascent and descent observation interval selection either by time or pressure increments. The WIGOS meeting agreed that the Phase of flight 0 08 004 would not be included in the new Standardized BUFR Template for AMDAR as the required level of detail has been incorporated in the detailed phase of flight 0 08 009. The WIGOS meeting also discussed whether there is a requirement for adding a new condition to the detailed phase of flight 0 08 009 that would cover an aircraft being placed in a holding pattern.

(7)      Refer to AMDAR Reference Manual for definition.

(8)      This parameter has been renamed Temperature/air temperature.

(9)      0 12 103 Dew-point temperature had been introduced in the templates for AMDAR profile data to simulate radiosounding data.

(10)      The old ACARS airframe icing code table 0 20 041 is not included.

(11)      A special automatic icing report, including these elements, is expected to become available from some aircraft and a down-link code has been published.

(12)      0 33 025 ACARS interpolated values was primarily used in the USA AMDAR Programme to indicate time and position being reported or interpolated. The name for this element has been changed to ACARS interpolated values indicator.

(13)      Delayed replication 1 03 000 refers to the following three descriptors 0 11 075, 0 11 076 and 0 11 039 to allow reporting of the Extended time of occurrence of peak EDR of all included values of 0 11 076 (Peak (EDR)). This allows each turbulence peak to be reported.

*Explanatory remarks to Note (13):*

According to Note (14), up to ten values of 0 11 076 (Peak (EDR)) may be reported.  However, 0 11 039 (Extended time of occurrence of peak EDR) was included only once in the template 3 11 010, version 0.  Therefore, it was not clear to which out of those ten values of 0 11 076, the time specification 0 11 039 referred.  If it had been the maximum value, the name of 0 11 039 should have been modified to read "Extended time of occurrence of maximum peak EDR".  If the time information on all the reported values of 0 11 076 (Peak (EDR)) is required, then 0 11 039 (Extended time of occurrence of peak EDR) should be included under the delayed replication as shown in the proposed template 3 11 010, version 5

(14)      Some aircraft report up to 10 pairs of (EDR) values per observation.  The corresponding times and position could be found by interpolation from the previous report. If the aircraft does not report it the number of replication 0 31 001 is set to zero.

(15)      0 11 039 allows observation intervals up to one hour. 0 11 038 allows up to 15 minutes only whereas observation intervals of 30 minutes or more are commonly used, hence 0 11 038 had been replaced by 0 11 039.

(16)      The EDR observing interval and associated averaging time differs according to individual observing schedule and cannot be assumed to be identical to the observation interval for the main elements.  It is desirable to include this information in the coded data.

(17)    Vertical gust velocity 0 11 034, Vertical gust acceleration 0 11 035 and Maximum derived equivalent vertical gust speed 0 11 036 have been added to meet the request for reflecting all entries of 3 11 004 in the Standardized BUFR template for AMDAR. The current ICAO standard for automated turbulence reporting is EDR.

(18)    Up to 254 EDR reports may be included in a BUFR message. If the aircraft does not report them, the number of replication 0 31 001 is set to zero.

(19)    Operator descriptor 2 04 Y has been introduced for representation of AMDAR quality information instead of flag table 0 33 079 () used in the previous versions of the AMDAR template 3 11 010. Some elements (such as Wind Speed, Wind Direction, Air Temperature) may appear more than once in the data described by 3 11 010.  Operator descriptor 2 04 Y allows to assign unambiguously the required quality information to the element to which it refers.

(20)    Each of the following elements, apart from delayed replication factors 0 31 000 and 0 31 001, shall be preceded by two bits providing information on the element being suspected or not. If the quality information on the element is not required, the associated field shall be set to 3. For this purpose, **code figure 8 (Two bit quality information**) is proposed to be used as defined in the Code table 0 31 021 (Associated field significance) :

*0 31 021*

| Code figure | |
|---|---|
| 8 | 0 -  Not suspected<br>1 -  Suspected<br>2 -  Reserved<br>3 -  Information not required |

(21)    Peak turbulence intensity (EDR) and Mean turbulence intensity (EDR) shall be preceded by seven bit information containing percentage confidence of Peak turbulence intensity (EDR) and Mean turbulence intensity (EDR), respectively.

(22)    Mixing ratio 0 13 002 is to be used for water vapour mass mixing ratio

(23)    New code figures 10 to 15 have been introduced into 0 33 026 (Moisture quality) as shown in the table below.

## 0 33 026 (Moisture quality)

| Code figure | |
|---|---|
| 0 | Normal operations - measurement mode |
| 1 | Normal operations - non-measurement mode |
| 2 | Small RH |
| 3 | Humidity element is wet |
| 4 | Humidity element contaminated |
| 5 | Heater fail |
| 6 | Heater fail and wet/contaminated humidity element |
| 7 | At least one of the input parameters used in the calculation of mixing ratio is invalid |
| 8 | Numeric error |
| 9 | Sensor not installed |
| 10 | Calculated RH > 100% |
| 11 | Input laser power too low |
| 12 | Probe WV Temp. out of range |
| 13 | Probe WV Press. out of range |
| 14 | Spectral line out of range |
| 15 | No laser output |
| 16-62 | Reserved |
| 63 | Missing value |

(24) A new entry 0 02 170 is proposed for Aircraft humidity sensors (Code table, 0, 0, 6):

| Code Figure | Sensor Type | Status |
|---|---|---|
| 0 | SpectraSensors WVSS-II, Version 1 | Operational |
| 1 | SpectraSensors WVSS-II, Version 2 | Operational |
| 2 | SpectraSensors WVSS-II, Version 3 | Operational |
| 3 – 61 | Reserved | |
| 62 | Other | |
| 63 | Missing Value | |

(25)      0 02 063 (Aircraft Roll Angle, Value) will not be reported but 0 02 064 (Aircraft Roll Angle Quality, Code Table) will because this provides the required information on the Roll Angle (e.g. Code Figure 1, Bad, means Roll Angle > 5 degrees from vertical).

(26)      This is used to increase scale 5 and data width 14 to scale 10 and data width 30 to cover the full range for water vapour mass mixing ratio being reported in kg kg$^{-1}$ with precision in $10^{-10}$ of kg kg$^{-1}$.

(27)      This is used to increase scale 0 and data width 7 of relative humidity to scale 2 and data width 14 to allow reporting relative humidity with precision in 0.01 %.