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| WORLD METEOROLOGICAL ORGANIZATION  COMMISSION FOR BASIC SYSTEMS  -----------------------------  FOURTH MEETING OF  INTER-PROGRAMME EXPERT TEAM ON DATA REPRESENTATION MAINTENANCE AND MONITORING  GENEVA, SWITZERLAND, 30 MAY - 3 JUNE 2016 |  | IPET-DRMM-IV / Doc. 3.2 (12)  (30. 5. 2016)  -------------------------  ITEM 3.2  ENGLISH ONLY |

3. BUFR AND CREX

**Radiosounding meta-data reporting: clarifications and amendments required**

*Submitted by Alexander Kats (Russia)*

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**Summary and Purpose of Document**

This document contains a discussion about a need in clarification of existing descriptors, amending existing code tables and introducing new descriptors for reporting metadata associated with upper-air radiosounding, in particular, from GRUAN sites

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**ACTION PROPOSED**

The meeting is invited to discuss the content of this document, evaluate its maturity and advice on the way for the further work

**ANNEXES:**

1. Review of existing and required BUFR metadata descriptors

**DISCUSSIONS**

GRUAN[[1]](#footnote-1) community requested a way for reporting pre-flight ground check results, details of flight train configuration (multi-payload flight, using radiosonde together with another instrument like ozonesonde), suspension length, volume of gas in balloon and uncertainties of results (addressed in a separate paper).

In response to request of GRUAN community on reporting GRUAN specific metadata along with radiosonde observations and in view of providing guidance to upper-air system manufacturers and data providers (network operators, third party software vendors) there were analyzed existing set of related BUFR descriptors and entries in respective Code and Flag tables and required clarifications and amendments.

Annex 1 contains detailed review of radiosounding related metadata provided by BUFR and needs in respective amendmends.

As many others, current heritage of BUFR metadata descriptors related to upper-air observations is rather messy and obscure for different reasons (preserving compatibility with TAC, meeting momentary need without necessary generalization, using specialized terminology absent in WMO documents and worldwide literature). There is a lack of consistency for allocation of code figures and bits in existing Code and Flag tables, they are often overlapped.

So, there are two ways to cope with this: either to withstand with existing descriptors with respective amendments and clarifications or develop new ones from the scratch.

For the first way there is a need also to decide what is the place for recommendations/clarifications/guidance: BUFR tables, B/C Regulations, CIMO Guide or something else.

**PROPOSAL**

Consider following comments, clarification and proposals:

**Existing descriptors**

0 02 003 “Radiosonde type”:

Recommendation:

For future allocation for use in BUFR – ground system should be better identified with 0 02 066 (and possibly other descriptors).

0 02 013 “Solar and infrared radiation correction”

Recommendation:

Changes in software and radiosonde version (via serial ID) should also allow identify modification of radiation correction.

Add new entry:

8 Solar and infrared corrected as specified by GRUAN

0 02 014 “Tracking technique/status of system used” and 0 02 003 “Type of measuring equipment used”:

Recommendation?: In case of releasing PTU only sonde without windfinding 0 02 014 and 0 02 003 shall be set to 0 and 15 (missed) respectively.

3 01 128 Additional information on radiosonde ascent:

Add element description to 0 35 035 “Reason for termination” in 3 01 128: Reason for ascent termination

0 01 081 Radiosonde serial number:

Recommendation?: Manufacturers should be encouraged:

- To explain their numbering system and implement it in such a way to allow identifying production date.

- To maintain history page it in such a way to allow identifying hardware and firmware details of particular radiosonde from the date of its production.

There is a need in a central repository for the information above (OSCAR/Surface, centres like NCDC?).

0 01 082 Radiosonde ascension number:

Recommendation?: 0 01 082 numbering should start from 1 for the very first ascent of the year.

0 01 083 Radiosonde release number:

Recommendation?: 0 01 083 numbering should start from 1 for a scheduled release.

If data of the first (or any previous) release were already reported before reporting results of successive release update sequence number in BUFR Section 1 of successive reports should not be adjusted.

0 01 095 Observer identification:

Recommendation?: To be used to report initials of observer responsible for the ascent (with respective description to be stored in a site log).

0 02 015 Radiosonde completeness:

Add new entries:

6 Pressure only radiosonde plus Loran-C relay

7 Pressure only radiosonde plus GNSS module

8 No-pressure radiosonde plus GNSS module

0 02 016 Radiosonde configuration:

Recommendation?: There is a need to put somewhere clarification about train regulator

A train regulator (also termed unwinder, dereeler or let-down) either add-on or built-in into the radiosonde may be used when the release is made in high winds.

0 02 017 Correction algorithms for humidity measurements:

Add new entry:

7 GRUAN solar radiation and time lag correction

0 02 081 Type of balloon

Add new entries:

7 Totex TA type balloons

8 Totex TX type balloons

9 KKS KS type balloons

10 ChemChina Zhuzhou HY balloons

Recommendation?:

For those balloons which manufacturers do not specify a type for produced balloons code figure 31 ‘Missing value’ should be used. For those balloons which manufacturers do not have a respective entry in Code table 0 02 080 ‘Balloon manufacturer’ but do specify a type for produced balloons code figure 30 ‘Other’ should be used. When none entry is applicable code figure 31 ‘Other’ shall be used.

0 02 083 Type of balloon shelter

Add new entries:

4 Automated unmanned sounding system

5 Basket bag balloon launcher for manual release

0 02 085 Amount of gas used in balloon

Add a Note under Class 2 of Table B or under Code table 0 02 085:

(xx) Descriptor 0 02 085 is to be used for reporting mass which inflated balloon can lift without mass of balloon, also known as nozzle lift.

0 02 086 Balloon flight train length

Add a Note under Class 2 of Table B or under Code table 0 02 08:

(xx) Descriptor 0 02 086 is to be used for reporting length (fully unwinded if train regulator is used) of line between balloon neck and radiosonde body top.

0 02 095 Type of pressure sensor

Add new entry:

5 Derived from GNSS height

0 02 097 Type of humidity sensor

Recommendation?: The code table should be populated with generic types of humidity sensors rather than with concrete radiosonde model types.

0 02 191 Geopotential height calculation

Editorial correction?:

0 Geopotential height calculated from pressure*, temperature and humidity by integration of hydrostatic equation starting from reference height with known surface pressure[[2]](#footnote-2)*

1 Geopotential height calculated from GPS *ellipsoidal* height *converted to height above a reference geoid*

2 Geopotential height calculated from radar height *augmented by height of aerial above mean sea level*

Add new entry:

3 Geopotential height calculated from GNSS *ellipsoidal* height *converted to height above a reference geoid*

or

3 Geopotential height *derived* from GNSS height

0 25 061 Software identification and version number

Recommendation?:

Manufacturers should be encouraged:

- To explain their versioning system and implement it to allow recognizing order of versions

- To maintain history page it in such a way to allow identifying specific features of particular version.

There is a need in a central repository for the information above (OSCAR/Surface, centres like NCDC?)

0 35 035 Reason for termination

Editorial correction?: Reason for sounding termination

Add new entries:

16 Abnormal or scattered pressure

17 Abnormal or scattered temperature

18 Abnormal or scattered GNSS data

19 Limiting angles

20 Abnormal or scattered range

21 Abnormal or scattered azimuth

22 Abnormal or scattered elevation

23 Excessive missing GNSS data

25 Excessive missing range

26 Excessive missing azimuth

27 Excessive missing elevation

28 Insufficient data quality of one or more parameters required for the second release

29 Balloon forced down by precipitation

or, in view of Czech Republic comment where more generic entries were required introduce a new Code table in Class 35

0 35 xxx Reason for sounding termination

with two more entries

30 Balloon descent detected

31 Invalid and/or missed data time limits exceeded

32-62 Reserved

63 Missed

Define entries in 0 02 012 Radiosonde computational method

0 Manufacturer computation

1 GRUAN computation

2-14 Reserved

15 Missed

Consider adding new descriptors:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TABLE |  |  |  |  | DATA |
| REFERENCE | ELEMENT NAME | UNIT | SCALE | REFERENCE | WIDTH |
| F X Y |  |  |  | VALUE | (Bits) |
| 0 03 xxx | Sounding procedure | Code table | 0 | 0 | 4 |
| 0 03 xxx | Volume of gas used in balloon | m3 | 3 | 0 | 13 |
| 0 03 xxx | Balloon flight train configuration  or  Additional information on balloon flight train configuration | Flag table | 0 | 0 | 24  or  20 |
| 0 08 xxx | Baseline check data significance | Code table | 0 | 0 | 4 |
| 0 08 xxx | Baseline check (environment/conditions) significance | Code table | 0 | 0 | 5 |

Note (x): 0 03 xxx Additional information on balloon flight train configuration is intended to supplement 0 02 016 Radiosonde configuration

with respective Flag and Code tables

**0 03 xxx**

***Balloon flight train configuration***

Unit/Scale/Reference/Width: Flag table/0/0/24

Bit No.

1 Train regulator

2 Light unit

3 Parachute

4 Rooftop release

5 Cutter

6 Hanger board

7 Shock absorber

8 Stabilizer

9 Detainer

10 Other radiosondes

11 Ozonezonde

12 Backscatter instrumentation

13 Other additional instrumentation

14-23 Reserved

All 24 Missing value

**0 03 xxx**

***Additional information on balloon flight train configuration***

Unit/Scale/Reference/Width: Flag table/0/0/20

Bit No.

1 Cutter

2 Hanger board

3 Shock absorber

4 Stabilizer

5 Detainer

6 Cutter

7 Other radiosondes

8 Ozonezonde

9 Backscatter instrumentation

10 Other additional instrumentation

11-19 Reserved

All 20 Missing value

**0 03 xxx**

***Type of flight rig***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figures

0 Solo (single radiosonde)

1 Block

2 Bar

3 Cross

4 T-rig

5 Double T-rig

6 Complex

7-14 Reserved

15 Missing value

**0 08 xxx**

***Baseline check data significance***

Code figure

0 Verified instrument reading

1 Reference instrument reading

2 Auxiliary instrument reading

3-14 Reserved

15 Missing value

**0 08 xxx**

***Baseline check (environment/conditions) significance***

Code figure

0 Manufacturer’s baseline check unit

1 National baseline check unit

2 Weather screen

3 GRUAN Standard humidity chamber

4 GRUAN Temperature-Humidity reference system

5 Environment chamber

6 Wind tunnel

7-30 Reserved

31 Missing value

Consider Table D sequences pattern for ground-check result like:

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME | ELEMENT DESCRIPTION |
| F X Y |
|  |  | (Radiosonde ground-check results) |  |
| 3 03 xxx  or  3 01 xxx |  |  |  |
|  | 3 01 011 | Year | Identification of |
|  |  | Month | ground-check time |
|  |  | Day |  |
|  | 3 01 013 | Hour |  |
|  |  | Minute |  |
|  |  | Second |  |
|  | 0 08 021 | Time significance | = 2 Time averaged |
|  | 0 04 026 | Time period or displacement | Ground-check duration |
|  | 0 08 xxx | Baseline check (environment/conditions) significance | Signify ground-check procedure |
|  | 0 03 008 | Artificially ventilated screen or shield | Under validation |
|  | 0 08 xxx | Baseline check data significance | = 0 Verified instrument reading |
|  | 0 10 004 | Pressure | Radiosonde pressure |
|  | 0 12 101 | Temperature/air temperature | Radiosonde temperature |
|  | 0 13 009 | Relative humidity (see Note 6) | Radiosonde humidity |
|  | 0 08 xxx | Baseline check data significance | = 1 Reference instrument reading |
|  | 0 12 101 | Temperature/air temperature | Reference temperature |
|  | 0 13 009 | Relative humidity (see Note 6) | Reference humidity |
|  | 0 08 xxx | Baseline check data significance | = 2 Auxiliary instrument reading |
|  | 0 10 004 | Pressure | Barometer reading |
|  | 0 08 xxx | Baseline check data significance | =missing to cancel the previous value |
|  | 0 08 xxx | Baseline check (environment/conditions) significance | =missing to cancel the previous value |
|  | 0 08 021 | Time significance | =missing to cancel the previous value |

ANNEX 1.

**Review of radiosounding related metadata provided by BUFR**

1. Metadata descriptors provided by TM309052

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME | ELEMENT DESCRIPTION |
| F X Y |
|  |  | (Sequence for representation of TEMP, TEMP SHIP and TEMP MOBIL observation type data) |  |
| 3 09 052 | 3 01 111 | Identification of launch site and instrumentation for P, T, U and wind measurements |  |
|  | 3 01 113 | Date/time of launch |  |
|  | 3 01 114 | Horizontal and vertical coordinates of launch site |  |
|  | 3 02 049 | Cloud information reported with vertical soundings |  |
|  | 0 22 043 | Sea/water temperature |  |
|  | 1 01 000 | Delayed replication of 1 descriptor |  |
|  | 0 31 002 | Extended delayed descriptor replication factor |  |
|  | 3 03 054 | Temperature, dewpoint and wind data at a pressure level with radiosonde position |  |
|  | 1 01 000 | Delayed replication of 1 descriptor |  |
|  | 0 31 001 | Delayed descriptor replication factor |  |
|  | 3 03 051 | Wind shear data at a pressure level with radiosonde position |  |

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME | ELEMENT DESCRIPTION |
| F X Y |
|  |  | (Identification of launch site and instrumentation for P, T, U and wind measurements) |  |
| 3 01 111 | 3 01 001 | WMO block and station numbers |  |
|  | 0 01 011 | Ship or mobile land station identifier |  |
|  | 0 02 011 | Radiosonde type |  |
|  | 0 02 013 | Solar and infrared radiation correction |  |
|  | 0 02 014 | Tracking technique/status of system used |  |
|  | 0 02 003 | Type of measuring equipment used |  |

**0 01 011**

***Ship or mobile land station identifier***

Unit/Scale/Reference/Width[[3]](#footnote-3): CCITT IA5/0/0/72 (9 characters right padded with space if necessary)

Required for identifying ship or mobile land stations, *shall* not be used for reports from fixed stations.

B/C25.2.1 «Ship or mobile land station identifier (0 01 011) shall be always reported not exceeding 9 characters in reports from ships or mobile stations. Ship or mobile station identifier 0 01 011 shall be always set to a missing value in reports from a fixed land station».

**0 02 011**

***Radiosonde type***

Unit/Scale/Reference/Width: Code table/0/0/8

BUFR equivalent of Code table 3685 **r­ara**‘***Radiosonde/sounding system used***’ for alphanumeric codes. Both refer to common Code table C-2. Unlike to Code table 3685 with entries 00..99, potential capacity of 0 02 011 is 255 entries while real one is essentially less due to ranges reserved for other purposes. Due to lack of capacity of Code table 3685 since 30/06/2007 new entries >100 in BUFR domain are mapped onto 0..99 range of TAC. For use in BUFR entries in effect after 30/06/2007 shall be more or equal to 100.

Despite of its name 0 02 011 in fact commonly designates a whole sounding system (a radiosonde + ground system) rather than a radiosonde itself as one can expect from the name of common Code table C-2. This allowed to make TEMP message more informative. However, characterizing all variety of sounding systems requires too much entries.

For future allocation for use in BUFR – ground system should be better identified with 0 02 066 (and possibly other descriptors).

**0 02 013**

***Solar and infrared radiation correction***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figure

0 No correction

1 CIMO solar corrected and CIMO infrared corrected

2 CIMO solar corrected and infrared corrected

3 CIMO solar corrected only

4 Solar and infrared corrected automatically by radiosonde system

5 Solar corrected automatically by radiosonde system

6 Solar and infrared corrected as specified by country

7 Solar corrected as specified by country

8–14 Reserved

15 Missing value

BUFR full equivalent of Code table 3849 **sr**‘***Solar and infrared radiation correction***’ for alphanumeric codes.

Meaning: Radiation correction of temperature measurements, additional (but not all) information could be found in CIMO Guide WMO No. 8. In use are entries 0, 4-7. Code figures 1-3 seem to be never in use (possibly they were introduced for corrections to be derived from results of WMO Radiosonde Intercomparison).

Unless other is required by a country, if radiation correction is applied manufactures should implement using code figures 4 and 5.

0 02 013 in fact describes only a method of radiation correction. A sounding system may implement different versions of radiation correction schemes.

Changes in software and radiosonde version (via serial ID) should also allow identify modification of radiation correction.

Anticipated development:

8 Solar and infrared corrected as specified by GRUAN

**0 02 014**

***Tracking technique/status of system used***

Unit/Scale/Reference/Width: Code table/0/0/7

Code figure for

Code figure for BUFR

sasa (Code table 0 02 014)

00 0 No wind finding

01 1 Automatic with auxiliary optical direction finding

02 2 Automatic with auxiliary radio direction finding

03 3 Automatic with auxiliary ranging

04 4 Not used

05 5 Automatic with multiple VLF-Omega signals

06 6 Automatic cross chain Loran-C

07 7 Automatic with auxiliary wind profiler

08 8 Automatic satellite navigation

09–18 9–18 Reserved

19 19 Tracking technique not specified

BUFR equivalent of Code table 3872 **sasa**‘***Tracking technique/status of system used***’ for alphanumeric codes. Both refer to common Code table C-7, while 0 02 014 uses little bit wider range 0..127.

In fact, Code table C-7 comprises two different parts. The second one with entries >=20 has something to do with reporting of status of ASAP system but they are usually not used because require active input from operators (Krockauer Rudolf, E-ASAP Operational Service Manager, personal communication, March 2016).

The first part has something to do with tracking balloon required for windfinding. 0 02 014 intersects to some extent with 0 02 003 ‘Type of measuring equipment used’ and seems to be redundant (maybe because **sasa** was introduced later than **a4**). But in view of expected using of 0 02 003 for specifying ground based remote sensing instrumentation 0 02 014 may remain useful.

**0 02 003**

***Type of measuring equipment used***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figure

0 Pressure instrument associated with wind measuring equipment

1 Optical theodolite

2 Radio theodolite

3 Radar

4 VLF-Omega

5 Loran C

6 Wind profiler

7 Satellite navigation

8 Radio-acoustic Sounding System (RASS)

9 Sodar

10–13 Reserved

14 Pressure instrument associated with wind measuring equipment but pressure element  
 failed during ascent

15 Missing value

BUFR analogue of Code table 0265 **a4**‘***Type of measuring equipment used***’ for alphanumeric codes. However, order of entries corresponding to the same code figures slightly differs:

**0265**

***Type of measuring equipment used***

0 Pressure instrument associated with wind-measuring equipment

1 Optical theodolite

2 Radiotheodolite

3 Radar

4 Pressure instrument associated with wind-measuring equipment but pressure element failed during ascent

5 VLF-Omega

6 Loran-C

7 Wind profiler

8 Satellite navigation

9 Reserved

So far for sounding with PTU only measurements 0 02 003 should be reported as 15 ‘Missed’. Do we need a dedicated entry for that in 0 02 003 taking into account that reserved entries are about to be allocated for remote sensing? 0 02 014=0 and 0 02 003=15 may be recommended for such a case with respective clarification.

1. Metadata descriptors provided by 3 01 128

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME | ELEMENT DESCRIPTION[[4]](#footnote-4) |
| F X Y |
|  |  | (Additional information on radiosonde ascent) |  |
| 3 01 128 | 0 01 081 | Radiosonde serial number |  |
|  | 0 01 082 | Radiosonde ascension number |  |
|  | 0 01 083 | Radiosonde release number |  |
|  | 0 01 095 | Observer identification |  |
|  | 0 02 015 | Radiosonde completeness |  |
|  | 0 02 016 | Radiosonde configuration |  |
|  | 0 02 017 | Correction algorithms for humidity measurements |  |
|  | 0 02 066 | Radiosonde ground receiving system |  |
|  | 0 02 067 | Radiosonde operating frequency |  |
|  | 0 02 080 | Balloon manufacturer |  |
|  | 0 02 081 | Type of balloon |  |
|  | 0 02 082 | Weight of balloon |  |
|  | 0 02 083 | Type of balloon shelter |  |
|  | 0 02 084 | Type of gas used in balloon |  |
|  | 0 02 085 | Amount of gas used in balloon |  |
|  | 0 02 086 | Balloon flight train length |  |
|  | 0 02 095 | Type of pressure sensor |  |
|  | 0 02 096 | Type of temperature sensor |  |
|  | 0 02 097 | Type of humidity sensor |  |
|  | 0 02 103 | Radome |  |
|  | 0 02 191 | Geopotential height calculation |  |
|  | 0 25 061 | Software identification and version number |  |
|  | 0 35 035 | Reason for termination | [Reason for ascent termination] |

**0 01 081**

***Radiosonde serial number***

Unit/Scale/Reference/Width: CCITT IA5/0/0/160 (20 characters right padded with space if necessary)

Content of 0 01 081 is beyond the scope of Manual on codes therefore its implementation is system dependent.

Manufacturers should be encouraged:

* To explain their numbering system and implement it in such a way to allow identifying production date.
* To maintain history page it in such a way to allow identifying hardware and firmware details of particular radiosonde from the date of its production.

There is a need in a central repository for the information above (OSCAR/Surface, centres like NCDC?)

**0 01 082**

***Radiosonde ascension number***

Unit/Scale/Reference/Width: Numeric/0/0/14

Note 12 under Class 1 Table B applies

Note 12 under Class 1 Table B:

(12) Descriptor 0 01 082 is to be used for reporting the sequential number of the current radiosonde reporting period (e.g. synoptic cycle) within a given year or other similar locally defined length of time. Descriptor 0 01 083 is to be used in the case of multiple sequential radiosonde releases during a single reporting period (e.g. synoptic cycle), in order to indicate which particular release generated the corresponding data values.

FM 94 BUFR, FM 95 CREX

0 01 082 numbering should start from 1 for the very first ascent of the year.

**0 01 083**

***Radiosonde release number***

Unit/Scale/Reference/Width: Numeric/0/0/3

Note 12 under Class 1 Table B (see above) applies.

When soundings abnormally terminate early (e.g., balloon burst, leaking or floating balloon, weak or fading signal, radiosonde failure, etc.) NHMS regulations may require another successive release close to time of scheduled observation. This ‘second release’ after failed ascent will acquire data for the same synoptic reporting hour as the first observation. 0 01 083 is to be used to distinguish among multiple observations launched to obtain a given site’s synoptic observation. It’s necessary to note that successive reports supplement rather than replace

0 01 083 numbering should start[[5]](#footnote-5) from 1 for a scheduled release.

If data of the first (or any previous) release were already reported before reporting results of successive release update sequence number in BUFR Section 1 should not be adjusted.

**0 01 095**

***Observer identification***

Unit/Scale/Reference/Width: CCITT IA5/0/0/32 (4 characters right padded with space if necessary)

So far content of 0 01 095 is beyond the scope of Manual on codes therefore implementation is NHMS dependent. Initials of observer responsible for the ascent with respective description to be stored in a site log seems to be a reasonable recommendation.

**0 02 015**

***Radiosonde completeness***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figure

0 Reserved

1 Pressure only radiosonde

2 Pressure only radiosonde plus transponder

3 Pressure only radiosonde plus radar reflector

4 No-pressure radiosonde plus transponder

5 No-pressure radiosonde plus radar reflector

6–14 Reserved

15 Missing value

The element was considered as describing radiosonde completeness in respect to PTU sounding and windfinding. More careful examination revealed it reproduces entries 91-95 in Common code table C-2. Comparison with entries 2-3 in C-2 confirms that 0 02 015 refers to radiosonde as it is defined in CIMO Guide Ch. I.12.

Although the descriptor seems to be redundant it’s not completely so as, for example, allows distinguishing primary and secondary radars.

Comments:

Radar reflector is a passive target (to be used with primary radar)

Transponder is an active target (to be used with secondary radar)

Examples:

1 “Pressure only radiosonde” – PTU radiosonde without windfinding capability

3 “Pressure only radiosonde plus radar reflector” - applicable to some Australian upper-air systems using PTU-only RS92 radiosondes equipped with reflectors

4 “No-pressure radiosonde plus transponder” – Russian upper-air systems: secondary radar coupled with a radiosonde without pressure sensor.

Anticipated expansion –

6 Pressure only radiosonde plus Loran-C relay

7 Pressure only radiosonde plus GNSS module

8 No-pressure radiosonde plus GNSS module

**0 02 016**

***Radiosonde configuration***

Unit/Scale/Reference/Width: Flag table/0/0/5

Bit No.

1 Train regulator

2 Light unit

3 Parachute

4 Rooftop release

All 5 Missing value

This Flag table in fact has something with flight train configuration and allows reporting such useful metadata as use of train regulator[[6]](#footnote-6) (i.e. de-reeler or unwinder) and parachute[[7]](#footnote-7). Using of light unit was intended for assisting manual tracking antenna positioning just after release in nighttime and may be not in use anymore. It might be also more logical to have in it a bit for signifying use of reflector. It’s necessary to note that the Flag table is fully completed and no more entries are available. It’s a pity as there is no more space for other flight train accessories such as hanger board, shock absorber, stabilizer, detainer, cutter etc. Potentially, approach used in 0 02 016 allows reporting flights with several radiosondes and other payload such as ozonesonde.

This may require introducing a new Flag table replacing 0 02 016.

**0 02 017**

***Correction algorithms for humidity measurements***

Unit/Scale/Reference/Width: Code table/0/0/6

Code figure

0 No corrections

1 Time lag correction provided by the manufacturer

2 Solar radiation correction provided by the manufacturer

3 Solar radiation and time lag correction provided by the manufacturer

4–30 Reserved

31 Missing value

This Code table in fact was requested by DWD on behalf of GRUAN Lead Centre.

Anticipated expansion –

4 National time lag correction

5 National solar radiation correction

6 National solar radiation and time lag correction

7 GRUAN solar radiation and time lag correction

Do we need ‘mixed entries’ like ‘Time lag correction provided by the manufacturer and national solar radiation correction”?

**0 02 066**

***Radiosonde ground receiving system***

Unit/Scale/Reference/Width: Code table/0/0/6

Code figure

0 InterMet IMS 2000

1 InterMet IMS 1500C

2 ShangHai GTC1

3 NanJing GTC2

4 NanJing GFE(L)1

5 MARL-A radar

6 VEKTOR-M radar

7–61 Reserved

62 Other

63 Missing value

The main purpose of the descriptor for anticipated future is to supplement and relive load on 0 02 011 ‘Radiosonde type’ concentrating the latter solely on radiosondes. When none entry is applicable code figure 62 ‘Other’ shall be used.

**0 02 067**

***Radiosonde operating frequency***

Unit/Scale/Reference/Width: Hz/-5/0/15

The descriptor seems to be self-descriptive and signifies carrier frequency of a radiosonde telemetry channel and shall be reported with 0 02 067 with precision up to 0.1 MHz.

**0 02 080**

***Balloon manufacturer***

Unit/Scale/Reference/Width: Code table/0/0/6

Code figure

0 Kaysam

1 Totex

2 KKS

3 Guangzhou Shuangyi (China)

4 ChemChina Zhuzhou (China)

5–61 Reserved

62 Other

63 Missing value

The descriptor signifies a manufacturer of a balloon in use and seems to be self-descriptive. For those balloons which manufacturers have no respective entries in 0 02 080 (e.g. PAWAN, India), code figure 62 ‘Other’ shall be used.

**0 02 081**

***Type of balloon***

Unit/Scale/Reference/Width: Code table/0/0/5

Code figure

0 GP26

1 GP28

2 GP30

3 HM26

4 HM28

5 HM30

6 SV16

7–29 Reserved

30 Other

31 Missing value

The meaning of existing entries is somewhat ambiguous. Undertaken discovery has shown that in listed in the Code table 0 02 081 designations GP26, GP28, GP30 etc, which are used internally in the NOAA NWS, a two digit numeric suffix designates minimum burs altitude for 90% balloons in kilometers (km) above mean sea level, while two-letter prefix do has something with a balloon type. GP designates General Purpose balloons, i.e. conventional sounding balloons. HM designates High-<*elastic?*>Modulus Balloons intended to be used under severe weather conditions. The entry SV16 was used to designate “severe weather balloons”, mentioned in older NOAA NWS documents, made from quite rigid material, HM and SV is not anymore in use in NOAA NWS (James Fitzgibbon, NOAA/NWS/SFSC, personal communication, May 2016).

Existing entries in Code table 0 02 081 seems to specify both balloon type characterization and balloon performance requirements. The latter seems to be redundant because for a particular manufacturer bursting height depends from a balloon weight (0 02 082) and amount of free lift.

From other side, knowing balloon manufacturer 0 02 080 and balloon weight 0 02 082 alone are not sufficient to characterize a balloon is not sufficient as balloon manufacturer may produce several types of balloons for different purposes with different performance in various conditions. For example, TOTEX produces TA and TX type balloons, where TX balloons has another formula optimized for cold atmosphere. Both TA and TX type balloons are produced in various weights.

Therefore it is suggested to use 0 02 081 to specify particular types (or models) of balloons produced by various manufactures and new entries to be requested are:

7 Totex TA type balloons

8 Totex TX type balloons

9 KKS KS type balloons

10 ChemChina Zhuzhou HY balloons

For those balloons which manufacturers do not specify a type for produced balloons code figure 31 ‘Missing value’ should be used. For those balloons which manufacturers do not have a respective entry in Code table 0 02 080 ‘Balloon manufacturer’ but do specify a type for produced balloons code figure 30 ‘Other’ should be used.

When none entry is applicable code figure 31 ‘Other’ shall be used.

Specific GRUAN requirement may be a need in code figures for ‘double balloon’ and ‘balloon with parachute inside’.

**0 02 082**

***Weight of balloon***

Unit/Scale/Reference/Width: kg/3/0/13

Weight of balloon is to be reported with precision up to 0.001 kg. Descriptor seems to signify nominal weight of balloon but actual weight may be reported as well if required. It’s necessary to mention that maximum weight that is possible to report is 2046 g. Thus for reporting larger balloons weight that may be required for heavy multi-radiosonde payload it is necessary to apply Table C 2 01 YYY operator that is not possible when 0 02 082 is a part of Table D sequence.

**0 02 083**

***Type of balloon shelter***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figure

0 High bay

1 Low bay

2 Balloon-inflated launch system (BILS)

3 Roof-top BILS

4–13 Reserved

14 Other

15 Missing value

Descriptor 0 02 083 “Type of balloon shelter”, as many others in 3 01 128, originates from NOAA NWS practice.



High bay with 4.3 meters wide by 5.5 meters high doors



Low bay

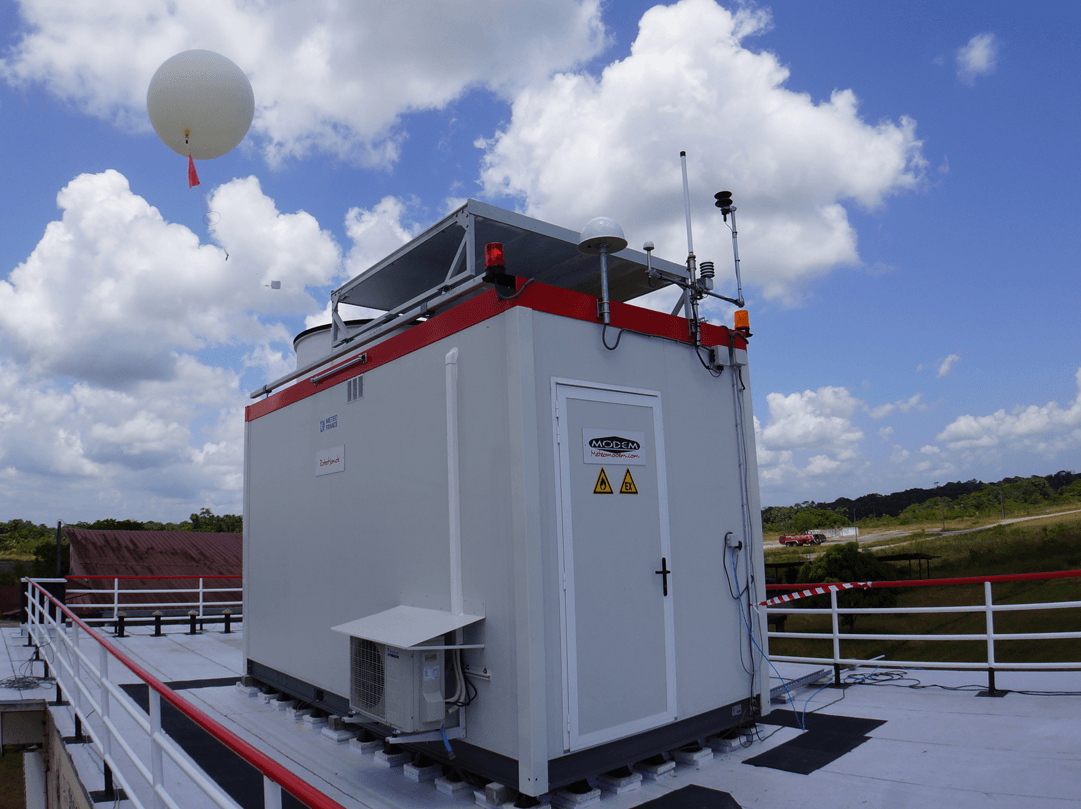




Roof-top?

Balloon-inflated launch system (BILS) seems to be ambiguous as the only found BILS acronym stands for Balloon Inflation and Launch Shelter, i.e. equipment intended for remote inflation and release of balloon.

Other NHMS in most cases may safely use code figures 14 ‘Other’ unless they have special reasons to allocate an additional entry to specify their balloon shelter. 0 02 083 was included into 3 01 128 bearing in mind necessity of indicating using one of systems for fully automated upper-air observations, produced in China, Finland, France and Japan for use for unmanned autonomous operation, such as AUTOSONDE, RobotSonde etc.



MODEM RobotSonde automatic launcher for unmanned sounding

E.g. ~15 MODEM RobotSonde are in operation worldwide using MODEM M2K2-DC and M10 sondes. Introducing 2 additional entries to 0 02 011 for them seems to be redundant.

Another possible additional entries may include basket type launcher (like Vaisala FB32 balloon launcher) and ASAP containers (which may be useful to distinguish manual shipboard realeses).

Code figure

4 Automated (unmanned) sounding system

5 Basket bag balloon launcher for manual release



An ARM site balloon launcher



Vaisala Balloon Launcher FB32

**0 02 084**

***Type of gas used in balloon***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figure

0 Hydrogen

1 Helium

2 Natural gas

3–13 Reserved

14 Other

15 Missing value

The descriptor signifies type of gas used for filling balloon and seems to be self-descriptive

**0 02 085**

***Amount of gas used in balloon***

Unit/Scale/Reference/Width: kg/3/0/13

Actually, the name 0 02 085 “Amount of gas used in balloon” is ambiguous - according to the element name and unit it should characterize a quantity which is rather difficult to measure at the upper-air station. However, it was discovered that in NOAA NWS upper-air manuals “Amount of gas used in balloon” is used as a synonym to “Nozzle lift” (one can [find](http://www.nws.noaa.gov/ops2/ops22/sfsc%20html/DCS%20Test%20Plan%20with%20Attachments.pdf) something like ‘Gas amount (nozzle lift, gm)’). The nozzle lift is the weight of the nozzle and total weight of weights, used to counterbalance a balloon filled with gas. It is equal to the free lift + the weight of radiosonde and all other flight train components such as suspension rope, parachute, radar reflector etc.

From NOAA NWS specifications

|  |  |
| --- | --- |
| Free Lift | Free lift is the number of grams of lift available over and above the number of grams of lift required by a balloon to support the weight of a complete radiosonde train. |
| Nozzle Lift | Nozzle lift is the number of grams of free lift plus the grams of lift required by a balloon to support the weight of a complete radiosonde train excluding the weight of the balloon. The radiosonde train not including the weight of the balloon consists of the radiosonde, parachute, light stick, dereeler or train regulator, and twine. |

It is also important that the nozzle lift is the quantity usually directly determined at upper-air station. Amount of gas used in balloon, i.e. nozzle lift is to be reported with precision up to 0.001 kg

Thus the name 0 02 085 may require re-formulation.

Note may be proposed under Class 2 of Table B or under Code table 0 02 085:

(xx) Descriptor 0 02 085 is to be used for reporting mass which inflated balloon can lift without mass of balloon, also known as nozzle lift.

However, automatic balloon launcher may use a gas flow meter to determine amount of gas. To cope with this issue there is a need in new descriptor in Class 3:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TABLE |  |  |  |  | DATA |
| REFERENCE | ELEMENT NAME | UNIT | SCALE | REFERENCE | WIDTH |
| F X Y |  |  |  | VALUE | (Bits) |
| 0 03 xxx | Volume of gas used in balloon | m3 | 3 | 0 | 13 |

**0 02 086**

***Balloon flight train length***

Unit/Scale/Reference/Width: m/1/0/10

This attribute of soundings is rather important as determine influence of balloon wake onto radiosonde sensors and magnitude of pendulum motion influencing windfinding[[8]](#footnote-8). There is no precise guidance for reporting this data element, but just from common sense: the flight-train connects the radiosonde to the balloon and may include a combination of parachute, train regulator (de-reeler), radar reflector and/or other related accessories. Balloon flight train length shall be reported with 0 02 086 with precision up to 0.1 m.

Note may be proposed under Class 2 of Table B or under Code table 0 02 08:

(xx) Descriptor 0 02 086 is to be used for reporting length (fully unwinded if de-reeler is used) of line between balloon neck and radiosonde body top.

**0 02 095**

***Type of pressure sensor***

Unit/Scale/Reference/Width: Code table/0/0/5

Code figure

0 Capacitance aneroid

1 Derived from GPS

2 Resistive strain gauge

3 Silicon capacitor

4 Derived from radar height

5–29 Reserved

30 Other

31 Missing value

Formally, descriptor 0 02 095 is not specific for radiosondes and Code table may be further populated with other types of pressure sensors not applicable to radiosondes. When none entry is applicable code figure 30 ‘Other’ shall be used.

Anticipated development –

5 Derived from GNSS[[9]](#footnote-9) height

**0 02 096**

***Type of temperature sensor***

Unit/Scale/Reference/Width: Code table/0/0/5

Code figure

0 Rod thermistor

1 Bead thermistor

2 Capacitance bead

3 Capacitance wire

4 Resistive sensor

5 Chip thermistor

6–29 Reserved

30 Other

31 Missing value

Formally, descriptor 0 02 096 is not specific for radiosondes and Code table may be further populated with other types of temperature sensors not applicable to radiosondes. When none entry is applicable code figure 30 ‘Other’ shall be used.

**0 02 097**

***Type of humidity sensor***

Unit/Scale/Reference/Width: Code table/0/0/5

Code figure

0 VIZ Mark II carbon hygristor

1 VIZ B2 hygristor

2 Vaisala A-Humicap

3 Vaisala H-Humicap

4 Capacitance sensor

5 Vaisala RS90

6 Sippican Mark IIA carbon hygristor

7 Twin alternatively heated Humicap capacitance sensor

8 Humicap capacitance sensor with active de-icing method

9 Carbon hygristor

10–29 Reserved

30 Other

31 Missing value

The Code table is obviously messy, include both concrete radiosonde model types and generic types and to some extent ambiguous (compare entries 5 and 7). Although formally, descriptor 0 02 097 is not specific for radiosondes, recently another descriptor 0 03 002 with the same name ‘Type of humidity sensor’ was proposed in Class 3 for use for surface observations. But so far there is no guarantee that Code table may not be further populated with other types of humidity sensors not applicable to radiosondes.

When none entry is applicable code figure 30 ‘Other’ shall be used.

Anticipated expansion –

11 Peltier-type mirror hygrometer[[10]](#footnote-10)

**0 02 103**

***Radome***

Unit/Scale/Reference/Width: Flag table/0/0/2

Bit No.

1 Radar antenna is protected by a radome

All 2 Missing value

Although being defined as a flag table this is in fact logical value (due to BUFR implementation). Applicable for radars and radiotheodolites which often uses radomes (from *radar* and *dome*). There is a radome in use when bit 1 =1 and not in use when bit 1=0. When non applicable – all bits shall set to 1.

**0 02 191**

***Geopotential height calculation***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figure

0 Geopotential height calculated from pressure

1 Geopotential height calculated from GPS height

2 Geopotential height calculated from radar height

3–14 Reserved

15 Missing value

The descriptor looks to some extent redundant in comparison to 0 02 095 “Type of pressure sensor”, but in fact quite meaningful. Entries may require some clarification (possibly – by a Note under the Code table)

0 Geopotential height calculated from pressure*, temperature and humidity by integration of hydrostatic equation starting from reference height with known surface pressure[[11]](#footnote-11)*

1 Geopotential height calculated from GPS *ellipsoidal* height *converted to height above a reference geoid*

2 Geopotential height calculated from radar height *augmented by height of aerial above MSL*

Anticipated development –

3 Geopotential height calculated from GNSS[[12]](#footnote-12) height

**0 25 061**

***Software identification and version number***

Unit/Scale/Reference/Width: CCITT IA5//0/0/96 bits (12 symbols right padded with space if necessary)

This descriptor is quite generic. Content of 0 25 061 is beyond the scope of Manual on codes therefore its implementation is system dependent.

Manufacturers should be encouraged:

* To explain their versioning system and implement it to allow recognizing order of versions
* To maintain history page it in such a way to allow identifying specific features of particular version.

There is a need in a central repository for the information above (OSCAR/Surface, centres like NCDC?)

**0 35 035**

***Reason for termination***

Unit/Scale/Reference/Width: Code table/0/0/5

Code figure

0 Reserved

1 Balloon burst

2 Balloon forced down by icing

3 Leaking or floating balloon

4 Weak or fading signal

5 Battery failure

6 Ground equipment failure

7 Signal interference

8 Radiosonde failure

9 Excessive missing data frames

10 Reserved

11 Excessive missing temperature

12 Excessive missing pressure

13 User terminated

14 Sudden lost of signal

15 Tracking lost

16–29 Reserved

30 Other

31 Missing value

This is a code table. As the element name may seems little bit ambiguous it may be useful to add a comment into the column “Element description” of 3 01 128: “Reason for ascent termination” (or to be suitable for dropsondes – “Reason for sounding termination”).

The main purpose is monitoring of instrumentation performance as in normal case the only expected reason is the balloon burst. But in case of abnormal termination quality of observations may be compromised by the end of observations.

Code entries are quite generic and self-explained therefore additional explanations are hardly required.

When none entry is applicable code figure 30 ‘Other’ shall be used.

Anticipated development –

16 Abnormal or scattered pressure

17 Abnormal or scattered temperature

18 Abnormal or scattered GNSS data

19 Limiting angles

20 Abnormal or scattered range

21 Abnormal or scattered azimuth

22 Abnormal or scattered elevation

23 Excessive missing GNSS data

25 Excessive missing range

26 Excessive missing azimuth

27 Excessive missing elevation

28 Insufficient data quality of one or more parameters required for the second release

29 Balloon forced down by precipitation

Two more entries “Increasing pressure” and “Max. interpolation time exceeded” were requested by Czech Republic. Both are more generic than already existed and may be useful when no human consideration of termination reason is possible. However, more generic entry descriptions would be suggested:

30 Balloon descent detected

31 Invalid and/or missed data time limits exceeded

1. Other existing BUFR descriptors

**0 01 093**

***Balloon lot number***

Unit/Scale/Reference/Width: CCITT IA5/0/0/96(12 characters right padded with space if necessary)

May be important for some NHMS having prescribed procedure for lot numbering.

**0 02 012**

***Radiosonde computational method***

Unit/Scale/Reference/Width: Code table/0/0/4

This code table with maximum capacity of 15 entries is not developed so far (more than 10 years). There was no idea what to use it for so far? As GRUAN upper-air soundings rely upon, at least so far, conventional sounding instrumentation but implement own launch procedure. Thus the same sounding may produce two different reports and there is a need in a way allowing to distinguish between them. This might be using 0 02 012

1. Manufacturer computation
2. GRUAN computation

**0 08 040**

***Flight level significance***

Unit/Scale/Reference/Width: Code table/0/0/6

Code figure

0 High-resolution data sample

1 Within 20 hPa of surface

2 Pressure less than 10 hPa (i.e., 9, 8, 7, etc.) when no other reason applies

3 Base pressure level for stability index

4 Begin doubtful temperature, height data

5 Begin missing data (all elements)

6 Begin missing relative humidity data

7 Begin missing temperature data

8 Highest level reached before balloon descent because of icing or turbulence

9 End doubtful temperature, height data

10 End missing data (all elements)

11 End missing relative humidity data

12 End missing temperature data

13 Zero degrees Celsius crossing(s) for RADAT

14 Standard pressure level

15 Operator-added level

16 Operator-deleted level

17 Balloon re-ascended beyond previous highest ascent level

18 Significant relative humidity level

19 Relative humidity level selection terminated

20 Surface level

21 Significant temperature level

22 Mandatory temperature level

23 Flight termination level

24 Tropopause(s)

25 Aircraft report

26 Interpolated (generated) level

27 Mandatory wind level

28 Significant wind level

29 Maximum wind level

30 Incremental wind level (fixed regional)

31 Incremental height level (generated)

32 Wind termination level

33 Pressure 100 to 110 hPa, when no other reason applies

34 Freezing level base

35 Freezing level top

36 Flight level base

37 Flight level top

38 Top of wind sounding

39 Bottom of wind sounding

40 Significant thermodynamic level (inversion)

41 Significant relative humidity level (according to NCDC criteria)

42 Significant temperature level (according to NCDC)

43 Begin missing wind data

44 End missing wind data

45–59 Reserved

60 Level of 80-knot isotach above jet

61 Level of 80-knot isotach below jet

62 Other

63 Missing value

This descriptor is used in NOAA NWS, e.g. code figure 1 seems to signify following NOAA NWS practice “A level shall be selected within 20 hPa of the surface level if a level has not already been selected in this range for other reasons. This level is necessary to ensure that any significant lapse rate near the surface is properly identified. The point of maximum temperature deviation from a linear relation between time (or the logarithm of pressure) and the surface temperature and the temperature 20 hPa above the surface shall be selected. The level shall not be selected if temperature is missing”. This is an example of how much know-how may be hidden behind a single entry in a code table.

**0 08 041**

***Data significance***

Unit/Scale/Reference/Width: Code table/0/0/5

Code figure

0 Parent site

1 Observation site

**2 Balloon manufacture date**

3 Balloon launch point

4 Surface observation

5 Surface observation displacement from launch point

6 Flight level observation

7 Flight level termination point

8 IFR ceiling and visibility

9 Mountain obscuration

10 Strong surface wind

11 Freezing level

12 Multiple freezing level

13 **Instrument manufacture date**

14–30 Reserved

31 Missing value

This code table allows signifying Balloon manufacture date and Instrument(radiosonde) manufacture date as well as relative position of surface observations (Table D sequence 3 02 050). Numerous examples of 0 08 041 use in Table D may give some idea what it is used for.

**0 25 069**

***Flight level pressure corrections***

Bit No.

1 Smoothed

2 Baseline adjusted

3 Normalized time interval

4 Outlier checked

5 Plausibility checked

6 Consistency checked

7 Interpolated

All 8 Missing value

This descriptor seems to be used in NOAA NWS for internal reporting high-resolution data– see examples in Table D.

**0 33 015**

***Data quality-check indicator***

Code figure

0 Passed all checks

1 Missing data check

2 Descending/reascending balloon check

3 Data plausibility check (above limits)

4 Data plausibility check (below limits)

5 Superadiabatic lapse rate check

6 Limiting angles check

7 Ascension rate check

8 Excessive change from previous flight

9 Balloon overhead check

10 Wind speed check

11 Wind direction check

12 Dependency check

13 Data valid but modified

14 Data outlier check

15–62 Reserved

63 Missing value

This code table may be used to indicate data quality-check within 3 09 052 using data present bit-map. However, detailed clarification is needed to allow unambiguous interpretation like one can find regarding balloon overhead check in FMH No. 3 “*Under light or calm wind conditions near the surface or with shifting winds aloft, the radiosonde may track directly over the RDF antenna (i.e., elevation angles approach 90 degrees) and the ground equipment antenna system may not be able to continue tracking. In such cases, the antenna drive mechanism "locks up," requiring operator intervention to regain antenna tracking. When the following conditions occur, the angular data may be in error and should be checked: the elevation angles are greater than 80 degrees within the first five minutes of the observation or the azimuth angles have changed by more than 100 degrees from one whole minute to the next for at least one of the elevation angles greater than 85 degrees.*

*In many instances, the RDF system software should detect this situation and automatically delete the wind data during the period of the lockup*.”

1. Additional GRUAN requirements

Introducing Class 3 “Sounding procedure” descriptor may address a need in distinguish between standard manufacturer and GRUAN soundings.

Class 3 descriptor “Volume of gas used in balloon” was requested by GRUAN community for Tateno (JMA) GRUAN site operated Vaisala AUTOSONDE but is of common use for such instrumentation.

One Class 3 descriptor “Balloon flight train configuration” or “Additional information on balloon flight train configuration” is required either to supersede 0 02 016 or augment it.

Another Class 3 descriptor “Type of flight rig” may be required to describe in details of multi-payload flight rig configuration which may influence radiosonde reading.

Two class 8 descriptors “Baseline check data significance” and “Baseline check (environment/conditions) significance” may be needed to specify baseline check.

Descriptors’ declaration:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| TABLE |  |  |  |  | DATA |
| REFERENCE | ELEMENT NAME | UNIT | SCALE | REFERENCE | WIDTH |
| F X Y |  |  |  | VALUE | (Bits) |
| 0 03 xxx | Sounding procedure | Code table | 0 | 0 | 4 |
| 0 03 xxx | Volume of gas used in balloon | m3 | 3 | 0 | 13 |
| 0 03 xxx | Balloon flight train configuration  or  Additional information on balloon flight train configuration | Flag table | 0 | 0 | 24  or  20 |
| 0 08 xxx | Baseline check data significance | Code table | 0 | 0 | 4 |
| 0 08 xxx | Baseline check (environment/conditions) significance | Code table | 0 | 0 | 5 |

Note (x): 0 03 xxx Additional information on balloon flight train configuration is intended to supplement 0 02 016 Radiosonde configuration

**0 03 xxx**

***Sounding procedure***

Code figure

1. As specified by manufacturer
2. As specified by GRUAN

3-14 Reserved

15 Missing value

**0 03 xxx**

***Balloon flight train configuration***

Unit/Scale/Reference/Width: Flag table/0/0/24

Bit No.

1 Train regulator

2 Light unit

3 Parachute

4 Rooftop release

5 Cutter

6 Hanger board

7 Shock absorber

8 Stabilizer

9 Detainer

10 Other radiosondes

11 Ozonezonde

12 Backscatter instrumentation

13 Other additional instrumentation

14-23 Reserved

All 24 Missing value

**0 03 xxx**

***Additional information on balloon flight train configuration***

Unit/Scale/Reference/Width: Flag table/0/0/20

Bit No.

1 Cutter

2 Hanger board

3 Shock absorber

4 Stabilizer

5 Detainer

6 Cutter

7 Other radiosondes

8 Ozonezonde

9 Backscatter instrumentation

10 Other additional instrumentation

11-19 Reserved

All 20 Missing value

**0 03 xxx**

***Type of flight rig***

Unit/Scale/Reference/Width: Code table/0/0/4

Code figures

0 Solo (single radiosonde)

1 Block

2 Bar

3 Cross

4 T-rig

5 Double T-rig

6 Complex

7-14 Reserved

15 Missing value

**0 08 xxx**

***Baseline check data significance***

Code figure

0 Verified instrument reading

1 Reference instrument reading

2 Auxiliary instrument reading

3-14 Reserved

15 Missing value

**0 08 xxx**

***Baseline check (environment/conditions) significance***

Code figure

0 Manufacturer’s baseline check unit

1 National baseline check unit

2 Weather screen

3 GRUAN Standard humidity chamber

4 GRUAN Temperature-Humidity reference system

5 Environment chamber

6 Wind tunnel

7-30 Reserved

31 Missing value

GRUAN ground check result include (SHC stands for GRUAN Standard Humidity Chamber):

|  |
| --- |
| Manufacturer Ground Check (Sonde temperature) |
| Manufacturer Ground Check (Reference temperature) |
| Manufacturer Ground Check (Sonde humidity) |
| Manufacturer Ground Check (Reference humidity) |
| GRUAN SHC Check (sonde temperature under 0% environment) |
| GRUAN SHC Check (Reference temperature under 0% environment) |
| GRUAN SHC Check (Sonde Humidity under 0% environment) |
| GRUAN SHC Check (Reference Humidity under 0% environment) |
| GRUAN SHC Check (sonde temperature under 100% environment) |
| GRUAN SHC Check (Reference temperature under 100% environment) |
| GRUAN SHC Check (Sonde Humidity under 100% environment) |
| GRUAN SHC Check (Reference Humidity under 100% environment) |

To address a need in reporting information about ground check it is proposed to consider Table D sequences pattern like:

|  |  |  |  |
| --- | --- | --- | --- |
| TABLE  REFERENCE | TABLE  REFERENCES | ELEMENT NAME | ELEMENT DESCRIPTION |
| F X Y |
|  |  | (Radiosonde ground-check results) |  |
| 3 03 xxx  or  3 01 xxx |  |  |  |
|  | 3 01 011 | Year | Identification of |
|  |  | Month | ground-check time |
|  |  | Day |  |
|  | 3 01 013 | Hour |  |
|  |  | Minute |  |
|  |  | Second |  |
|  | 0 08 021 | Time significance | = 2 Time averaged |
|  | 0 04 026 | Time period or displacement | Ground-check duration |
|  | 0 08 xxx | Baseline check (environment/conditions) significance | Signify ground-check procedure |
|  | 0 03 008 | Artificially ventilated screen or shield | Under validation |
|  | 0 08 xxx | Baseline check data significance | = 0 Verified instrument reading |
|  | 0 10 004 | Pressure | Radiosonde pressure |
|  | 0 12 101 | Temperature/air temperature | Radiosonde temperature |
|  | 0 13 009 | Relative humidity (see Note 6) | Radiosonde humidity |
|  | 0 08 xxx | Baseline check data significance | = 1 Reference instrument reading |
|  | 0 12 101 | Temperature/air temperature | Reference temperature |
|  | 0 13 009 | Relative humidity (see Note 6) | Reference humidity |
|  | 0 08 xxx | Baseline check data significance | = 2 Auxiliary instrument reading |
|  | 0 10 004 | Pressure | Barometer reading |
|  | 0 08 xxx | Baseline check data significance | =missing to cancel the previous value |
|  | 0 08 xxx | Baseline check (environment/conditions) significance | =missing to cancel the previous value |
|  | 0 08 021 | Time significance | =missing to cancel the previous value |

Precision may be increased if required. There is also a question where to put this sequence in relation to 3 01 128 and 3 09 052.

1. GRUAN is GCOS Reference Upper Air Network aimed for providing long-term reference observations of upper air essential climate variables. [↑](#footnote-ref-1)
2. Some NHMS adjust surface barometer pressure to radiosonde release level [↑](#footnote-ref-2)
3. Hereinafter under the name of descriptor are indicated: unit, scale, reference value and bit width [↑](#footnote-ref-3)
4. So far empty [↑](#footnote-ref-4)
5. For information – in NOAA NWS practice 1,2 and 3 are used for numbering successive releases while 0 is used for test observation. [↑](#footnote-ref-5)
6. NOAA Federal Meteorological Handbook FMH No.3. Rawinsonde and Pibal Observations: “2.3.2.2 Train Regulators. A train regulator (also termed dereeler or let-down) may be used when the release is made in high winds. Train regulators come in various designs. Train regulators may be provided by the radiosonde manufacturer as an add-on or incorporated into the radiosonde itself or may be acquired separately.” Potentially, type of train regulator and dereeling length also may need to be reported in BUFR. [↑](#footnote-ref-6)
7. Type and characteristics of parachute also may need to be reported in BUFR. [↑](#footnote-ref-7)
8. Nowadays, data processing software may include special filtering to get rid of those effects and it may be useful for data user to be informed about that in BUFR message. [↑](#footnote-ref-8)
9. Applicable to GLONASS, Galileo, Beidou and combined use of multiple GNSS constellations [↑](#footnote-ref-9)
10. Suitable for MeteoLabor SnowWhite [↑](#footnote-ref-10)
11. Some NHMS adjust surface barometer pressure to radiosonde release level [↑](#footnote-ref-11)
12. Applicable to GLONASS, Galileo, Beidou and combined use of multiple GNSS constellations [↑](#footnote-ref-12)