

PART C

COMMON FEATURES TO BINARY AND ALPHANUMERIC CODES

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a. FM SYSTEM OF NUMBERING TABLE-DRIVEN ALPHANUMERIC CODES

Each table-driven code bears a number, preceded by the letters FM. This number is followed by a Roman numeral to identify the session of CBS which either approved the code as a new one or made the latest amendment to its previous version. A code approved or amended by correspondence after a session of CBS receives the number of that session.

Furthermore, an indicator term is used to designate the code colloquially and is therefore called a “code name”.

Note on nomenclature:

Changes and augmentations to the structure of the CREX data representation shall be identified as different “CREX edition numbers”. The previous edition number was 1. The new edition number is 2.

Changes to the content of the parameter Tables A, B, C and D shall be identified as different “table versions”. The previous tables were Version 32; the changes described in this edition will become “Tables A, B, C and D, Version 33”.

Further CREX editions and table versions may be generated independently of one another in the future as requirements dictate.

The FM system of numbering the codes, together with the corresponding code names and their reference list of CBS approved decision, is the following:

FM SYSTEM OF TABLE-DRIVEN ALPHANUMERIC CODES

FM 95–XIV CREX

Character form for the representation and exchange of data

Res. 8 (EC-LI), Rec. 8 (CBS-99), Rec. 9 (CBS-00), approved by the President of WMO, Res. 4 (EC-LIII), Rec. 9 (CBS-01), approved by the President of WMO, Res. 2 (EC-LVII), Res. 10 (EC-LIX) and Res. 7 (EC-LXI), and adoption between CBS sessions (2010, 2012 and 2013)

b. LIST OF TABLE-DRIVEN ALPHANUMERIC CODES WITH THEIR SPECIFICATIONS AND ASSOCIATED CODE TABLES

FM 95–XIV CREX

Character form for the representation and exchange of data

CODE FORM

SECTION 0	Indicator section
SECTION 1	Data description section
SECTION 2	Data section
SECTION 3	(Optional section)
SECTION 4	End section

Notes:

- (1) CREX is the name of a character code for the representation and exchange of meteorological and other data.
- (2) CREX uses many of the principles of FM 94 BUFR.
- (3) CREX may be used for the exchange of data for which there is no suitable existing WMO code form.
- (4) A CREX message shall consist of one or more subsets of related meteorological data defined, described, and represented by a single CREX entity. For observational data, each subset shall correspond to one report.
- (5) A CREX message consists of sections:

<i>Section number</i>	<i>Name</i>	<i>Contents</i>
0	Indicator section	"CREX"
1	Data description section	CREX master table number, edition number, table version number, BUFR master table number, version number of local table, data category and sub-category, originating centre and sub-centre, sequence number of message, number of subsets, date and time, then a collection of descriptors which define the form and content of data subsets making the data section, and an optional check digit indicator "E"
2	Data section	A set of data items defined by Section 1
3	Optional section	"SUPP" followed by additional items for local use
4	End section	"7777"

- (6) It will be noted that CREX representation is suitable for the manual encoding and visual display of meteorological and other data.

REGULATIONS

95.1 General

- 95.1.1 The beginning and ending of the data representation form shall be identified by the characters "CREX" and "7777", respectively.
- 95.1.2 Information within CREX shall be character coded.
- 95.1.3 A group is a sequence of one or more contiguous characters corresponding to a single data descriptor or data value. Groups shall be separated from each other by one or more space characters. Multiple space characters shall be used when needed to improve human readability.
- 95.1.4 The subset terminator shall be represented by the character string "+". The subset terminator shall not be used when the subset is the last subset.
- 95.1.5 The section terminator shall be represented by the character string "++". The section terminator shall additionally function as a subset terminator for the last subset.

95.2 Section 0 – Indicator section

- 95.2.1 Section 0 shall be four characters long consisting of the character sequence "CREX".

95.3 Section 1 – Data description section

95.3.1 Table indicators

- 95.3.1.1 The data description section shall begin with the CREX table descriptor starting with the letter T and followed by a 10-digit number (tteevvbbww) without a separator character. The first two digits (tt) shall define the CREX master table used (tt = 00 if the standard WMO FM 95 CREX tables are used). The next two digits (ee) shall indicate the CREX edition number used, the next two (vv) the CREX table version number used, the next two (bb) the BUFR master table version number used and the last two (ww) the version number of local table (*however for use of local table see Notes 6 and 7 of CREX Table B*).
- 95.3.1.2 Immediately following the CREX table descriptor and a space character as separator, Section 1 shall contain a six-digit number (nnnmmm) preceded by the letter A. The first three digits (nnn) define the data category referenced to CREX Table A. The next three digits (mmm) shall indicate the sub-category from Common Code table C-13.
- 95.3.2 Other indicators
- 95.3.2.1 Immediately following the CREX table descriptors and a space character as separator, Section 1 shall contain an eight-digit number (ooooopp) preceded by the letter P. The first five digits (ooooo) define the originating centre from Common Code table C-11. The next three digits (ppp) shall indicate the originating sub-centre from Common Code table C-12.
- 95.3.2.2 Immediately following the CREX indicator for originating centre and a space character as separator, Section 1 shall contain a two-digit number (uu) preceded by the letter U. The two digits (uu) define the sequence number of the message (00 for original message, uu for updated version).
- 95.3.2.3 Immediately following the CREX indicator for the sequence number and a space character as separator, Section 1 shall contain a three-digit number (sss) preceded by the letter S. The three digits (sss) define the number of subsets in the report.
- 95.3.2.4 Immediately following the CREX indicator for the number of subsets and a space character as separator, Section 1 shall contain an eight-digit number (yyyymmdd) preceded by the letter Y.

The first four digits (yyyy) define the year of the most typical time for the CREX message content. The next two digits (mm) define the month and the last two digits (dd) define the day.

- 95.3.2.5 Immediately following the CREX indicator for the date and a space character as separator, Section 1 shall contain a four-digit number (hhnn) preceded by the letter H. The first two digits (hh) define the hour of the most typical time for the CREX message content and the next two digits (nn) define the minutes.

95.3.3 Data description syntax for CREX

- 95.3.3.1 After the CREX indicators defining the most typical time for the CREX message content, Section 1 shall have one or more data descriptor(s). Data descriptors shall be preceded by a space character as separator. Data descriptors shall occupy 6 characters. Each descriptor shall have three parts: F (one letter), xx (two digits), yyy (three digits or – (minus sign) followed by two digits for C02yyy data description operator for negative scales – see CREX Table C).

- 95.3.3.2 The first part (F) of a data descriptor shall be: B, C, D or R.

- 95.3.3.3 If F = B, the descriptor shall function as “element descriptor”, and it shall define a single data item by reference to CREX Table B named: Bxxyyy.

- 95.3.3.4 If F = C, the descriptor shall function as “operator descriptor”, and it shall define an operation by reference to CREX Table C named: Cxxyyy.

- 95.3.3.5 If F = R, the descriptor shall function as “replication descriptor”. The two digits “xx” shall define the number of following descriptors to be repeated the number of times defined by the three digits “yyy”. If “yyy” equal “000”, the descriptor defines a delayed replication. Delayed replication is the replication of data values of which the number of replication is known only in the observed report and will therefore be part of the data section (for example: number of levels in a sounding). A corresponding number of four digits in the data section shall then define the number of replications of the data values corresponding to the following xx descriptors in the data description section.

- 95.3.3.6 If F = D, the descriptor shall function as “sequence descriptor”, and it shall define a list of element descriptors, replication descriptors, operator descriptors and/or sequence descriptors by reference to CREX Table D and named: Dxxyyy.

- 95.3.4 CREX Table B shall define the element descriptors. If one entry in CREX Table B and one entry in BUFR Table B have the same table reference, the element name shall be the same in both tables. CREX Table B entries shall contain:

- (a) The table reference (B xx yyy);
- (b) The element name (64 characters maximum);
- (c) The units to be used for data representation in CREX, or instead, a reference to a code table or flag table which will then define the possible data value for the element;
- (d) The scale factor to be applied to the data value for CREX purposes; the scale defines the precision of the value. No decimal points shall be used in the data section, so a positive scale means that so many figures after the decimal point are included (e.g. scale = 2 means values coded in hundredths, e.g. height coded in centimetre). A negative scale means that so many figures before the decimal point are not included (e.g. heights in hundreds of metres would have scale = –2);
- (e) The number of characters to be used in CREX to represent the corresponding data value (without counting the sign);
- (f) Reference values for CREX elements are always zero and there shall be no column for this attribute in CREX tables.

Note: Each entry in CREX Table B defining element descriptor should correspond with entries in BUFR Table B and listed in the same table, in Part B, Binary codes, BUFR/CREX Table B.

- 95.3.4.1 Units should be based on standard international units of the SI system. Alternatively, in exceptional cases, consideration may be given to other standard common units used by the data producer and the users, where a convincing case can be made that those units are more

appropriate. In such a case, priority shall be given to units contained in WMO Common Table C-6 or, in the case of descriptors for aviation products, ICAO Annex 5.

- 95.3.4.2 An operator descriptor shall be used to define change of unit, scale, or data width. The change shall apply only to the data value of the element referenced in the following element descriptor. The “yyy” digits of the operator descriptor shall define the new unit (yyy being equal to the code figure of the new unit defined in Common Code table C-6 listing all the possible units), the new scale or the new data width. The original Table B unit, scale or data width shall be back in force again for that element when subsequently referenced in the data description section until a new change occurs.

Note: Change of unit, scale or data width should be avoided; it should be only a last resort solution. These changes are not recommended in a common CREX Table D sequence. The change operators should not be used when the end user of the message would be a human reader.

- 95.3.4.3 CREX code tables shall have the same code figures as BUFR code tables. As CREX code tables are generally longer than corresponding BUFR code tables (for example: 99 entries rather than 63), the value corresponding to “Missing” and the values over within the BUFR code table shall be declared “Not used” within the corresponding CREX table (“63” to “99” Not used, in the example).

- 95.3.4.4 CREX flag tables shall be the same as BUFR flag tables. However, in CREX, flag tables shall be expressed using the octal representation in the following way: a set of three bits being represented by a figure from 0 to 7 (the leftmost bit being the first bit in the table rank), zeros being added on the left when the number of flags is not a multiple of 3:

000 = 0 (no bit set)
 001 = 1 (bit 3 set)
 010 = 2 (bit 2 set)
 011 = 3 (bits 2 and 3 set)
 100 = 4 (bit 1 set)
 101 = 5 (bits 1 and 3 set)
 110 = 6 (bits 1 and 2 set)
 111 = 7 (all bits set).

For example, the seven flag table sequence “1100110” transformed with the addition on the left of two zeros to “001100110” would be translated to “146” in octal.

Missing value for a flag table shall be indicated by a set of solidi “/” covering the data width.

- 95.3.5 Element descriptors corresponding to the following classes in CREX Table B shall remain in effect until superseded by redefinition:

Class

- 00 Reserved
- 01 Identification
- 02 Instrumentation
- 03 Reserved
- 04 Location (time)
- 05 Location (horizontal-1)
- 06 Location (horizontal-2)
- 07 Location (vertical)
- 08 Significance qualifiers
- 09 Reserved

Note: Redefinition is effected by the occurrence of element descriptors which contradict the preceding element descriptors from these classes. If two or more elements from the same class do not contradict one another, they all apply.

- 95.3.5.1 The consecutive occurrence of two identical element descriptors or identical sets of element

descriptors from Classes 04 to 07, inclusive, shall denote a range of values bounded by the corresponding element values. This enables the definition of layers and simple time periods.

95.3.5.2 The definition of line, areas, volumes and more complex time attributes shall be accomplished using descriptors from Classes 04 to 07 in association with suitable descriptors from Class 08.

95.3.5.3 The consecutive occurrence of two or more non-identical element descriptors from Classes 04 to 07, inclusive, shall infer that all such elements remain in effect until redefined, unless such elements define an increment.

95.3.5.4 Data items defined by element descriptors in Class 10 or above shall not behave as coordinates with respect to subsequent data.

95.3.5.5 Increments:

Any occurrence of an element descriptor from Classes 04 to 07 which defines an increment shall indicate that the location corresponding to that class shall be incremented by the corresponding data value. In the case of successive increments from the same class, this means that each increment shall apply in a cumulative manner, with all preceding increments remaining in effect.

Displacements:

In contrast, any displacement descriptor from Classes 04 to 07 does not redefine the location corresponding to that class, but shall define only a transient displaced location from the location corresponding to that class. In the case of successive displacements from the same class, this means that each displacement shall apply independently and in a non-cumulative manner to the location corresponding to that class.

95.3.5.6 Time or location increment descriptors, from Classes 04 to 07 inclusive, may be associated with replication descriptors in the following way: when an increment descriptor immediately precedes a replication descriptor, or is separated from it by one or more operator descriptors from Table C, this shall signify that such increments shall be applied for each replication; the application of the increments shall take effect from the beginning of each defined replication, including the first.

95.3.5.7 If a CREX message is made up of more than one subset, each subset shall be treated as though it was the first subset encountered.

95.3.6 A check digit indicator is optional at the end of section 1. If present, it shall take the form of the single character "E".

95.4 **Section 2 – Data section**

95.4.1 The data section shall be comprised of one or more subsets of groups. Each group shall represent one data value. The sequence of data values shall correspond in order to the list of descriptors defined by Section 1 and shall be terminated by subset terminator, or, in the case of the last subset, by the section terminator.

95.4.2 Each data value shall be coded using the number of characters defined in the CREX Table B entry of the corresponding direct element descriptor in Section 1 or of the corresponding element descriptor within a sequence of descriptors defined by a sequence descriptor in Section 1. However, values of the CREX Table B entry, which are equal to or beyond the missing value of the corresponding BUFR Table B entry, shall not be used. If the data value is a number defining a delayed replication (descriptor "Rxx000" in Section 1), it shall comprise four digits.

95.4.3 Each numerical data value shall include leading zeroes when the number of digits required to

represent the value is smaller than the number of characters defined in the corresponding CREX Table B entry or for the delayed repetition number, to keep the number of characters representing the data value always equal to the original data width defined in CREX tables or Regulations, in order to facilitate the presentation alignment and the decoding process.

- 95.4.4 Positive numerical data values shall be unsigned. Negative numerical data values only shall be signed and represented with the negative sign immediately preceding the data value.
- 95.4.5 Each data value having a unit defined as character shall include trailing blanks when the number of characters required to represent the data value is smaller than the number of characters defined in the corresponding CREX Table B entry, to keep the number of characters representing the data value always equal to the original data width defined in CREX tables, in order to facilitate the presentation alignment and the decoding process.
- 95.4.6 A missing value shall be represented as a group of solidi "/" characters equal in number to the number of characters normally required to represent the value concerned.
- 95.4.7 If the check digit indicator "E" is present at the end of Section 1, a check digit shall be added in front of each data value, immediately preceding the first character of each data value. The check digit shall take the value of the unit digit of the ordered number of the data value, counting along the data subset in which it is contained, starting from 0 (the digit increases from 0 to 9 cyclically). The check digit shall precede immediately the negative sign if the data value is negative.
- 95.5 **Section 3 – Optional section**
- 95.5.1 Section 3 is optional and if present, shall contain additional items as may be defined within each centre for specific use.
- 95.5.2 Section 3, if present, shall start with the four-character sequence "SUPP" and shall end with a section terminator.
- 95.6 **Section 4 – End section**
- 95.6.1 Section 4 shall be four characters long coded as "7777". Section 4 shall not have a section terminator.

SPECIFICATIONS OF SECTIONS

Notes:

- (1) Each section contains one or more groups of characters separated by one separator character.
- (2) In the following, each group is numbered as group 1, group 2 and so on, from the beginning of the section.

Section 0 – Indicator section

Group No.	Contents	Meaning
1	CREX	CREX: Beginning of the CREX message

Section 1 – Data description section

Group No.	Contents	Meaning
1	Ttteevvbbww	T: Indicator for CREX tables tt: CREX Master Table used (00 for WMO standard FM 95 CREX tables) ee: CREX edition number (02) vv: CREX master table version number (see Common Code table C–0) bb: BUFR master table version number used (see Common Code table C–0) ww: Version number of local table
2	Annnmmm	A: Indicator for CREX Table A entry nnn: Data category from CREX Table A mmm: International data sub-category from Common Code table C–13
3	Pooooopp	P: Indicator for originating centre ooooo: Originating centre from Common Code table C–11 ppp: Originating sub-centre from Common Code table C–12
4	Uuu	U: Indicator for sequence number of message uu: Update sequence number (00 for original messages and for messages containing only delayed reports; incremented for the other updates)
5	Ssss	S: Indicator for number of subsets sss: Number of subsets included in the report
6	Yyyyymmdd	Y: Indicator for date yyyy: Year mm: Month dd: Day
7	Hhhnn	H: Indicator for time hh: Hour nn: Minute
8 to n	Bxxyyy, Cxxyyy, Dxxyyy, and/or Rxxyyy	B,C,D: Indicators for CREX Tables B, C, D entries xxyyy: 5 digits each which indicate references from CREX Tables B, C, and/or D R: Indicator for replication xx: Number of replicated descriptors yyy: Number of replications (delayed replication if yyy = 0)
(n + 1)	(E)	E: Optional check digit indicator

Note: When accuracy of the time does not define a time unit, then the value for this unit is set to zero (e.g. SYNOP observation at 09 UTC, then minute = 0).

Section 2 – Data section

Group No.	Contents	Meaning
1 to m	(d) Data values	d: Optional check digit Data: Data values corresponding to section 1 descriptors values

Section 3 – Optional section

Group No.	Contents	Meaning
1	SUPP	SUPP: The four letters SUPP indicate the presence of a supplementary optional section
2 to p	Items for local use	Additional items for local use developed by the generating centre

Section 4 – End section

Group No.	Contents	Meaning
1	7777	7777: End of CREX

VISUALIZATION OF CREX CODE FORM

(Bold characters are fixed alphanumeric characters; features in brackets are optional)

CREX++

Ttteevvbbww Annnmmm Pooooopp Uuu Ssss Yyyymmdd Hhhnn

Rxyyy (E)++

or Bxyyy

or Cxyyy

or Dxyyy

((d)Data values+)

.....

.....

((d)Data values+)

(d)Data values++

(SUPP Items for local use++)

7777

Note: If there is more than one subset, there shall be one "+" padded at the end of each subset, except for the last one (see Regulations 95.1.4, 95.1.5 and 95.4.1).

CREX TABLES, CODE TABLES, FLAG TABLES AND TEMPLATE EXAMPLES

FM 95 CREX refers to three types of tables: CREX tables, code tables and flag tables.

CREX tables

Tables containing information used to describe, classify and define the contents of a CREX message are called CREX tables. Four CREX tables are defined: Tables A, B, C and D. Entry numbering shall be the same in CREX tables and BUFR tables for the same entity represented. Table B entries shall be listed in the common BUFR/CREX Table B in Part B, Binary codes. Table D common sequences shall not be defined in both CREX Table D and BUFR Table D unless otherwise a conversion between both Tables D is not simple, that is, the conversion is not completed by simple replacement of part "F" of each descriptor. If a CREX Table D sequence is not defined in BUFR Table D, it shall be assigned a number not used by any BUFR sequence. Similarly, new BUFR Table D sequences shall be assigned a number not used by any CREX Table D sequence.

Code tables and flag tables

CREX Table B defines some elements by means of code tables or flag tables. Within this general description are included code tables referenced by code figures and flag tables, where each bit is set to 0 or 1 to indicate a false or true value with respect to a specific criterion. Within CREX all code tables and flag tables refer to elements defined within CREX Table B; they are numbered according to the xx and yyy values of the corresponding Table B reference.

Code tables in CREX

CREX code tables have the same code figure as BUFR code tables and are not reproduced. Values of the CREX code, which are equal to or beyond the missing value of BUFR code figure, shall not be used. A missing value in CREX for a code table shall be indicated by a set of solidi "/" covering the data width.

Flag tables in CREX

CREX flag tables shall be the same as BUFR flag tables. However flag tables in CREX shall be expressed using octal representation in the following way: a set of three bits being represented by a figure from 0 to 7 (the leftmost bit being the first bit in the table rank), zeros being added on the left when the number of flags is not a multiple of 3:

000 = 0 (not bit set)
 001 = 1 (bit 3 set)
 010 = 2 (bit 2 set)
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 110 = 6 (bits 1 and 2 set)
 111 = 7 (all bits set).

For example, the seven flag table sequence "1100110" transformed with the addition on the left of two zeros to "001100110" would be translated to "146" in octal.

CREX flag tables are the same as BUFR flag tables and are not reproduced here.

In CREX, a missing value for a flag table shall be indicated by a set of solidi "/" covering the data width.

CREX template examples

Examples of templates of some CREX messages are listed as models in Part C, CREX Attachment to help users understand the CREX code.