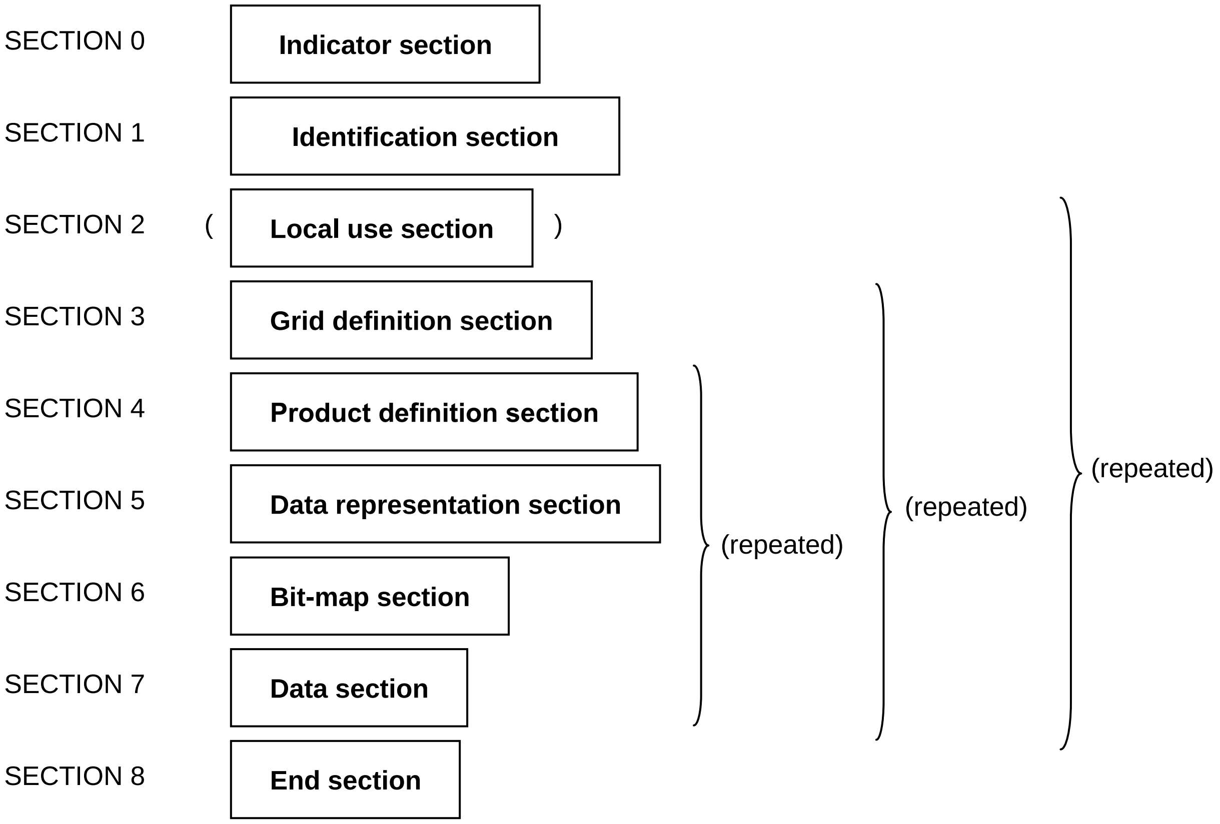
FM 92–XIV GRIB General regularly distributed information in binary form

CODE FORM:



Notes:

(1) GRIB is the name of a data representation form for general regularly distributed information in binary.

(2) Data encoded in GRIB consists of a continuous bit-stream made of a sequence of octets (1 octet = 8 bits).

(3) The octets of a GRIB message are grouped in sections:

Section number	*Name*	*Contents*
0	Indicator section	"GRIB", discipline, GRIB edition number, length of message
1	Identification section	Length of section, section number, characteristics that apply to all processed data in the GRIB message
2	Local use section (optional)	Length of section, section number, additional items for local use by originating centres
3	Grid definition section	Length of section, section number, definition of grid surface and geometry of data values within the surface
4	Product definition section	Length of section, section number, description of the nature of the data
5	Data representation section	Length of section, section number, description of how the data values are represented
6	Bit-map section	Length of section, section number, indication of presence or absence of data at each of the grid points, as applicable
7	Data section	Length of section, section number, data values
8	End section	"7777"

(4) Sequences of GRIB sections 2 to 7, sections 3 to 7 or sections 4 to 7 may be repeated within a single GRIB message. All sections within such repeated sequences must be present and shall appear in the numerical order noted above. Unrepeated sections remain in effect until redefined.

(5) It will be noted that the GRIB code is not suitable for visual data recognition without computer interpretation.

(6) The representation of data by means of a series of bits is independent of any particular machine representation.

(7) Message and section lengths are expressed in octets. Octets are numbered 1, 2, 3, etc., starting at the beginning of each section. Therefore, octet numbers in a template refer to the respective section.

(8) Bit positions within octets are referred to as bit 1 to bit 8, where bit 1 is the most significant and bit 8 is the least significant. Thus, an octet with only bit 8 set to 1 would have the integer value 1.

(9) As used in "GRIB", "International Alphabet No. 5" is regarded as an 8-bit alphabet with bit 1 set to zero.

(10) The IEEE single precision floating point representation is specified in the standard ISO/IEC 559–1985 and ANSI/IEEE 754–1985 (R1991), which should be consulted for more details. The representation occupies four octets and is:

seeeeeee emmmmmmm mmmmmmmm mmmmmmmm

where:

s is the sign bit, 0 means positive, 1 negative

e...e is an 8 bit biased exponent

m...m is the mantissa, with the first bit deleted.

The value of the number is given by the following table:

e...e	*m...m*	*Value of number*
0	Any	$(-1)^s\,(m...m)2^{-23}2^{-126} = (-1)^s(m...m)2^{-149}$
1...254	Any	$(-1)^s\,(1.0 + (m...m)2^{-23})2^{((e...e)-127)}$
255	0	Positive (s=0) or Negative (s=1) infinity
255	>0	NaN (Not a valid Number, result of illegal operation)

Normally, only biased exponent values from 1 through 254 inclusive are used, except for positive or negative zero which is represented by setting both the biased exponent and the mantissa to 0.

The numbers are stored with the high-order octet first. The sign bit will be the first bit of the first octet. The low-order bit of the mantissa will be the last (eighth) bit of the fourth octet.

This floating point representation has been chosen because it is in common use in modern computer hardware. Some computers use this representation with the order of the octets reversed. They will have to convert the representation, either by reversing the octets or by computing the floating point value directly using the above formulas.

REGULATIONS:

92.1 **General**

92.1.1 The GRIB code shall be used for the exchange and storage of general regularly distributed information expressed in binary form.

92.1.2 The beginning and the end of the code shall be identified by 4 octets coded according to the International Alphabet No. 5 to represent the indicators “GRIB” and “7777” in Indicator section 0 and End section 8, respectively. All other octets included in the code shall represent data in binary form.

92.1.3 Each section included in the code shall always end on an octet boundary. This rule shall be applied by appending bits set to zero to the section, where necessary.

92.1.4 All bits set to “1” for any value indicates that value is missing. This rule shall not apply to packed data.

92.1.5 If applicable, negative values shall be indicated by setting the most significant bit to “1”.

92.1.6 Latitude, longitude and angle values shall be in units of 10^{-6} degree, except for specific cases explicitly stated in some grid definitions.

92.1.7 The latitude values shall be limited to the range 0 to 90 degrees inclusive. The orientation shall be north latitude positive, south latitude negative. Bit 1 is set to 1 to indicate south latitude.

92.1.8 The longitude values shall be limited to the range 0 to 360 degrees inclusive. The orientation shall be east longitude positive, with only positive values being used.

92.1.9 The latitude and longitude of the first grid point and the last grid point shall always be given for regular grids.

92.1.10 Vector components at the North and South Poles shall be coded according to the following conventions.

92.1.10.1 If the resolution and component flags in section 3 (Flag table 3.3) indicate that the vector components are relative to the defined grid, the vector components at the Pole shall be resolved relative to the grid.

92.1.10.2 Otherwise, for projections where there are multiple points at a given pole, the vector components shall be resolved as if measured an infinitesimal distance from the Pole at the longitude corresponding to each grid point. At the North Pole, the West to East (x direction) component at a grid point with longitude L shall be resolved along the meridian 90 degrees East of L, and the South to North (y direction) component shall be resolved along the meridian 180 degrees from L. At the South Pole, the West to East component at a grid point with longitude L shall be resolved along the meridian 90 degrees East of L and the South to North component shall be resolved along L.

92.1.10.3 Otherwise, if there is only one Pole point, either on a cylindrical projection with all but one Pole point deleted, or on any projection (such as polar stereographic) where the Pole maps to a unique point, the West to East and South to North components shall be resolved along longitudes 270° and 0°, respectively at the North Pole and along longitudes 270° and 180°, respectively at the South Pole.

Note: This differs from the treatment of the Poles in the WMO traditional alphanumeric codes.

92.1.11 The first and last grid points shall not necessarily correspond to the first and last data points, respectively, if the bit-map is used.

92.1.12 Items in sections 3 and 4 which consist of a scale factor F and a scaled value V are related to the original value L as follows:

$L \times 10^F = V$

92.2 **Section 0 – Indicator section**

92.2.1 Section 0 shall always be 16 octets long.

92.2.2 The first four octets shall always be character coded according to the International Alphabet No. 5 as "GRIB".

92.2.3 The remainder of the section shall contain reserved octets, followed by the Discipline, the GRIB edition number, and the length of the entire GRIB message (including the Indicator section).

92.3 **Section 1 – Identification section**

92.3.1 The length of the section, in units of octets, shall be expressed over the group of the first four octets, i.e. over the first 32 bits.

92.3.2 The section number shall be expressed in the fifth octet.

92.3.3 Octets beyond 21 are for an Identification template. If no Identification template is used, optional section must not be present.

92.3.4 Calendar is assumed to be Gregorian unless otherwise stated in an Identification template.

92.4 **Section 2 – Local use section**

92.4.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.4.2 Section 2 is optional.

92.5 **Section 3 – Grid definition section**

92.5.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.6 **Section 4 – Product definition section**

92.6.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.6.2 To maintain orthogonal structure of GRIB Edition 2, parameter names in Code table 4.2 should not contain surface type and statistical process as part of the name.

92.7 **Section 5 – Data representation section**

92.7.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.8 **Section 6 – Bit-map section**

92.8.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.9 **Section 7 – Data section**

92.9.1 Regulations 92.3.1 and 92.3.2 shall apply.

92.9.2 Data shall be coded using the minimum number of bits necessary to provide the accuracy required by international agreement. This required accuracy/precision shall be achieved by scaling the data by multiplication by an appropriate power of 10 (the power may be 0) before forming the non-negative differences, and then using the binary scaling to select the precision of the transmitted value.

92.9.3 The data shall be packed by the method identified in section 5.

92.9.4 Data shall be coded in the form of non-negative scaled differences from a reference value of the whole field plus, if applicable, a local reference value.

Notes:

(1) A reference value is normally the minimum value of the data set which is represented.

(2) For grid-point values, complex packing features are intended to reduce the whole size of the GRIB message (data compression without loss of information with respect to simple packing). The basic concept is to reduce data size thanks to local redundancy. This is achieved just before packing, by splitting the whole set of scaled data values into groups, on which local references (such as local minima) are removed. It is done with some overhead, because extra descriptors are needed to manage the groups' characteristics. An optional pre-processing of the scaled values (spatial differencing) may also be applied before splitting into groups, and combined methods, along with use of alternate row scanning mode, are very efficient on interpolated data.

(3) For spectral data, complex packing is provided for better accuracy of packing. This is because many spectral coefficients have small values (regardless of the sign), especially for large wave numbers. The first principle is not to pack a subset of coefficients, associated with small wave numbers so that the amplitude of the packed coefficients is reduced. The second principle is to apply an operator to the remaining part of the spectrum: with appropriate tuning it leads to a more homogeneous set of values to pack.

(4) The original data value Y (in the units of Code table 4.2, unless Notes in Code table 4.10 apply) can be recovered with the formula:

$$Y \times 10^{D} = R + (X1 + X2) \times 2^{E}$$

For simple packing and all spectral data

E = Binary scale factor

D = Decimal scale factor

R = Reference value of the whole field

X1 = 0

X2 = Scaled (encoded) value.

For complex grid-point packing schemes, E, D and R are as above, but

X1 = Reference value (scaled integer) of the group the data value belongs to

X2 = Scaled (encoded) value with the group reference value (X1) removed.

92.10 **Section 8 – End section**

92.10.1 The end section shall always be 4 octets long, character coded according to the International Alphabet No. 5 as "7777".

Editorial note: click following links to respective chapters in separate files.

SPECIFICATIONS OF OCTET CONTENTS

TEMPLATE DEFINITIONS

CODE AND FLAG TABLES