U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
NATIONAL METEOROLOGICAL CENTER

Office Note 388

G R I B

(Edition 1)

THE WMO FORMAT

FOR

THE STORAGE OF WEATHER PRODUCT INFORMATION

AND

THE EXCHANGE OF WEATHER PRODUCT MESSAGES

IN GRIDDED BINARY FORM

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Revised
(see overleaf)

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This is an unreviewed manuscript,

primarily intended for informal exchange of information
among NMC staff members

REVISION HISTORY

since the last full revision/reprinting

dated March 3, 1993

August 31, 1993§	p.6:	Added orig center for NWS/NMC/Reanal and corrected DeBilt number.
	p.7:	Added gen code 70 for QLM hurricane
	p.9:	Added grids 75,76,77 for QLM
	p.13,14:	Reoriented Grids 37-44 (WAFC/ICAO) such that left hand column is at 330E (30W)
	p.13,13.1:	Added table of number of points in lat circles of grids 37-44
	p.15:	Added description of Grid 1
	p.18:	Corrected long grid spacing in degrees and corrected location of Map 204
	p.20	Adjusted location of map 208 to conform to change in map 204
	p.28:	Added MSL variants 128 & 129; Added lat. lon. as parameters 176 & 177; added parameters 204, 205, 211, 212, 218.
	p.29:	Added Note 4
	p.48:	Clarification of table 11.

Appendix A. Revised to include "Z" as first character in WMO header. Used for "off-hour" forecast hours.

INTRODUCTION

THE WORLD METEOROLOGICAL ORGANIZATION (WMO) COMMISSION FOR BASIC SYSTEMS (CBS) EXTRAORDINARY MEETING NUMBER VIII (1985) APPROVED A GENERAL PURPOSE, BIT-ORIENTED DATA EXCHANGE FORMAT, DESIGNATED FM 92-VIII EXT. GRIB (GRIDDED BINARY). IT IS AN EFFICIENT VEHICLE FOR TRANSMITTING LARGE VOLUMES OF GRIDDED DATA TO AUTOMATED CENTERS OVER HIGH SPEED TELECOMMUNICATION LINES USING MODERN PROTOCOLS. BY PACKING INFORMATION INTO THE GRIB CODE, MESSAGES CAN BE MADE MORE COMPACT THAN CHARACTER ORIENTED BULLETINS, PRODUCING FASTER COMPUTER-TO-COMPUTER TRANSMISSIONS. GRIB CAN EQUALLY WELL SERVE AS A DATA STORAGE FORMAT, GENERATING THE SAME EFFICIENCIES RELATIVE TO INFORMATION STORAGE AND RETRIEVAL DEVICES.

CHANGES AND EXTENSIONS TO GRIB WERE APPROVED AT THE REGULAR MEETING OF THE WMO/CBS IN FEBRUARY, 1988; ADDITIONAL CHANGES WERE INTRODUCED AT THE CBS/WGDM/SUB-GROUP ON DATA REPRESENTATION MEETINGS IN MAY 1989 AND IN OCTOBER 1990. THE LAST SET OF CHANGES WERE OF SUCH STRUCTURAL MAGNITUDE AS TO REQUIRE A NEW EDITION OF GRIB, EDITION 1, WHICH THIS DOCUMENT DESCRIBES.

NOTE: THE EDITION NUMBER IS IN THE SAME LOCATION, RELATIVE TO THE START OF THE GRIB MESSAGE, FOR ALL EDITIONS. THUS, DECODING PROGRAMS CAN DETECT WHICH EDITION LAYOUT TO EXPECT IN THE REMAINING PORTION OF THE MESSAGE. THIS IS APPROPRIATE FOR ARCHIVES OF MESSAGES ENCODED IN EARLIER EDITIONS OR DURING TRANSITION PERIODS.

EACH GRIB RECORD INTENDED FOR EITHER TRANSMISSION OR STORAGE CONTAINS SINGLE VALUE, OR A MATRIX OF VALUES, AT AN ARRAY OF GRID POINTS, OR A SET OF SPECTRAL COEFFICIENTS, FOR PARAMETERS AT A SINGLE LEVEL (OR LAYER) AS A CONTINUOUS BIT STREAM. LOGICAL DIVISIONS OF THE RECORD ARE DESIGNATED AS "SECTIONS", EACH OF WHICH PROVIDES CONTROL INFORMATION AND/OR DATA. A GRIB RECORD CONSISTS OF SIX SECTIONS, TWO OF WHICH ARE OPTIONAL:

(0) INDICATOR SECTION

(1) PRODUCT DEFINITION SECTION (PDS)

(2) GRID DESCRIPTION SECTION (GDS) - OPTIONAL

(3) BIT MAP SECTION (BMS) - OPTIONAL

(4) BINARY DATA SECTION (BDS)

(5) '7777' (ASCII CHARACTERS)

MOST CENTERS REQUIRE BULLETIN HEADERS TO ENABLE THEM TO RECEIVE, IDENTIFY, AND SWITCH MESSAGES; NMC IS NO EXCEPTION. THE STANDARD WMO ABBREVIATED HEADING FOR GRIB IS DESCRIBED IN APPENDIX A.

IN THIS DOCUMENTATION, CERTAIN SYMBOLS ARE USED TO CLARIFY THE CONTENTS OF OCTETS (GROUPS OF EIGHT CONSECUTIVE BINARY BITS, "BYTES" IN AMERICAN USAGE). IF UNADORNED LETTERS ARE USED, THEY ARE SYMBOLIC AND THEIR MEANINGS ARE DESCRIBED IN THE TEXT; A DECIMAL NUMBER IS SIMPLY PRINTED AS IS; A CHARACTER OR STRING OF CHARACTERS IS REPRESENTED INSIDE SINGLE QUOTE MARKS. INTERNATIONAL ALPHABET NO. 5, WHICH IS IDENTICAL IN ITS ESSENTIAL ELEMENTS TO THE U.S. NATIONAL STANDARD 7-BIT ASCII, IS USED FOR CHARACTER REPRESENTATION IN THE GRIB CODE.

OCTETS ARE NUMBERED CONSECUTIVELY FROM THE START OF EACH SECTION; BITS WITHIN AN OCTET ARE ALSO NUMBERED FROM LEFT (THE MOST SIGNIFICANT BIT) TO RIGHT (THE LEAST SIGNIFICANT BIT). THUS AN OCTET WITH BIT 8 SET TO THE VALUE 1 WOULD HAVE THE INTEGER VALUE 1; BIT 7 SET TO ONE WOULD HAVE A VALUE OF 2, ETC.

THE NUMBERING OF TABLES IN THE FOLLOWING TEXT CORRESPONDS TO THE DESCRIPTION OF GRIB IN THE WMO MANUAL ON CODES<[1]>. Some additional tables not found in the WMO Manual are indicated by letters. These, generally, contain information unique to the NWS or NOAA.

A final caveat: this document does <u>not</u> include all the features in GRIB as described in the Manual on Codes. This document selects out those features which are of particular interest to the National Weather Service at the present time. Some of the "advanced" features are alluded to in this document; please refer to the Manual for full details.

DATA PACKING METHOD.

THE CODE FORM REPRESENTS NUMERIC DATA AS A SERIES OF BINARY DIGITS (BITS). SUCH DATA REPRESENTATION IS INDEPENDENT OF ANY PARTICULAR MACHINE REPRESENTATION; BY CONVENTION DATA LENGTHS ARE

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1 <?> World Meteorological Organization publication No. 306, Manual on Codes, Vol. 1, Part B, Secretariat of the WMO, Geneva, Switzerland, 1988, plus Supplements No. 1, 2, & 3

MEASURED IN OCTETS. DATA ARE CODED AS BINARY INTEGERS USING THE MINIMUM NUMBER OF BITS REQUIRED FOR THE DESIRED PRECISION. NUMERIC VALUES, WITH UNITS AS SHOWN IN TABLE 2, ARE FIRST SCALED BY A POWER OF TEN TO ACHIEVE AN APPROPRIATE DECIMAL PRECISION, A REFERENCE VALUE IS SUBTRACTED FROM THEM TO REDUCE REDUNDANCY AND ELIMINATE NEGATIVE VALUES, AND THEY ARE THEN FURTHER SCALED BY A POWER OF TWO TO PACK THEM INTO A PRE-SELECTED WORD LENGTH.

THE REPRESENTATION OF A SINGLE VALUE IS SUCH THAT:

$$Y * 10^{D} = R + (X * 2^{E})$$

where

Y = original or unpacked value; units as in Table 2;
D = decimal scale factor, to achieve desired precision
(sign bit, followed by a 15-bit integer);
R = reference value (32 bits);
X = internal value (No. of bits varies for each record);
E = binary scale factor for word-length packing
(sign bit, followed by a 15-bit integer).

The reference value (R) is the minimum value of the decimally scaled data that is being encoded. R is placed in the Binary Data Section in four octets as a single precision floating-point number:

sAAAAAAA BBBBBBBB BBBBBBBB BBBBBBBB

where s = sign bit, encoded as 0 => positive
1 => negative
A = 7-bit binary integer, the characteristic
B = 24-bit binary integer, the mantissa.

The appropriate formula to recover the value of R is:

$$R = (-1)^{s} * 2^{(-24)} * B * 16^{(A-64)}$$

This formula is the standard IBM representation for a single precision (real) floating point number. (Consideration is being given to using the IEEE floating point representation in the future, in a later Edition of GRIB.)

Both the decimal scaling factor and/or the binary scaling factors may equal 0. It is not necessary to use the binary scaling to "fit" the numbers into a prespecified word size; an alternative encoding practice is to change the word length (the same for all the points, of course) to accommodate the largest departure from the reference value. A properly written GRIB decoder should be able to decode either option with no change in the logic as long as the decoder makes no prior assumptions about word lengths. All the necessary parameters are included in the GRIB message, of course.

GRIB CODE FORM:

WITH THE EXCEPTION OF THE INDICATOR SECTION AND THE END SECTION ALL OCTETS CONTAIN BINARY VALUES. ALL SECTIONS CONTAIN AN EVEN NUMBER OF OCTETS; THE VARIABLE LENGTH SECTIONS ARE PADDED WITH ZERO VALUES AS NECESSARY. THESE EXTRA BITS MUST BE ACCOUNTED FOR IN FINDING ONE'S WAY THROUGH THE SECTIONS; THEIR CONTENT SHOULD BE IGNORED.

section 0: the Indicator Section (IS)

THE INDICATOR SECTION SERVES TO IDENTIFY THE START OF THE RECORD IN A HUMAN READABLE FORM; TO INDICATE THE TOTAL LENGTH OF THE MESSAGE, AND TO INDICATE THE EDITION NUMBER OF THE MESSAGE. IT IS ALWAYS EIGHT OCTETS LONG.

OCTET NO.	IS CONTENT
1-4	'GRIB' (CODED CCITT-ITA NO. 5) (ASCII);
5-7	TOTAL LENGTH, IN OCTETS, OF GRIB MESSAGE (INCLUDING SECTIONS 0 & 5);
8	EDITION NUMBER - CURRENTLY 1

section 1: the PRODUCT DEFINITION SECTION (PDS).

THE PDS CONTAINS INDICATORS FOR THE PARAMETER TABLE VERSION, THE ORIGINATING CENTER, THE NUMERICAL MODEL (OR "GENERATING PROCESS") THAT CREATED THE DATA, THE GEOGRAPHICAL AREA COVERED BY THE DATA, THE PARAMETER ITSELF, AND THE ACTUAL VALUES FOR THE APPROPRIATE VERTICAL LEVEL OR LAYER, THE DECIMAL SCALE FACTOR, AND DATE/TIME INFORMATION. THE PDS IS AT LEAST 28 OCTETS LONG BUT IT MAY BE LONGER IF AN ORIGINATING CENTER CHOOSES TO MAKE IT SO. USERS OF GRIB MESSAGES ARE STRONGLY URGED TO USE THE LENGTH-OF-SECTION PORTION OF THE PDS TO DETERMINE WHERE THE NEXT SECTION BEGINS. DO NOT ASSUME A FIXED OCTET LENGTH.

OCTET NO. PDS CONTENT

1 - 3 LENGTH IN OCTETS OF THE PRODUCT DEFINITION SECTION

4 PARAMETER TABLE VERSION NUMBER.
CURRENTLY VERSION 1 FOR INTERNATIONAL EXCHANGE
PARAMETER TABLE VERSION NUMBERS 128-254 ARE
RESERVED FOR LOCAL USE.

5 IDENTIFICATION OF CENTER (SEE TABLE 0)

6 GENERATING PROCESS ID NUMBER
(ALLOCATED BY THE ORIGINATING CENTER; SEE TABLE A)

7 GRID IDENTIFICATION (GEOGRAPHICAL LOCATION AND
AREA; SEE TABLE
B)

8 FLAG SPECIFYING THE PRESENCE OR ABSENCE OF A GDS
OR A BMS (SEE TABLE 1)

9 INDICATOR OF PARAMETER AND UNITS (SEE TABLE 2)

10 INDICATOR OF TYPE OF LEVEL OR LAYER
(SEE TABLES 3 & 3A)

11-12 HEIGHT, PRESSURE, ETC. OF THE LEVEL OR LAYER
(SEE TABLE 3)

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13   YEAR OF CENTURY    \  INITIAL (OR REFERENCE)
                    |  TIME OF FORECAST - UTC
14   MONTH OF YEAR      |
                    |       OR
15   DAY OF MONTH       >
                    |  START OF TIME PERIOD
16   HOUR OF DAY        |   FOR AVERAGING OR
                    |   ACCUMULATION OF
17   MINUTE OF HOUR     /   ANALYSES
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18 FORECAST TIME UNIT (SEE TABLE 4)
19 P1 - PERIOD OF TIME (NUMBER OF TIME UNITS)
(0 FOR ANALYSIS OR INITIALIZED ANALYSIS.)
UNITS OF TIME GIVEN BY CONTENT OF OCTET 18.

20 P2 - PERIOD OF TIME (NUMBER OF TIME UNITS)
OR
TIME INTERVAL BETWEEN SUCCESSIVE ANALYSES,
SUCCESSIVE INITIALIZED ANALYSES, OR FORECASTS,

UNDERGOING AVERAGING OR ACCUMULATION.
UNITS GIVEN BY OCTET 18.

21 TIME RANGE INDICATOR (SEE TABLE 5)

22-23 NUMBER INCLUDED IN AVERAGE, WHEN OCTET 21 (TABLE 5) INDICATES AN AVERAGE OR ACCUMULATION; OTHERWISE SET TO ZERO.

24 NUMBER MISSING FROM AVERAGES OR ACCUMULATIONS.

25 CENTURY OF INITIAL (REFERENCE) TIME (=20 UNTIL JAN. 1, 2001)

26 RESERVED - SET TO 0

27-28 THE DECIMAL SCALE FACTOR D. A NEGATIVE VALUE IS INDICATED BY SETTING THE HIGH ORDER BIT (BIT NO. 1) IN OCTET 27 TO 1 (ON).

29-40 RESERVED (NEED NOT BE PRESENT)

41-... RESERVED FOR ORIGINATING CENTER USE.

NOTE: OCTET 8 MAY INDICATE THE PRESENCE OF THE GRID DESCRIPTION SECTION (GDS) EVEN THOUGH OCTET 7 SPECIFIES A PREDEFINED GRID. IN THIS CASE THE GDS MUST DESCRIBE THAT GRID - THIS DEVICE SERVES AS A MECHANISM FOR TRANSMITTING NEW "PREDEFINED" GRIDS TO USERS PRIOR TO THEIR FORMAL PUBLICATION IN THIS OR THE OFFICIAL WMO DOCUMENTATION.

TABLES FOR THE PDS

TABLE 0. ORIGINATING CENTER
(PDS Octet 5)

VALUE	CENTER
07	US Weather Service - National Met. Center
08	US NWS - NMC - Reanalysis project.

34	Japanese Meteorological Agency - Tokyo
54	Canadian Meteorological Service - Montreal
58	US Navy - Fleet Numerical Oceanography Center
59	NOAA Forecast Systems Lab, Boulder CO
74	U.K. Met Office - Bracknell
97	European Space Agency (ESA)
98	European Center for Medium-Range Weather Forecasts - Reading
99	DeBilt
150	ABRFC - Arkansas-Red River RFC, Tulsa OK
151	Alaska RFC, Anchorage, AK
152	CBRFC - Colorado Basin RFC, Salt Lake City, UT
153	CNRFC - California-Nevada RFC, Sacramento, CA
154	LMRFC - Lower Mississippi RFC, Slidel, LA
155	MARFC - Middle Atlantic RFC, State College, PA
156	MBRFC - Missouri Basin RFC, Kansas City, MO
157	NCRFC - North Central RFC, Minneapolis, MN
158	NERFC - Northeast RFC, Hartford, CT
159	NWRFC - Northwest RFC, Portland, OR
160	OHRFC - Ohio Basin RFC, Cincinnati, OH
161	SERFC - Southeast RFC, Atlanta, GA
162	WGRFC - West Gulf RFC, Fort Worth, TX
170	OUN - Norman OK WFO

TABLE A. Generating Process or Model (PDS Octet 6)

VALUE	MODEL
10	Global Wind-Wave Forecast Model
19	Limited-area Fine Mesh (LFM) analysis
25	Snow Cover Analysis
39	Nested Grid forecast Model (NGM)
42	Global Optimum Interpolation Analysis (GOI) from "Aviation" run
43	Global Optimum Interpolation Analysis (GOI) from "Final" run
44	Sea Surface Temperature Analysis
53	LFM-Fourth Order Forecast Model
64	Regional Optimum Interpolation Analysis (ROI)
68	80 wave triangular, 18-layer Spectral model from "Aviation" run
69	80 wave triangular, 18 layer Spectral model from "Medium Range Forecast" run
70	Quasi-Lagrangian Hurricane Model (QLM)
73	Fog Forecast model - Ocean Prod. Center
74	Gulf of Mexico Wind/Wave
75	Gulf of Alaska Wind/Wave
76	Bias corrected Medium Range Forecast
77	126 wave triangular, 18 layer Spectral model from "Aviation" run
78	126 wave triangular, 18 layer Spectral model from "Medium Range Forecast" run
79	Backup from the previous run
80	62 wave triangular, 18 layer Spectral model from "Medium Range Forecast" run
81	Spectral Statistical Interpolation (SSI) analysis from "Aviation" run.
82	Spectral Statistical Interpolation (SSI) analysis from "Final" run.
83	ETA Model - 80 km version
84	ETA Model - 40 km version
85	ETA Model - 30 km version
86	MAPS Model, from Forecast Systems Lab (Isentropic; scale: 60km at 40N)
150	NWS River Forecast System (NWSRFS)
151	NWS Flash Flood Guidance System (NWSFFGS)
152	WSR-88D Stage II Precipitation Analysis

TABLE B. GRID IDENTIFICATION
(PDS Octet 7)

MASTER LIST OF NMC STORAGE GRIDS

VALUE	GRID	GRID INCREMENT
1	1679-point (73x23) Mercator grid with (1,1) at (0W,48.09S), (73,23) at (0W, 48.09N); I increasing eastward, Equator at J=12.	5 degs of longitude
2	10512-point (144x73) global longitude-latitude grid. (1,1) at 0E, 90N, matrix layout. N.B.: prime meridian not duplicated.	2.5 deg
3	65160-point (360x181) global longitude-latitude grid. (1,1) at 0E, 90N, matrix layout. N.B.: prime meridian not duplicated.	1.0 deg
5	3021-point (53x57) N. Hemisphere polar stereographic grid oriented 105W; Pole at (27,49). (LFM analysis)	190.5 km at 60N
6	2385-point (53x45) N. Hemisphere polar stereographic grid oriented 105W; Pole at (27,49). (LFM Forecast)	190.5 km at 60N
21-26	International Exchange and Family of Services (FOS) grids - see below	
27	4225-point (65x65) N. Hemisphere polar stereographic grid oriented 80W; Pole at (33,33).	381 km at 60N
28	4225-point (65x65) S. Hemisphere polar stereographic grid oriented 100E; Pole at (33,33).	381 km at 60S
29	5365-point (145x37) N. Hemisphere longitude/latitude grid for latitudes 0N	2.5 degs

	to 90N; (1,1) at (0E,0N).	
30	5365-point (145x37) S. Hemisphere longitude/latitude grid for latitudes 90S to 0S; (1,1) at (0E,90S).	2.5 degs
33	8326-point (181x46) N. Hemisphere longitude/latitude grid for latitudes 0N to 90N; (1,1) at (0E,0N).	2 degs
34	8326-point (181x46) S. Hemisphere longitude/latitude grid for latitudes 90S to 0S; (1,1) at (0E,90S).	2 degs
37 - 44	Eight lat-long 1.25x1.25 "thinned" grids, covering the globe by octants of 3447 points. Full GRIB specifications below. For WAFC, ICAO, Family of Services (FOS), and International exchange.	
50	Family of Services "regional grid" - see below.	
55	6177-point (87x71) N. Hemisphere polar stereographic grid oriented 105W; Pole at (44,38). (2/3 bedient NH sfc anl)	254 km at 60N
56	6177-point (87x71) N. Hemisphere polar stereographic grid oriented 105W; Pole at (40,73). (1/3 bedient NA sfc anl)	127 km at 60N
61-64	International Exchange & FOS grids - see below.	
75	12321-point (111x111) N. Hemisphere Lambert Conformal grid. No fixed location; used by QLM Hurricane model.	40 km at 30&60 deg N
76	12321-point (111x111) S. Hemisphere Lambert Conformal grid. No fixed location; used by QLM Hurricane model.	40 km at 30&60 deg S
77	12321-point (111x111) N. Hemisphere Mercator grid. No fixed location; used by QLM Hurricane model.	40 km at 22.5 deg N&S

85	32400-point (360x90) N. Hemisphere longitude/latitude grid; longitudes: 0.5E to 359.5E (0.5W); latitudes: 0.5N to 89.5N; origin (1,1) at (0.5E,0.5N)	1 deg
86	32400-point (360x90) S. Hemisphere longitude/latitude grid; longitudes: 0.5E to 359.5E (0.5W); latitudes: 89.5S to 0.5S; origin (1,1) at (0.5E,89.5S)	1 deg
87	5022 point (81x62) N. Hemisphere polar stereographic grid oriented at 105W. Pole at (31.91, 112.53) Used for RUC. (60 km at 40N). See below for GRIB specification.	68.153 km at 60N
90	12902 point (92x141 semi-staggered) lat. long., rotated such that center located at 52.0N, 111.0W; LL at 37.5W, 35S Unfilled E grid for 80 km ETA model	lat.14/26 deg lon.15/26 deg
91	25803 point (183x141) lat. long., rotated such that center located at 52.0N, 111.0W; LL at 37.5W,35S Filled E grid for 80 km ETA model	lat.14/26 deg lon.15/26 deg
92	2 4162 point (127x191 semi-staggered) lat. long., rotated such that center located at 41.0N, 97.0W; LL at 35W,25S Unfilled E grid for 40 km ETA model	lat. 5/57 deg lon. 5/18 deg
93	48323 point (253x191)lat. long., rotated such that center located at 41.0N, 97.0W; LL at 35W ,25S Filled E grid for 40 km ETA model	lat.15/57 deg lon.5/18 deg
98	Global Gaussian T62 grid. See GRIB specifications below	
100	6889-point (83x83) N. Hemisphere polar stereographic grid oriented 105W; Pole at (40.5,88.5). (NGM Original C-Grid)	91.452 km at 60N

101	10283-point (113x91) N. Hemisphere polar stereographic grid oriented 105W; Pole at (58.5,92.5). (NGM "Big C-Grid")	91.452 km at 60N
103	3640-point (65x56) N. Hemisphere polar stereographic grid oriented 105W; Pole at (25.5,84.5) (used by ARL)	91.452 km at 60N
104	16170-point (147x110) N. Hemisphere polar stereographic grid oriented 105W; pole at (75.5,109.5). (NGM Super C grid)	90.75464 km at 60N
105	6889-point (83x83) N. Hemisphere polar stereographic grid oriented 105W; pole at (40.5,88.5). (U.S. area subset of NGM Super C grid, used by ETA model)	90.75464 km at 60N
106	19305 point (165x117) N. Hemisphere stereographic grid oriented 105W; pole at (80,176) Hi res. ETA (2 x resolution of Super C)	45.37732 km at 60N
107	11040 point (120x92) N. Hemisphere stereographic grid oriented 105W; pole at (46,167) subset of Hi res. ETA; for ETA & MAPS/RUC	45.37732 km at 60N
126	Global Gaussian T126 grid. See GRIB specifications below	
201-nnn	AWIPS grids. See specifications below.	
255	(non-standard grid - defined in the GDS)	

NOTE ON NMC STORAGE GRIDS:

ON THE POLAR STEREOGRAPHIC GRIDS, THE VECTOR WIND IS RESOLVED INTO U AND V COMPONENTS WITH RESPECT TO THE GRID COORDINATES, I.E., U REPRESENTS MOTION IN THE DIRECTION OF INCREASING X (I) COORDINATE, V IN THE DIRECTION OF INCREASING Y (J). ON THE LATITUDE-LONGITUDE GRIDS, U AND V ARE TRUE EASTWARD AND NORTHWARD COMPONENTS, RESPECTIVELY. HOWEVER, TAKE NOTE OF TABLE 7, BELOW, WHICH ALLOWS FOR THE SPECIFICATION OF OTHER POSSIBILITIES.

INTERNATIONAL EXCHANGE AND FAMILY OF SERVICES (FOS) GRIDS

VALUE	RESOLUTION (DEGREES) LON X LAT	AREA COVERAGE (DEGREES)	GRID SHAPE COLS ROWS		GRID POINTS
21	5.0 X 2.5	0-180E, 0-90N	37	36 + POLE	1333
22	5.0 X 2.5	180W-0, 0-90N	37	36 + POLE	1333
23	5.0 X 2.5	0-180E, 90S-0	POLE + 37	36	1333
24	5.0 X 2.5	180W-0, 90S-0	POLE + 37	36	1333
25	5.0 X 5.0	0-355E, 0-90N	72	18 + POLE	1297
26	5.0 X 5.0	0-355E, 90S-0	POLE + 72	18	1297
50	2.5 X 1.25	(SEE NOTE IV)			964
61	2.0 X 2.0	0-180E, 0-90N	91	45 + POLE	4096
62	2.0 X 2.0	180W-0, 0-90N	91	45 + POLE	4096
63	2.0 X 2.0	0-180E, 90S-0	POLE + 91	45	4096
64	2.0 X 2.0	180W-0, 90S-0	POLE + 91	45	4096

255 (NON-STANDARD GRID - DEFINED IN THE GDS)

NOTES ON INTERNATIONAL EXCHANGE/FOS GRIDS:

(I) THE GRID POINTS ARE LAID OUT IN A LINEAR ARRAY SUCH THAT THE LONGITUDE INDEX (THE COLUMNS) IS THE MOST RAPIDLY VARYING. FOR THE NORTHERN HEMISPHERE GRIDS THE FIRST POINT IN THE RECORD IS AT THE INTERSECTION OF THE WESTERN-MOST MERIDIAN AND SOUTHERN-MOST CIRCLE OF LATITUDE; THE LAST POINT IS THE SINGLE POLAR VALUE (SEE NOTE III, BELOW). FOR THE SOUTHERN HEMISPHERE GRIDS THE FIRST POINT IN THE RECORD IS THE SINGLE POLAR VALUE (SEE NOTE III, BELOW); THE LAST POINT IS AT THE INTERSECTION OF THE EASTERN-MOST MERIDIAN AND NORTHERN-MOST CIRCLE OF LATITUDE. FOR THOSE FAMILIAR WITH FORTRAN SUBSCRIPTING CONVENTIONS, LONGITUDE IS THE FIRST SUBSCRIPT, LATITUDE THE SECOND.

(II) IN GRIDS 21 THROUGH 26, AND 61 THROUGH 64, THE VALUES ON THE SHARED BOUNDARIES ARE INCLUDED IN EACH AREA.

(III) THE DATUM FOR THE POLE POINT IS GIVEN ONLY ONCE IN EACH GRID. THE USER MUST EXPAND, IF DESIRED, THE SINGLE POLE POINT VALUE TO ALL THE POLE "POINTS" AT THE POLE ROW OF A LATITUDE-LONGITUDE GRID. SCALAR QUANTITY VALUES ARE THE SAME FOR ALL POLE POINTS ON A THE GRID. WIND COMPONENTS AT THE POLES ARE GIVEN BY THE FORMULAE:

$$U = -SPEED * SIN(DD) \quad \& \quad V = -SPEED * COS(DD)$$

WHERE DD IS THE DIRECTION OF THE WIND AS REPORTED ACCORDING TO THE SPECIFICATION OF WIND DIRECTION AT THE POLES (REFER TO WMO MANUAL

ON CODES <1>, CODE TABLE 878).

THE WMO CONVENTION CAN BE GIVEN THIS OPERATIONAL DEFINITION: AT THE NORTH POLE, FACE INTO THE WIND AND REPORT THE VALUE OF THE WEST LONGITUDE MERIDIAN ALONG WHICH THE WIND IS COMING AT YOU; AT THE SOUTH POLE DO LIKEWISE BUT REPORT THE EAST LONGITUDE MERIDIAN VALUE. THIS IS EQUIVALENT TO PLACING THE ORIGIN OF A RIGHT-HANDED CARTESIAN COORDINATE SYSTEM ON THE NORTH POLE WITH THE Y-AXIS POINTING TO THE PRIME (0 DEGREE) MERIDIAN AND THE X-AXIS POINTING TO THE 90 DEGREES WEST MERIDIAN, AND THEN RESOLVING ANY VECTOR WIND AT THE POLE POINT INTO COMPONENTS ALONG THOSE AXES. AT THE SOUTH POLE THE COORDINATE AXES ARE ORIENTED SUCH THAT THE Y-AXIS POINTS TOWARD 180 DEGREES WEST. THOSE COMPONENTS ARE THE U- AND V-VALUES GIVEN AS THE SINGLE PAIR OF POLE POINT WINDS IN THE GRIB FORMAT.

IN TERMS OF A LONGITUDE/LATITUDE GRID THESE ARE THE WIND COMPONENTS FOR THE POLE POINT AT THE 180 DEGREE MERIDIAN. FOR EXAMPLE, ON A 2.5X2.5 DEGREE NORTHERN HEMISPHERE GRID (145X37 POINTS), WITH THE ABSCISSA ALONG THE EQUATOR AND THE ORDINATE ALONG THE PRIME MERIDIAN, THE TRANSMITTED NORTH POLE WIND COMPONENTS ARE THOSE THAT BELONG AT THE GRIDPOINT (73,37). THE WIND COMPONENTS AT THE OTHER GRID POINTS ALONG THE POLE ROW MAY BE OBTAINED THROUGH SUITABLE ROTATION OF THE COORDINATE SYSTEM. ALL THE COMPONENTS AT THE POLE ROW ARE, OF COURSE, SIMPLY REPRESENTATIONS OF THE SAME VECTOR WIND VIEWED FROM DIFFERING (ROTATED) COORDINATE SYSTEMS. IN THE SOUTHERN HEMISPHERE THE ANALOGOUS SITUATION HOLDS; THE SINGLE SET OF TRANSMITTED POLE POINT WIND COMPONENTS BELONG AT THE GRIDPOINT (73,1).

(IV) GRID 50 IS A SET OF POINTS OVER THE CONTIGUOUS UNITED STATES AND ENVIRONS ON A GRID EXTENDING FROM 20N (ROW NO. 1) TO 60N (ROW NO. 33) IN 1.25 DEGREE INTERVALS. THE GRID INCREASES IN LONGITUDINAL EXTENT FROM SOUTH TO NORTH IN THE FOLLOWING MANNER:

ROWS	NO. POINTS	LONGITUDINAL EXTENT
1-4	22	122.5W - 70.0W
5-8	24	125.0W - 67.5W
9-12	26	127.5W - 65.0W
13-16	28	130.0W - 62.5W
17-20	30	132.5W - 60.0W
21-24	32	135.0W - 57.5W
25-28	34	137.5W - 55.0W
29-33	36	140.0W - 52.5W

WAFC/ICAO/INTERNATIONAL EXCHANGE/FOS GRIDS

(Grids 37 - 44)

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Global Coverage of Grids
Octants of the Globe

In the figure the boxes indicate the location of the octants of the globe, the numbers are the corresponding grid identification numbers (PDS Octet 7), and the letters are the grid identification used in the WMO heading (see Appendix A).

The left and right meridional columns of each octant/grid are shared with the neighbors.

The basic grid point separation is 1.25x1.25 deg. on a latitude / longitude array, but the grid is "thinned" by reducing the number of points in each row as one goes northward (or southward) away from the equator. The latitudinal increment is always 1.25 deg.; this results in 73 rows where the pole is included as a "row", not a single gridpoint.

The longitudinal spacing at the equator is also 1.25 deg.; there will be 73 gridpoints there in each octant.

The number of points on each latitudinal row, other than the equator, is given by this formula (using FORTRAN notation):

```
NPOINTS = IFIX(2.0 + (90.0/1.25) * COS(LATITUDE))
```

Thus at the pole there will be two gridpoints, one each at the meridians that delineate the edges of the octant. The formula was worked out so that there will be (approximately) equal geographic separation between the grid points uniformly across the globe.

Because of variations in precision and roundoff error in different computers, the value of NPOINTS may vary by 1 at "critical" latitudes when calculated on various hardware platforms. Here is a table of the exact values of NPOINTS as a function of latitude as used in the internationally exchanged grids. These numbers will, of course, be found in the Grid Description Section of each GRIB bulletin.

Latitude Range inclusive (north or south)	NPOINTS
0.00 - 8.75	73
10.00 - 12.50	72
13.75 - 16.25	71
17.50 - 18.75	70
20.00 - 21.25	69
22.50	68
23.75 - 25.00	65
30.00	64

Table B: GRIDS (cont.)

31.25	63
32.50	62
33.75	61
35.00 - 36.25	60
37.50	59
38.75	58
40.00	57
41.25	56
42.50	55
43.75	54
45.00	52
46.25	51
47.50	50
48.75	49
50.00	48
51.25	47
52.50	45
53.75	44

Latitude Range inclusive (north or south)	NPOINTS
55.00	43
56.25	42
57.50	40
58.75	39
60.00	38
61.25	36
62.50	35
63.75	33
65.00	32
66.25	30
67.50	29
68.75	28
70.00	26
71.25	25
72.50	23
73.75	22
75.00	20
76.25	19
77.50	17
78.75	16
80.00	14
81.25	12
82.50	11
83.75	9
85.00	8
86.25	6
87.50	5
88.75	3
90.00	2

When all this is put together the result is that there are 3447 points of data actually transmitted in any individual GRIB bulletin containing one octant of the globe.

In the GRIB bulletins all of this information will be included in the Grid Description Section (GDS); the GDS must be included in order to describe the thinned or "quasi-regular" grid structure. See Section 2 and Table C for the general description of the GDS; what follows are the specific values of the variables in the GDS that describe these eight grids.

GDS Contents

Table B: GRIDS (cont.)

Octets	Value or variable
1-3	178 (length of GDS)
4	0 (or 255, either indicating no PV)
5	33 (pointer to start of PL list)
6	0
7-32	Grid description - see below
33-178	number of points in each of 73 rows (2 octets per point)

Details of Octets 7-32 - Grid Description

Octets	Variable & Value
7-8	Ni = 73
9-10	Nj = 73

	GRID:	37	38	39	40	41	42	43	44
11-13	La1 =	0	0	0	0	90S	90S	90S	90S
14-16	Lo1 =	330	60	150	240	330	60	150	240

17 Resolution & Component Flag = [10000000] (binary)

GRID: 37 38 39 40 41 42 43 44

Table B: GRIDS (cont.)

Octets									
18-20	La2 =	90N	90N	90N	90N	0	0	0	0
21-23	Lo2 =	60	150	240	330	60	150	240	330

24-25	Di = 1.25 deg
26-27	Dj = 1.25 deg
28	Scan Mode = [01000000] (binary)
29-32	Set to 0 (unused)

Note that the scanning direction is from the bottom (south edge) to the top of the octant grids, regardless of the hemisphere. Thus in the northern hemisphere the first 73 data points (in the BDS) will be the equatorial values and the last two will be the polar values. The PL counts in the GDS octets 33-178 will, of course, indicate contain these numbers.

In the southern hemisphere, the first two data points will be the south pole values, and the last 73 points will be the equatorial values. Octets 33-34 in the GDS will contain "2", octets 35-36 will contain a "3", and so on to octet 177-178 which will contain "73".

SELECTED NMC GRIDS DEFINED USING GRIB SPECIFICATIONS
(See Table C for definition of symbols)

VALUE	GRID DESCRIPTIONS	
1	Tropical Strip (Mercator)	
	Ni =	73
	Nj =	23
	La1 =	48.09S
	Lo1 =	0.0E
	Res. & Comp. flag =	1 0 0 0 0 0 0 0
	La2 =	48.09N
	Lo2 =	0.0W

Latin = 22.5
Scanning Mode (Bits 1 2 3) = 0 1 0
Di = Dj = 513.669 km

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	48.09S, 0.00E
(1,23) =	48.09N, 0.00E
(73,23) =	48.09N, 0.00W
(73,1) =	48.09S, 0.00W

The longitudinal grid spacing is 5.00 degrees.

87 U.S. Area; used in MAPS/RUC
(60km at 40N)
(N. Hem. polar stereographic)

Nx =	81
Ny =	62
La1 =	22.8756N
Lo1 =	239.5089E = 120.4911W
Res. & Comp. flag = 0 0 0 0 1 0 0 0	
Lov =	255.000E = 105.000W
Dx = Dy =	68.153 km
Projection Flag (Bit 1) = 0	
Scanning Mode (Bits 1 2 3) = 0 1 0	

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	22.8756N, 120.4911W
(1,62) =	52,4887N, 136.5458W
(81,62) =	46.0172N, 60.8284W
(81,1) =	20.1284N, 81.2432W

The pole point is at (I,J) = (31.91,112.53)

98 Global Gaussian Latitude/Longitude T62 Resolution

Ni = 192
Nj = 94
La1 = 88.542N
Lo1 = 0.0E
Res. & Comp. flag = 1 0 0 0 0 0 0 0
La2 = 88.542S
Lo2 = 358.125E = 1.875W
Di = 1.875 degrees
N = 47 (number of lat. circles, pole to equator)
Scanning Mode = 00000000(NB:matrix style)

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	88.542N, 0.0E (upper left)
(1,190) =	88.542S, 0.0E
(384,190) =	88.542S, 359.0625E
(384,1) =	88.542N, 359.0625E

----

126 Global Gaussian Latitude/Longitude T126 Resolution

Ni = 384
Nj = 190
La1 = 89.277N
Lo1 = 0.0E
Res. & Comp. flag = 1 0 0 0 0 0 0 0
La2 = 89.277S
Lo2 = 359.0625E = 0.9375W
Di = 0.9375 degrees
N = 95 (# of lat circles pole to equator)
Scanning Mode = 00000000(NB:matrix style)

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	89.277N, 0.0E (upper left)
(1,190) =	89.277S, 0.0E
(384,190) =	89.277S, 359.0625E
(384,1) =	89.277N, 359.0625E

AWIPS-90 STORAGE AND TRANSMISSION GRIDS

Note: The following grids are intended for use in the U.S. Weather Service's Advanced Weather Information Processing System for the 1990s (AWIPS-90). Their definition is subject to change as the AWIPS-90 requirements are further refined.

VALUE AWIPS GRID DESCRIPTIONS
(See Table C for definition of symbols)

201 Hemispheric
(polar stereographic)

Nx =	65
Ny =	65
La1 =	-20.826N = 20.826S
Lo1 =	210.000E = 150.000W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	255.000E = 105.000W
Dx = Dy =	381.000 km

Projection Flag (Bit 1) = 0
Scanning Mode (Bits 1 2 3) = 0 1 0

The pole point is at (I,J) = (33,33)

Map 201 is the same as NMC storage grid 27, except it is rotated to 105 deg. orientation.

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202 National - CONUS
(polar stereographic)

Nx =	65
Ny =	43
La1 =	7.838N
Lo1 =	218.972E = 141.028W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	255.000E = 105.000W
Dx = Dy =	190.500 km

Projection Flag (Bit 1) = 0
Scanning Mode (Bits 1 2 3) = 0 1 0

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	7.838N, 141.028W
(1,43) =	35.616N, 168.577E
(65,43) =	35.617N, 18.576W

	(65,1) =	7.838N, 68.973W
The pole point is at	(I,J) =	(33,45)

203 National - Alaska
(polar stereographic)

Nx =	45
Ny =	39
La1 =	19.132N
Lo1 =	174.163E = 185.837W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	210.000E = 150.000W
Dx = Dy =	190.500 km

Projection Flag (Bit 1) = 0
Scanning Mode (Bits 1 2 3) = 0 1 0

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	19.132N, 174.163E
(1,39) =	44.646N, 115.601E
(45,39) =	57.634N, 53.660W
(45,1) =	24.361N, 123.434W

The pole point is at (I,J) = (27,37)

----

204 National - Hawaii
(Mercator)

Ni =	93
Nj =	68
La1 =	25.000S
Lo1 =	110.000E
Res. & Comp. flag =	1 0 0 0 0 0 0 0
La2 =	60.644N
Lo2 =	109.129W
Latin =	20.000

Scanning Mode (Bits 1 2 3) = 0 1 0
Di = Dj = 160.000 km

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	25.000S, 110.000E
(1,68) =	60.644N, 110.000E
(93,68) =	60.644N, 109.129W
(93,1) =	25.000S, 109.129W

The longitudinal grid spacing is 1.531 degrees.

205 National - Puerto Rico
(polar stereographic)

Nx =	45
Ny =	39
La1 =	0.616N
Lo1 =	275.096E = 84.904W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	300.000E = 60.000W
Dx = Dy =	190.500 km

Projection Flag (Bit 1) = 0
Scanning Mode (Bits 1 2 3) = 0 1 0

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	0.616N, 84.904W
(1,39) =	36.257N, 115.304W
(45,39) =	45.620N, 15.000W
(45,1) =	3.389N, 42.181W

The pole point is at (I,J) = (27,57)

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206 Regional - Central US MARD
(Lambert Conformal)

Nx =	51
Ny =	41
La1 =	22.289N
Lo1 =	242.009E = 117.991W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	265.000E = 95.000W
Dx = Dy =	81.2705 km

Projection Flag = 0 (not bipolar)
Scanning Mode (Bits 1 2 3) = 0 1 0
Latin 1 = 25.000N
Latin 2 = 25.000N (tangent cone)

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	22.289N, 117.991W
(1,41) =	50.081N, 124.898W
(51,41) =	50.072N, 73.182W
(51,1) =	23.142N, 78.275W

The Dx, Dy grid increment (at 25 deg north) was selected so that the grid spacing would be exactly 80.000 km at 35 deg north; the intersection of 35N & 95W falls on point (30,16).

207 Regional - Alaska
(polar stereographic)

Nx =	49
Ny =	35
La1 =	42.085N
Lo1 =	184.359E = 175.641W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	210.000E = 150.000W
Dx = Dy =	95.250 km

Projection Flag (Bit 1) = 0
Scanning Mode (Bits 1 2 3) = 0 1 0

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	42.085N, 175.641W
(1,35) =	63.976N, 153.689E
(49,35) =	63.976N, 93.689W
(49,1) =	42.085N, 124.359W

The pole point is at (I,J) = (25,51)

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208 Regional - Hawaii
(Mercator)

Ni =	29
Nj =	27
La1 =	9.343N
Lo1 =	192.685E = 167.315W
Res. & Comp. flag =	1 0 0 0 0 0 0 0
La2 =	28.092N
Lo2 =	145.878W
Latin =	20.000
Scanning Mode (Bits 1 2 3) =	0 1 0
Di = Dj =	80.000 km

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	9.343N, 167.315W
(1,27) =	28.092N, 167.315W
(29,27) =	28.092N, 145.878W
(29,1) =	9.343N, 145.878W

The longitudinal grid spacing is 0.766 degrees. The grid is positioned such that the odd-numbered rows and columns coincide with the National grid, No. 204; the lower left corner of the regional grid is located at National (204) grid-point (55,24) and the upper right corner is located at (69,37).

209	Regional - Central US MARD - Double Res. (Lambert Conformal)

Nx =	101
Ny =	81
La1 =	22.289N
Lo1 =	242.00962E = 117.991W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	265.000E = 95.000W
Dx = Dy =	40.63525 km
Projection Flag =	0 (not bipolar)

Scanning Mode (Bits 1 2 3) = 0 1 0
Latin 1 = 25.000N
Latin 2 = 25.000N (tangent cone)

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	22.289N, 117.991W
(1,81) =	50.081N, 124.898W
(101,81) =	50.072N, 73.182W
(101,1) =	23.142N, 78.275W

The Dx, Dy grid increment (at 25 deg north) was selected so that the grid spacing would be exactly 40.000 km at 35 deg north; the intersection of 35N & 95W falls on point (59,31).

210	Regional - Puerto Rico (Mercator)

Ni =	25
Nj =	25
La1 =	9.000N
Lo1 =	283.000E = 77.000W
Res. & Comp. flag =	1 0 0 0 0 0 0 0
La2 =	26.422N
Lo2 =	58.625W
Latin =	20.000
Di = Dj =	80.000 km

Scanning Mode (Bits 1 2 3) = 0 1 0

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	9.000N, 77.000W
(1,25) =	26.422N, 77.000W
(25,25) =	26.422N, 58.625W
(25,1) =	9.000N, 58.626W

The longitudinal grid spacing is 0.766 degrees

211 Regional - CONUS
(Lambert Conformal)

Nx =	93
Ny =	65
La1 =	12.190N
Lo1 =	226.541E = 133.459W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	265.000E = 95.000W
Dx = Dy =	81.2705 km

Projection Flag = 0 (not bipolar)
Scanning Mode (Bits 1 2 3) = 0 1 0
Latin 1 = 25.000N
Latin 2 = 25.000N (tangent cone)

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	12.190N, 133.459W
(1,65) =	54.536N, 152.856W
(93,65) =	57.290N, 49.385W
(93,1) =	14.335N, 65.091W

The Dx, Dy grid increment (at 25 deg north) was selected so that the grid spacing would be exactly 80.000 km at 35 deg north; the intersection of 35N & 95W falls on point (53,25).

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212 Regional - CONUS - double resolution
(Lambert Conformal)

Nx =	185
Ny =	129
La1 =	12.190N
Lo1 =	226.514E = 133.459W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	265.000E = 95.000W
Dx = Dy =	40.63525 km

Projection Flag = 0 (not bipolar)
Scanning Mode (Bits 1 2 3) = 0 1 0
Latin 1 = 25.000N
Latin 2 = 25.000N (tangent cone)

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	12.190N, 133.459W
(1,129) =	54.536N, 122.856W
(185,129) =	57.290N, 49.385W

(185,1) = 14.335N, 65.091W

The Dx, Dy grid increment (at 25 deg north) was selected so that the grid spacing would be exactly 40.000 km at 35 deg north; the intersection of 35N & 95W falls on point (105,49).

213 National - CONUS - Double Resolution (polar stereographic)

Nx =	129
Ny =	85
La1 =	7.838N
Lo1 =	218.972E = 141.028W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	255.000E = 105.000W
Dx = Dy =	95.250 km

Projection Flag (Bit 1) = 0
Scanning Mode (Bits 1 2 3) = 0 1 0

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	7.838N, 141.028W
(1,85) =	35.617N, 168.577E
(129,85) =	35.617N, 18.577W
(129,1) =	7.838N, 68.973W

The pole point is at (I,J) = (65,89)

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214 Regional - Alaska - Double Resolution (polar stereographic)

Nx =	97
Ny =	69
La1 =	42.085N
Lo1 =	184.359E = 175.641W
Res. & Comp. flag =	0 0 0 0 1 0 0 0
Lov =	210.000E = 150.000W
Dx = Dy =	47.625 km

Projection Flag(Bit 1) = 0
Scanning Mode (Bits 1 2 3) = 0 1 0

For reference here are the lat/lon values of the corners of the grid:

(1,1) =	42.085N, 175.641W
(1,69) =	63.975N, 153.690E
(97,69) =	63.975N, 93.689W
(97,1) =	42.085N, 124.358W

The pole point is at (I,J) = (49,101)

TABLE 1. FLAG FOR GDS OR BMS
(PDS Octet 8)

The bit flag indicates the omission or inclusion of the Grid Description and/or Bit Map Sections.

BIT	VALUE	MEANING
1	0	GDS Omitted
	1	GDS Included
2	0	BMS Omitted
	1	BMS Included
3-8	0	reserved

TABLE 2. PARAMETERS & UNITS
Version 1
(PDS Octet 9)

VALUE	PARAMETER	UNITS
000	Reserved	
001	Pressure	Pa
002	Pressure reduced to MSL	Pa
003	Pressure tendency	Pa/s
004		
005		
006	Geopotential	m^2/s^2
007	Geopotential height	gpm
008	Geometric height	m
009		
010		
011	Temperature	deg. K
012	Virtual temperature	deg. K
013	Potential temperature	deg. K
014	Pseudo-adiabatic potential temperature	deg. K
015	Maximum temperature	deg. K
016	Minimum temperature	deg. K
017	Dew point temperature	deg. K
018	Dew point depression (or deficit)	deg. K
019	Lapse rate	deg. K/m
020		
021	Radar Spectra (1)	-
022	Radar Spectra (2)	-
023	Radar Spectra (3)	-
024		
025	Temperature anomaly	deg. K
026	Pressure anomaly	Pa
027	Geopotential height anomaly	gpm
028	Wave Spectra (1)	-
029	Wave Spectra (2)	-
030	Wave Spectra (3)	-
031	Wind direction	deg. true
032	Wind speed	m/s

033	u-component of wind	m/s
034	v-component of wind	m/s
035	Stream function	m^2/s
036	Velocity potential	m^2/s
037	Montgomery stream function	m^2/s^2
038	Sigma coord. vertical velocity	/s
039	Pressure Vertical velocity	Pa/s
040	Geometric Vertical velocity	m/s
041	Absolute vorticity	/s
042	Absolute divergence	/s
043	Relative vorticity	/s
044	Relative divergence	/s
045	Vertical u-component shear	/s
046	Vertical v-component shear	/s
047	Direction of current	deg. true
048	Speed of current	m/s
049	u-component of current	m/s
050	v-component of current	m/s
051	Specific humidity	kg/kg
052	Relative humidity	%
053	Humidity mixing ratio	kg/kg
054	Precipitable water	kg/m^2
055	Vapor pressure	Pa
056	Saturation deficit	Pa
057	Evaporation	kg/m^2
058		
059	Precipitation rate	$kg/m^2/s$
060	Thunderstorm probability	%
061	Total precipitation	kg/m^2
062	Large scale precipitation	kg/m^2
063	Convective precipitation	kg/m^2
064	Snowfall rate water equivalent	kg/m^2s
065	Water equiv. of accum. snow depth	kg/m^2
066	Snow depth	m
067	Mixed layer depth	m
068	Transient thermocline depth	m
069	Main thermocline depth	m
070	Main thermocline anomaly	m

071	Total cloud cover	%
072	Convective cloud cover	%
073	Low cloud cover	%
074	Medium cloud cover	%
075	High cloud cover	%
076	Cloud water	kg/m^2
077	Condensation pressure of parcel lifted from indicated surface	Pa
078		
079		
080	Water Temperature	deg K
081	Land-sea mask (1=land; 0=sea)	1/0
082	Deviation of sea level from mean	m
083	Surface roughness	m
084	Albedo	%
085	Soil temperature	deg. K
086	Soil moisture content	kg/m^2
087	Vegetation	%
088	Salinity	kg/kg
089	Density	kg/m^3
090		
091	Ice concentration (ice=1; no ice=0)	1/0
092	Ice thickness	m
093	Direction of ice drift	deg. true
094	Speed of ice drift	m/s
095	u-component of ice drift	m/s
096	v-component of ice drift	m/s
097	Ice growth rate	m/s
098	Ice divergence	/s
099		
100	Significant height of combined wind waves and swell	m
101	Direction of wind waves	deg. true
102	Significant height of wind waves	m
103	Mean period of wind waves	s
104	Direction of swell waves	deg. true
105	Significant height of swell waves	m
106	Mean period of swell waves	s
107	Primary wave direction	deg. true
108	Primary wave mean period	s
109	Secondary wave direction	deg. true
110	Secondary wave mean period	s

111	Net short-wave radiation (surface)	W/m^2
112	Net long wave radiation (surface)	W/m^2
113	Net short-wave radiation (top of atmos.)	W/m^2
114	Net long wave radiation (top of atmos.)	W/m^2
115	Long wave radiation	W/m^2
116	Short wave radiation	W/m^2
117	Global radiation	W/m^2
118		
119		
120		
121	Latent heat flux	W/m^2
122	Sensible heat flux	W/m^2
123	Boundary layer dissipation	W/m^2
124		
125		
126		
127	Image data	

TABLE 2.(cont.)

VALUE	PARAMETER	UNITS
(128 - 254 Reserved for use by originating center)		
	NWS/NMC usage as follows...	
128	Mean Sea Level Pressure (MSLSA) (Standard Atmosphere Reduction)	Pa
129	Mean Sea Level Pressure (MSLMA) (MAPS System Reduction)	Pa
130	Mean Sea Level Pressure (MSLET) (ETA Model Reduction)	Pa
131	Surface lifted index	Deg. K
132	Best (4 layer) lifted index	Deg. K
133	K index	Deg. K
134	Sweat index	Deg. K
135	Horizontal moisture divergence	kg/kg/s
136	Vertical speed shear	/s
137	Visibility	m
150	Covariance between meridional and zonal components of the wind. Defined as [uv]-[u][v], where "[]" indicates the mean over the indicated time span.	m^2/s^2
151	Covariance between temperature and zonal component of the wind. Defined as [uT]-[u][T], where "[]" indicates the mean over the indicated time span.	K*m/s
152	Covariance between temperature and meridional component of the wind. Defined as [vT]-[v][T], where "[]" indicates the mean over the indicated time span.	K*m/s
157	Convective Available Potential Energy	J/kg
158	Turbulent Kinetic Energy	J/kg
176	latitude (-90 to +90) (NLAT)	deg
177	east longitude (0-360)(ELON)	deg
201	Ice-free water surface	%

TABLE 2.(cont.)

VALUE	PARAMETER	UNITS
204	downward short wave rad. flux (DSWRF)	W/m**2
205	downward long wave rad. flux (DLWRF)	W/m**2
207	Moisture availability	%
208	Exchange coefficient	$(kg/m^3)(m/s)$
209	No. of mixed layers next to surface	integer
211	upward short wave rad. flux (USWRF)	W/m**2
212	upward long wave rad. flux (ULWRF)	W/m**2
213	Amount of non-convective cloud	%
216	Temperature tendency by all radiation	Deg.K/s
218	precip.index(0.0-1.00)(see note)(PREIX)	fraction
220	Natural log of surface pressure	ln(kPa)
222	5-wave geopotential height	gpm
255	Missing	

Notes:

1) By convention, downward fluxes of radiation or other quantities are assigned negative values; upward fluxes of radiation or other quantities are assigned positive values.

2) The u and v components of vector quantities are defined with reference to GDS Octet 17 and Table 7.

3) provision is made for three types of spectra:

   1) Direction and Frequency
   2) Direction and radial number
   3) Radial number and radial number

4) Precipitation index (#218) defined as the fraction of satellite observed pixels with temperatures <235K over 1.0x1.0 box, centered at the gridpoint.

TABLE 3. TYPE AND VALUE OF LEVEL
(PDS Octets 10, 11, & 12)

Octet Number 10		Number 11	Number 12
VALUE	MEANING	CONTENTS	
0 - 99	special codes, see Table 3a	0	0
100	isobaric level	pressure in hectoPascals (hPa) (2 octets)	
101	layer between two isobaric levels	pressure of top (kPa)	pressure of bottom (kPa)
102	mean sea level	0	0
103	fixed height level	height above mean sea level (MSL) in meters	
104	layer between two height levels above msl	height of top (hm)	height of bottom (hm)
105	fixed height above ground	height in meters (2 octets)	
106	layer between two height levels above ground	height of top (hm)	height of bottom (hm)
107	sigma level	sigma value in 1/10000 (2 octets)	
108	layer between two sigma levels	sigma value at top in 1/100	sigma value at bottom in 1/100
109	Hybrid level	level number (2 octets)	
110	layer between two hybrid levels	level number of top	level number of bottom

111	depth below land surface	centimeters (2 octets)	
112	layer between two depths below land surface	depth of upper surface (cm)	depth of lower surface (cm)

TABLE 3. TYPE AND VALUE OF LEVEL
(continued)

VALUE	MEANING	CONTENTS Number 11	CONTENTS Number 12
(Octet Number 10)		Number 11	Number 12
113	isentropic (theta) level	Potential Temp. degrees K (2 octets)	
114	layer between two isentropic levels	475K minus theta of top in Deg. K	475K minus theta of bottom in deg. K
121	layer between two isobaric surfaces (high precision)	1100 hPa minus pressure of top, in hPa	1100 hPa minus pressure of bottom, in hPa
128	layer between two sigma levels (high precision)	1.1 minus sigma of top, in 1/1000 of sigma	1.1 minus sigma of bottom, in 1/1000 of sigma
141	layer between two isobaric surfaces (mixed precision)	pressure of top, in kPa	1100hPa minus pressure of bottom, in hPa
160	depth below sea level	meters (2 octets)	

Note: The numbering allows for additions within this framework:

100-119	normal precision
120-139	high precision
140-159	mixed precision

TABLE 3a. SPECIAL LEVELS
(PDS Octet 10)

VALUE	LEVEL
01	surface (of the Earth, which

TABLE 3. TYPE AND VALUE OF LEVEL
(continued)

Octet Number 10	Number 11	Number 12
VALUE	MEANING	CONTENTS
		includes sea surface)
	02	cloud base level
	03	cloud top level
	04	0 deg (C) isotherm level
	05	adiabatic condensation level (lifted from boundary layer)
	06	maximum wind speed level
	07	tropopause level
	08-99	reserved

TABLE 4. FORECAST TIME UNIT
(PDS Octet 18)

VALUE	TIME UNIT
0	minute
1	hour
2	day
3	month
4	year
5	decade
6	normal (30 years)
7	century
8-253	reserved
254	second

TABLE 5.
TIME RANGE INDICATOR
(PDS Octet 21)

VALUE	MEANING
0	Forecast product valid at reference time + P1 (P1>0), or Uninitialized analysis product for reference time (P1=0). or Image product for reference time (P1=0)
1	Initialized analysis product for reference time (P1=0).
2	Product with a valid time ranging between reference time + P1 and reference time + P2
3	Average (reference time + P1 to reference time + P2)
4	Accumulation

	(reference time + P1 to reference time + P2) product considered valid at reference time + P2
5	Difference (reference time + P2 minus reference time + P1) product considered valid at reference time + P2
6-9	reserved
10	P1 occupies octets 19 and 20; product valid at reference time + P1
11-112	reserved
113	Average of N forecasts (or initialized analyses); each product has forecast period of P1 (P1=0 for initialized analyses); products have reference times at intervals of P2, beginning at the given reference time.
114	Accumulation of N forecasts (or initialized analyses); each product has forecast period of P1 (P1=0 for initialized analyses); products have reference times at intervals of P2, beginning at the given reference time.
115	Average of N forecasts, all with the same reference time; the first has a forecast period of P1, the remaining forecasts follow at intervals of P2.
116	Accumulation of N forecasts, all with the same reference time; the first has a forecast period of P1, the remaining follow at intervals of P2.
117	Average of N forecasts, the first has a period of P1, the subsequent ones have forecast periods reduced from the previous one by an interval of P2; the reference time for the first is given in octets 13-17, the subsequent ones

	have reference times increased from the previous one by an interval of P2. Thus all the forecasts have the same valid time, given by the initial reference time + P1.
118	Temporal variance, or covariance, of N initialized analyses; each product has forecast period P1=0; products have reference times at intervals of P2, beginning at the given reference time.
119 -122	reserved
123	Average of N uninitialized analyses, starting at the reference time, at intervals of P2.
124	Accumulation of N uninitialized analyses, starting at the reference time, at intervals of P2.
125-254	reserved

NOTES:

1) For analysis products, or the first of a series of analysis products, the reference time (octets 13 to 17) indicates the valid time.

2) For forecast products, or the first of a series of forecast products, the reference time indicates the valid time of the analysis upon which the (first) forecast is based.

3) Initialized analysis products are allocated numbers distinct from those allocated to uninitialized analysis products.

4) A value of 10 allows the period of a forecast to be extended over two octets; this is to assist with extended range forecasts.

5) Where products or a series of products are averaged or accumulated, the number involved is to be represented in octets 22-23 of Section 1, while any number missing is to be represented in octet 24.

6) Forecasts of the accumulation or difference of some quantity (e.g. quantitative precipitation forecasts), indicated by values of 4 or 5 in octet 21, have a product valid time given by the reference time + P2; the period of accumulation, or difference, can be calculated as P2 - P1.

A few examples may help to clarify the use of Table 5:

For analysis products P1 is zero and the time range indicator is also zero; for initialized products (sometimes called "zero hour forecasts") P1 is zero, but octet 21 is set to 1.

For forecasts, typically, P1 contains the number of hours of the forecast (the unit indicator given in octet 18 would be 1) and octet 21 contains a zero.

Value 115 would be used, typically, for multiple day mean forecasts, all derived from the same initial conditions.

Value 117 would be used, typically, for Monte Carlo type calculations: many forecasts valid at the same time from different initial (reference) times.

Averages, accumulations, and differences get a somewhat specialized treatment. If octet 21 (Table 5) has a value between 2 and 5 (inclusive) then the reference time + P1 is the initial date/time and the reference time + P2 is the final date/time of the period over which averaging or accumulation takes place. If, however, octet 21 has a value of 113, 114, 115, 116, 117, 118, 123, or 124 then P2 specifies the time interval between each of the fields (or the forecast initial times) that have been averaged or accumulated. These latter values of octet 21 require the quantities averaged to be equally separated in time; the former values, 3 and 4 in particular, allow for irregular or unspecified intervals of time between the fields that are averaged or accumulated.

section 2: GRID DESCRIPTION SECTION (GDS)

THE PURPOSE OF THE (OPTIONAL) GDS IS TO PROVIDE A GRID DESCRIPTION FOR GRIDS NOT DEFINED BY NUMBER IN TABLE 3.

OCTET NO.	GDS CONTENT
1 - 3	LENGTH IN OCTETS OF THE GRID DESCRIPTION SECTION
4	NV, THE NUMBER OF VERTICAL COORDINATE PARAMETERS
5	PV, THE LOCATION (OCTET NUMBER) OF THE LIST OF VERTICAL COORDINATE PARAMETERS, IF PRESENT OR PL, THE LOCATION (OCTET NUMBER) OF THE LIST OF NUMBERS OF POINTS IN EACH ROW (WHEN NO VERTICAL PARAMETERS ARE PRESENT), IF PRESENT OR 255 (ALL BITS SET TO 1) IF NEITHER ARE PRESENT
6	DATA REPRESENTATION TYPE (SEE TABLE 6)
7 - 32	GRID DESCRIPTION, ACCORDING TO DATA REPRESENTATION TYPE, EXCEPT LAMBERT OR MERCATOR.
OR	
7 - 42	GRID DESCRIPTION FOR LAMBERT OR MERCATOR GRID
PV	LIST OF VERTICAL COORDINATE PARAMETERS (LENGTH = NV X 4 OCTETS); IF PRESENT, THEN PL = 4 X NV + PV
PL	LIST OF NUMBERS OF POINTS IN EACH ROW, USED FOR QUASI-REGULAR GRIDS (LENGTH = NROWS X 2 OCTETS, WHERE NROWS IS THE TOTAL NUMBER OF ROWS DEFINED WITHIN THE GRID DESCRIPTION)

NOTE: NV AND PV RELATE TO "ADVANCED" FEATURES OF GRIB NOT, AT PRESENT, IN USE IN THE NATIONAL WEATHER SERVICE. SEE THE WMO MANUAL ON CODES<1> FOR THE DESCRIPTIONS OF THOSE FEATURES.

PL IS USED FOR "QUASI-REGULAR" OR "THINNED" GRIDS; E.G., A LAT/LON GRID WHERE THE NUMBER OF POINTS IN EACH ROW IS REDUCED AS ONE MOVES POLEWARD FROM THE EQUATOR.

THE REDUCTION USUALLY FOLLOWS SOME MATHEMATICAL FORMULA INVOLVING THE COSINE OF THE LATITUDE, TO GENERATE AN (APPROXIMATELY) EQUALLY SPACED GRID ARRAY. THE ASSOCIATION OF THE NUMBERS IN OCTET PL (AND FOLLOWING) WITH THE PARTICULAR ROW FOLLOWS THE SCANNING MODE SPECIFICATION IN TABLE 8.

TABLES FOR THE GDS

TABLE 6. DATA REPRESENTATION TYPE
(GDS Octet 6)

VALUE	MEANING
0	Latitude/Longitude Grid also called Equidistant Cylindrical or Plate Carree projection grid
1	Mercator Projection Grid
2	Gnomonic Projection Grid
3	Lambert Conformal, secant or tangent, conical or bipolar (normal or oblique) Projection Grid
4	Gaussian Latitude/Longitude Grid
5	Polar Stereographic Projection Grid
6 - 12	(reserved - see Manual on Codes)
13	Oblique Lambert conformal, secant or tangent, conical or bipolar, projection
14 - 49	(reserved - see Manual on Codes)
50	Spherical Harmonic Coefficients
51 - 89	(reserved - see Manual on Codes)
90	Space view perspective or orthographic grid
91 - 254	(reserved - see Manual on Codes)

TABLE C. Sundry Grid Definitions

LATITUDE/LONGITUDE GRIDS INCLUDING GAUSSIAN (GDS Octets 7 - 32)

OCTET NO.	CONTENT & MEANING
7 - 8	Ni - No. of points along a latitude circle
9 - 10	Nj - No. of points along a longitude meridian
11 - 13	La_1 - latitude of first grid point units: millidegrees (degrees x 1000) values limited to range 0 - 90,000 bit 1 (leftmost) set to 1 for south latitude
14 - 16	Lo_1 - longitude of first grid point units: millidegrees (degrees x 1000) values limited to range 0 - 360,000 bit 1 (leftmost) set to 1 for west longitude
17	Resolution and component flags (Table 7)
18 - 20	La_2 - Latitude of last grid point (same units, value range, and bit 1 as La_1)
21 - 23	Lo_2 - Longitude of last grid point (same units, value range, and bit 1 as Lo_1)
24 - 25	Di - Longitudinal Direction Increment (same units as Lo_1) (if not given, all bits set = 1)
26 - 27	<u>Regular Lat/Lon Grid</u>: Dj - Latitudinal Direction Increment (same units as La_1) (if not given, all bits set = 1) or <u>Gaussian Grid</u>:

		N - number of latitude circles between a pole and the equator Mandatory if Gaussian Grid specified
28	Scanning mode flags (See Table 8)	
29 - 32	Reserved (set to zero)	

Note: The latitude and longitude of the first and last grid points should always be given, for regular grids.

POLAR STEREOGRAPHIC GRIDS
(GDS Octets 7 - 32)

OCTET NO.	CONTENT & MEANING
7 - 8	Nx - Number of points along x-axis
9 - 10	Ny - Number of points along y-axis
11 - 13	La1 - Latitude of first grid point
14 - 16	Lo1 - Longitude of first grid point
17	Resolution and component flags (see Table 7)
18 - 20	Lov - The orientation of the grid; i.e., the east longitude value of the meridian which is parallel to the y-axis (or columns of the grid) along which latitude increases as the y-coordinate increases. (Note: The orientation longitude may, or may not, appear within a particular grid.)
21 - 23	Dx - the X-direction grid length (see Note 2)
24 - 26	Dy - the Y-direction grid length (see note 2)
27	Projection center flag (see note 5)
28	Scanning mode (see Table 8)
29 - 32	Set to 0 (reserved)

NOTES:

1. Latitude and longitude are in millidegrees (thousandths)

2. Grid lengths are in units of meters, at the 60 degree latitude circle nearest to the pole in the projection plane.

3. Latitude values are limited to the range 0 - 90,000. Bit 1 is set to 1 to indicate south latitude.

4. Longitude values are limited to the range 0 - 360,000. Bit one is set to 1 to indicate west longitude.

5. Octet 27:
   Bit 1 set to 0 if the North pole is on the projection plane.
   Bit 1 set to 1 if the South pole is on the projection plane.

6. The first and last grid points may not necessarily be the same as the first and last data points if the bit map section (BMS) is used.

7. The resolution flag (bit 1 of Table 7) is not applicable.

LAMBERT CONFORMAL SECANT OR TANGENT CONE GRIDS
(GDS Octets 7 - 42)

OCTET NO.	CONTENT & MEANING
7 - 8	Nx - Number of points along x-axis
9 - 10	Ny - Number of points along y-axis
11 - 13	La1 - Latitude of first grid point
14 - 16	Lo1 - Longitude of first grid point
17	Resolution and component flags (see Table 7)
18 - 20	Lov - The orientation of the grid; i.e., the east longitude value of the meridian which is parallel to the y-axis (or columns of the grid) along which latitude increases as the y-coordinate increases. (Note: The orientation longitude may, or may not, appear within a particular grid.)
21 - 23	Dx - the X-direction grid length (see note 2)
24 - 26	Dy - the Y-direction grid length (see Note 2)
27	Projection center flag (see note 5)
28	Scanning mode (see Table 8)
29 - 31	Latin 1 - The first latitude from the pole at which the secant cone cuts the spherical earth. (See Note 8)
32 - 34	Latin 2 - The second latitude from the pole at which the secant cone cuts the spherical earth. (See Note 8)
35 - 37	Latitude of southern pole (millidegrees)
38 - 40	Longitude of southern pole (millidegrees)
41 - 42	Reserved (set to 0)

NOTES:

1. Latitude and longitude are in millidegrees (thousandths)

2. Grid lengths are in units of meters, at the intersection latitude circle nearest to the pole in the projection plane.

3. Latitude values are limited to the range 0 - 90,000. Bit 1 is set to 1 to indicate south latitude.

4. Longitude values are limited to the range 0 - 360,000. Bit one is set to 1 to indicate west longitude.

5. Octet 27:
   Bit 1 set to 0 if the North pole is on the projection plane.
   Bit 1 set to 1 if the South pole is on the projection plane.
   Bit 2 set to 0 if only one projection center used
   Bit 2 set to 1 if projection is bipolar and symmetric

6. The first and last grid points may not necessarily be the same as the first and last data points if the bit map section (BMS) is used.

7. The resolution flag (bit 1 of Table 7) is not applicable.

8. If Latin 1 = Latin 2 then the projection is on a tangent cone.

MERCATOR GRIDS
(GDS Octets 7 - 42)

OCTET NO.	CONTENT & MEANING
7 - 8	Ni - Number of points along a latitude circle
9 - 10	Nj - Number of points along a longitude meridian
11 - 13	La1 - Latitude of first grid point
14 - 16	Lo1 - Longitude of first grid point
17	Resolution and component flags (see Table 7)
18 - 20	La2 - latitude of last grid point
21 - 23	Lo2 - longitude of last grid point
24 - 26	Latin - The latitude(s) at which the Mercator projection cylinder intersects the earth.
27	Reserved (set to 0)
28	Scanning mode (see Table 8)
29 - 31	Di - the longitudinal direction increment (see Note 2)
32 - 34	Dj - the latitudinal direction increment (see note 2)
35 - 42	Reserved (set to 0)

NOTES:

TABLE C. Sundry Grid Descriptions
(continued)

1. Latitude and longitude are in millidegrees (thousandths)
2. Grid lengths are in units of meters, at the circle of latitude specified by Latin.
3. Latitude values are limited to the range 0 - 90,000. Bit 1 is set to 1 to indicate south latitude.
4. Longitude values are limited to the range 0 - 360,000. Bit one is set to 1 to indicate west longitude.
5. The latitude and longitude of the last grid point should always be given.
6. The first and last grid points may not necessarily be the same as the first and last data points if the bit map section (BMS) is used.

TABLE C. Sundry Grid Descriptions
(continued)

SPHERICAL HARMONIC COEFFICIENTS
(GDS Octets 7 - 32)

OCTET NO.	CONTENT & MEANING
7 - 8	J - Pentagonal Resolution Parameter
9 - 10	K - Pentagonal Resolution Parameter
11 - 12	M - Pentagonal Resolution Parameter
13	Representation Type (See Table 9)
14	Coefficient Storage Mode (See Table 10)
15 - 32	Set to zero (reserved)

TABLE 7 - RESOLUTION AND COMPONENT FLAGS
(GDS Octet 17)

Bit	Value	Meaning
1	0	Direction increments not given
	1	Direction increments given
2	0	Earth assumed spherical with radius = 6367.47 km
	1	Earth assumed oblate spheroid with size as determined by IAU in 1965: 6378.160 km, 6356.775 km, f = 1/297.0
3-4		reserved (set to 0)
5	0	u- and v-components of vector quantities resolved relative to easterly and northerly directions
	1	u and v components of vector quantities resolved relative to the defined grid in the direction of increasing x and y

TABLE C. Sundry Grid Descriptions
(continued)

	(or i and j) coordinates	respectively
6-8	reserved (set to 0)	

TABLE 8. SCANNING MODE FLAG
(GDS Octet 28)

BIT	VALUE	MEANING
1	0	Points scan in +i direction
	1	Points scan in -i direction
2	0	Points scan in -j direction
	1	Points scan in +j direction
3	0	Adjacent points in i direction are consecutive (FORTRAN: (I,J))
	1	Adjacent points in j direction are consecutive (FORTRAN: (J,I))

Note: i direction is defined as west to east along a parallel of latitude, or left to right along an x axis.

j direction is defined as south to north along a meridian of longitude, or bottom to top along a y axis.

TABLE 9. SPECTRAL REPRESENTATION TYPE
(GDS Octet 13)

VALUE	MEANING
1	Associated Legendre Polynomials of the First Kind with normalization such that the integral equals 1

TABLE 10. COEFFICIENT STORAGE MODE
(GDS Octet 14)

VALUE	MEANING
1	The complex coefficients X_n^m are stored for $m \geq 0$ as pairs of real numbers $Re(X_n^m)$, $Im(X_n^m)$ ordered with n increasing from m to N(m), first for m = 0 and then for m = 1, 2, 3,...M. The real part of the (0,0) coefficient is stored in octets 12-15 of the BDS, as a floating point number in the same manner as the packing reference value, with units as in Table 2. The remaining coefficients, starting

with the imaginary part of the (0,0) coefficient, are packed according to the GRIB packing algorithm, with units as given in Table 5, in octets 16 and onward in the BDS.

NOTES ON SPECTRAL TRUNCATION:

Using the associated Legendre Polynomials of the First Kind, P_n^m, as typical expansion functions, any variable $x(\lambda,\mu)$, which is a function of longitude, λ , and sin(latitude), μ , can be represented by

µ §

In the summations, M is the maximum zonal wave number that is to be included, and K & J together define the maximum meridional total wave number N(m), which, it should be noted, is a function of m. A sketch shows the relationships:

µ §

In this figure, the ordinate is n the zonal wave number, the abscissa, m, is the total meridional wave number, the vertical line at m = M is the zonal truncation, and the diagonal passing through (0,0) is the line n = m. The Legendre Polynomials are defined only on or above this line, that is for $n \geq m$. On the n-axis, the horizontal line at n = K indicates the upper limit to n values, and the diagonal that intersects the n-axis at n = J indicates the upper limit of the area in which the Polynomials are defined. The shaded irregular pentagon defined by the n-axis, the diagonal from n = J, the horizontal n = K, the vertical m = M, and the other diagonal n = m surrounds the region of the (n x m) plane containing the Legendre Polynomials used in the expansion.

This general pentagonal truncation reduces to some familiar common truncations as special cases:

Triangular: K = J = M and N(m) = J
Rhomboidal: K = J + M and N(m) = J + m
Trapezoidal: K = J, K > M and N(m) = J

In all of the above m can take on negative values to represent the imaginary part of the spectral coefficients.

section 3: BIT MAP SECTION (BMS).

THE PURPOSE OF THE (OPTIONAL) BMS IS TO PROVIDE EITHER A BIT MAP OR A REFERENCE TO A BIT MAP PRE-DEFINED BY THE CENTER. THE BIT MAP CONSISTS OF CONTIGUOUS BITS WITH A BIT-TO-DATA-POINT CORRESPONDENCE AS DEFINED IN THE GRID DESCRIPTION. A BIT SET EQUAL TO 1 IMPLIES THE PRESENCE OF A DATUM FOR THAT GRID POINT IN THE BDS; A VALUE OF ZERO IMPLIES THE ABSENCE OF SUCH.

OCTET NO.

1 - 3 LENGTH IN OCTETS OF BIT MAP SECTION

4 NUMBER OF UNUSED BITS AT END OF SECTION 3.

5 - 6 NUMERIC:

NUMERIC = 0: A BIT MAP FOLLOWS;
OTHERWISE : THE NUMERIC REFERS TO A PREDEFINED BIT MAP PROVIDED BY THE CENTER

7 - NNN BIT MAP, ZERO FILLED TO AN EVEN NUMBER OF OCTETS

section 4: BINARY DATA SECTION (BDS).

THE BDS CONTAINS THE PACKED DATA AND THE BINARY SCALING INFORMATION NEEDED TO RECONSTRUCT THE ORIGINAL DATA FROM THE PACKED DATA. THE REQUIRED DECIMAL SCALE FACTOR IS FOUND IN THE PDS, ABOVE. THE DATA STREAM IS ZERO FILLED TO AN EVEN NUMBER OF OCTETS.

OCTET NO.	
1 - 3	LENGTH IN OCTETS OF BINARY DATA SECTION
4	BITS 1 THROUGH 4: FLAG - SEE TABLE 11 BITS 5 THROUGH 8: NUMBER OF UNUSED BITS AT END OF SECTION 4.
5 - 6	THE BINARY SCALE FACTOR (E). A NEGATIVE VALUE IS INDICATED BY SETTING THE HIGH ORDER BIT (BIT NO. 1) IN OCTET 5 TO 1 (ON).
7 - 10	REFERENCE VALUE (MINIMUM VALUE); FLOATING POINT REPRESENTATION OF THE NUMBER.
11	NUMBER OF BITS INTO WHICH A DATUM POINT IS PACKED
12 -NNN	VARIABLE, DEPENDING ON OCTET 4; ZERO FILLED TO AN EVEN NUMBER OF OCTETS.
14	OPTIONALLY, MAY CONTAIN AN EXTENSION OF THE FLAGS IN OCTET 4. SEE TABLE 11.

HERE ARE SOME OF THE VARIOUS FORMS THE BINARY DATA CAN TAKE; THE FLAG TABLE IN BDS OCTET 4, POSSIBLY EXTENDED INTO OCTET 14, IDENTIFIES WHICH VARIANT IS IN USE.

GRID-POINT DATA - SIMPLE PACKING

HERE THE DATA SIMPLY BEGIN IN OCTET 12 AND CONTINUE, PACKED ACCORDING TO THE ALGORITHM DESCRIBED ABOVE, WITHOUT ANY PARTICULAR REGARD FOR COMPUTER "WORD" BOUNDARIES, UNTIL THERE IS NO MORE DATA. THERE MAY BE SOME "ZERO-FILL" BITS AT THE END.

IF ALL THE DATA IN A GRID POINT FIELD HAPPEN TO HAVE THE SAME VALUE, THEN ALL OF THE DEVIATIONS FROM THE REFERENCE VALUE ARE SET TO ZERO. SINCE A ZERO VALUE REQUIRES NO BITS FOR PACKING, OCTET 11 IS SET TO ZERO, THUS INDICATING A FIELD OF CONSTANT DATA, THE VALUE OF

WHICH IS GIVEN BY THE REFERENCE VALUE. UNDER THESE CIRCUMSTANCES, OCTET 12 IS SET TO ZERO (THE REQUIRED "ZERO FILL TO AN EVEN NUMBER OF OCTETS") AND BITS 5-8 OF OCTET 4 CONTAIN AN 8. THE NUMBER OF DATA POINTS IN THE FIELD IS IMPLIED BY THE GRID IDENTIFICATION GIVEN IN THE PDS AND/OR THE GDS AND BMS.

SPHERICAL HARMONIC COEFFICIENTS - SIMPLE PACKING

OCTETS 12-15 CONTAIN THE REAL PART OF THE (0.0) COEFFICIENT IN THE SAME FLOATING POINT FORMAT AS THE REFERENCE VALUE IN OCTETS 7-10. THE IMAGINARY PART OF THE (0.0) COEFFICIENT, MATHEMATICALLY, IS ALWAYS EQUAL ZERO. OCTETS 16 TO THE END CONTAIN THE REMAINING COEFFICIENTS PACKED UP AS BINARY DATA WITH THE SAME SORT OF SCALING, REFERENCE VALUE, AND THE LIKE, AS WITH GRID-POINT NUMBERS. EXCLUDING THE (0,0) COEFFICIENT, WHICH IS USUALLY MUCH LARGER THAN THE OTHERS, FROM THE PACKING OPERATION MEANS THAT THE REMAINING COEFFICIENTS CAN BE PACKED TO A GIVEN PRECISION MORE EFFICIENTLY (FEWER BITS PER WORD) THAN WOULD BE THE CASE OTHERWISE.

GRID-POINT DATA - COMPLEX PACKING

[THIS SECTION TO BE COMPLETED AT A LATER DATE.]

TABLES FOR THE BDS

TABLE 11. FLAG
(BDS Octet 4 and, optionally, 14)

Bit	Value	Meaning
1	0	Grid point data
	1	Spherical Harmonic Coefficients
2	0	Simple packing
	1	Second order ("Complex") Packing
3	0	Original data were floating point values
	1	Original data were integer values
4	0	No additional flags at octet 14
	1	Octet 14 contains flag bits 5 - 12

The following gives the meaning of the bits in octet 14 ONLY if bit 4 is set to 1. Otherwise octet 14 contains regular binary data.

Bit	Value	Meaning
5		Reserved (set to 0)
6	0	Single datum at each grid point
	1	Matrix of values at each grid point
7	0	No secondary bit maps
	1	Secondary bit maps present
8	0	Second order values have constant width
	1	Second order values have different widths
9-12		Reserved (set to 0)

Notes:

(1) Bit 4 is set to 1 to indicate that bits 5 to 12 are contained in octet 14 of the data section.

(2) Bit 3 is set to 1 to indicate that the original data was integers; when this is the case any non-zero reference values should be rounded to an integer value.

(3) When secondary bit maps are present in the data (used in association with second order packing and, optionally, with a matrix of values at each point) this is indicated by setting bit 7 to 1.

(4) When octet 14 contains the extended flag information octets 12 and 13 will also contain "special" information; the actual data will begin in a subsequent octet. See above.

At present, the "extension" of Table 11 into octet 14 and the associated "advanced" features of GRIB are limited to spherical harmonics and second order("complex") packing in the National Weather Service. Additional variations are included in the WMO Documentation.

section 5: End Section

THE END SECTION SERVES A HUMAN READABLE INDICATION OF THE END OF A GRIB RECORD. IT CAN ALSO BE USED FOR COMPUTER VERIFICATION THAT A COMPLETE GRIB RECORD IS AVAILABLE FOR DATA EXTRACTION. IT SHOULD NOT BE USED AS A SEARCH TARGET SINCE A '7777' BIT COMBINATION COULD EXIST ANYWHERE IN THE BINARY DATA STREAM.

OCTET NO.	
1-4	'7777' (CODED CCITT-ITA NO. 5)

APPENDIX A

OUTLINE OF WMO BULLETIN HEADERS

USED WITH

G R I B

WMO BULLETIN HEADER

The WMO abbreviated heading is used to identify the NMC GRIB messages; however, it is not a complete description of their content. The user is cautioned against using the header as the sole determiner of the record content; she should, of course, rely on the Product Definition Section for that purpose.

Note: In the following, a hexadecimal number is enclosed in parentheses followed by the designation "hex".

The information needed to identify the NMC product is contained in 21 octets. The characters are encoded using the CCITT-ITA No. 5, also known (in the US) as ASCII characters, and are defined as follows:

Octet no.	Header Content
1	The character 'H' for GRIB bulletins sent to the NWS Family of Services, used for the WAFS program, and for general International Exchange or The characters 'Y' or 'Z' for GRIB bulletins intended for the NWS AWIPS program.
2	A letter character specifying the type parameter as shown in Table A.1.
3	A letter character specifying the grid area as defined in Table A.2.
4	A letter or numeric character indicating the time difference between the reference time and valid time of the data as listed in Table A.3, i.e., the forecast length.
5-6	Numeric characters as defined in Table A.4. Usually the pressure level, sometimes just a sequence number. Some values have special level or layer meanings.
7	Blank (20)hex
8-11	Four characters identifying the originating center. These are always 'KWBC' for NMC-produced messages.
12	Blank (20)hex
13-14	Two numeric characters providing the reference day of the month (01-31) of the data.
15-18	Four numeric characters providing the reference hour and minute of the data.
19-22	Four OPTIONAL characters: one blank (20)hex, then 'Pxx', where xx=01-99. Used to indicate sequential parts of very long messages that have been divided using the BLOK feature. See Appendix B.

19-21 OR 23-25 Two ASCII carriage returns and a line feed, (0D0D0A)hex.

The first six characters are commonly referred to as

T_1 T_2 A_1 A_2 ii

In summary...

Generic Meaning of T_1 T_2 A_1 A_2 ii:

T_1: Type of bulletin: "H" for GRIB messages for Family of Services, WAFS, and International Exchange; "Y" or "Z" for AWIPS GRIB messages

T_2: Type of data/parameter

A_1: Grid

A_2: Analysis or forecast hour

ii: Numeric. Usually the pressure level, sometimes just a sequence number. Some values have special level or layer meanings.

In the following tables, the columns headed AWIPS are augmentations to the common Family of Services (FOS),National, and International Exchange variables. FOS, National and International GRIB messages (with H as the initial character) draw upon the left hand columns only. AWIPS GRIB messages (with Y or Z as the initial character) use letters from both columns. If both columns contain entries for the same designator, the T_1 character (H, Y, or Z) indicates which entry to use.

TABLE A.1 TYPE PARAMETERS - T_2
(Header Octet 2)

DESIGNATOR	PARAMETER Usage: FOS & International (H)	AWIPS (Y or Z)
A		
B		Vertical Wind Shear
C		Vorticity
D		Thunderstorm probability
E	Total Precipitation	
F	Long Wave Radiation	Precipitable Water
G		Convective Precip.
H	Height (geopotential)	
I		
J		
K	Primary Wave Period	
L	Primary Wave Direction	
M	Secondary Wave Period	
N	Secondary Wave Direction	
O	Vertical velocity	
P	Pressure	
Q		Stability Index (Best 4-layer index)
R	Relative humidity	
S	Snow	
T	Temperature	
U	u wind component	
V	v wind component	
W		
X	Surface Lifted index	
Y		
Z		

TABLE A.2 GRID DESIGNATOR - A_1

(Header Octet 3)

DESIGNATOR	GRID Number (See Table B) FOS & International (H)	AWIPS (Y or Z)
A	21	201 - Northern Hemisphere
B	22	
C	23	
D	24	
E	25	
F	26	
G	50	
H		213 - National CONUS with Double Resolution
I	37	202 - National CONUS
J	38	203 - National Alaska
K	39	204 - National Hawaii
L	40	205 - National Puerto Rico
M	41	206 - Regional MARD
N	42	207 - Regional Alaska
O	43	208 - Regional Hawaii
P	44	210 - Regional Puerto Rico
Q		211 - Regional CONUS
R		212 - Regional CONUS with Double Resolution
S		209 - Regional MARD with Double Resolution
T	61	214 - Regional Alaska with Double Resolution
U	62	
V	63	
W	64	
X	(Used for experimental transmissions)	
Y		
Z		

TABLE A.3 FORECAST HOUR DESIGNATOR - A_2
(Header Octet 4)

DESIGNATOR	HOUR
	FOS & International (H)
A	00 hour analysis
B	06 hour fcst
C	12 "
D	18 "
E	24 "
F	30 "
G	36 "
H	42 "
I	48 "
J	60 "
K	72 "
L	84 "
M	96 "
N	108 "
O	120 "
P	132 "
Q	144 "
R	156 "
S	168 "
T	180 "
U	192 "
V	204 "
W	216 "
X	228 "
Y	240 "
Z	Reserved for special purposes

Note: The following designators are used for AWIPS only, with "Z" as the first character in the header.

DESIGNATOR	HOUR
A	2 hour fcst
B	3 "
C	4 "
D	8 "

E	9	"
F	10	"
G	14	"
H	15	"
I	16	"
J	20	"
K	21	"
M	54	"
N	66	"

TABLE A.4 LEVEL DESIGNATORS - ii
(Header Octets 5 and 6)
(H, Y, or Z)

DESIGNATOR	LEVEL or LAYER
00	Entire Atmosphere
99	1000 hPa
98	Air Properties at Surface of Earth
97	Level of the tropopause
96	Level of the maximum wind
95	950 hPa
94	Level of 0 deg C isotherm
93	Land/Water Properties at Surface of Earth/Ocean
92	Boundary Layer
91	Any parameter reduced to Sea Level

Note: The following levels are used to indicate geometric height for aviation flight levels, not pressure levels

81	810 hPa ~ 1828 m = 6000 ft FL
73	730 hPa ~ 2743 m = 9000 ft FL
64	640 hPa ~ 3658 m = 12000 ft FL

Otherwise, the designator given is the hundreds and tens digits of the hPa level in the atmosphere, e.g. 70=700hPa; 03=30hPa, etc..

SPECIAL NOTE

The following version of Table A.4 contains changes recently approved by the WMO. They are **NOT** in effect as yet but are scheduled to go into effect on **November 3, 1993**. The table is presented here for your edification, so you can make proper preparations, so I won't have to print a new copy of this document after Nov. 3, and so I can say "I told you so!" when all your codes fail on Nov. 4, 1993

TABLE A.4 LEVEL DESIGNATORS - ii
(Header Octets 5 and 6)
(H, Y, or Z)

DESIGNATOR	LEVEL or LAYER
00	Entire Atmosphere
99	1000 hPa
98	Air Properties at Surface of Earth
97	Level of the tropopause
96	Level of the maximum wind
95	950 hPa
94	Level of 0 deg. C isotherm
93	Not assigned
92	925 hPa
91	Not assigned
90	900 hPa
89	Any parameter reduced to Sea Level
88	Land/Water Properties at Surface of Earth/Ocean
87	Not assigned
86	Boundary Layer

Note: The following levels are used to indicate geometric height for aviation flight levels, not pressure levels

81	810 hPa ~ 1828 m = 6000 ft FL
73	730 hPa ~ 2743 m = 9000 ft FL
64	640 hPa ~ 3658 m = 12000 ft FL

Otherwise, the designator given is the hundreds and tens digits of the hPa level in the atmosphere, e.g. 70=700hPa; 03=30hPa, etc..

APPENDIX B

The BLOK feature

for subdividing large GRIB (and/or BUFR) bulletins

BLOK

The BLOK feature is used to subdivide large GRIB bulletins to allow them to fit into existing (limited) communications or data storage facilities. Once divided, the individual subdivisions (BLOKs) can not stand alone - they must be reassembled back into the single bulletin whence they came for any processing. However, from a communications or storage standpoint, each individual BLOK is considered as a distinct bulletin or record and will be uniquely identified.

The application of the BLOK feature is quite straightforward: a given GRIB record - all the bits from "GRIB" through "7777" - may be partitioned at any point (without any regard for the contents) or any number of points. The only rule is that the separate parts must contain an even number of octets. The separate parts are then encased in a BLOK envelope (details follow), and that's it. It is, of course, up to the receiver of a collection of BLOKs to strip off the BLOK envelopes and put the GRIB message back together again. Just get all the king's horses and all the king's men to help do so.

Here is the structure and content of the BLOK envelope.

Section 0 - Indicator section

Octet No.	Contents
1-4	'BLOK' - 4 ASCII characters
5-7	Total length of this BLOK, in octets
8	BLOK Edition Number - currently 0
9-11	Total length of original GRIB message, in octets
12	Flag - see Table B.1 - indicates presence or absence of Section 1
13	Total number of related BLOKs
14	Sequence number of this BLOK
15-16	reserved, set to 0

Section 1 - Identification section - optional

If present, this section contains the complete Product Definition Section (PDS) from the original GRIB message. If this section is included in one BLOK, it must be included in all related BLOKs.

Section 2 - Data section

This section contains an arbitrary part of the original GRIB message - the only restriction is that this section contain an even number of octets.

Section 3 - End section

Octet No.	Contents
1-4	'7777' - 4 ASCII characters

Table B.1

Section 1 present Flag

Bit	Value	Meaning
1	0	Optional Section 1 omitted
	1	Optional Section 1 present
2-8		Reserved (set to 0)

Keep in mind that each subdivision of the original bulletin will be completely surrounded by a BLOK envelope, from 'BLOK' through '7777'.

Note that the last BLOK of a set for a given bulletin will have two '7777's in a row; the first is the one that marks the end of the original bulletin, the second marks the end of the (last) BLOK.

When BLOKs are sent out as individual messages with identifying WMO headers, the 'Pxx' characters that are an optional part of the header shall be included in the header. See Appendix A. In this way the complete WMO header shall be unique for each message even though the TTAAii portion of the headers will be the same, reflecting that each BLOK, for a single GRIB message, contains the same information.