APPENDIX L: **Level 1b Formats Valid from Sept. 8, 1992 to Nov. 15, 1994**

On Sept. 8, 1992, NESDIS implemented enhancements to the current NOAA polar satellite Level 1b digital data format beginning with the orbits shown below. This enhancement utilized spare bytes within the current data fields. These enhancements arose as a result of several requests from users to increase the usefulness and accuracy of Earth location information within the Level 1b data. The dataset header record now includes osculating Keplerian and Cartesian orbital parameters. The size of data records was increased in order to improve the accuracy of the solar zenith angle to one tenth of a degree.

However, NESDIS detected a problem in the HRPT Level 1b data on Sept. 24, 1992. The problem appeared as a dark line parallel to the orbit subtrack where the video data was replaced with data intended for the spare bytes. Investigations revealed that the error was present in all HRPT and LAC data since the update on Sept. 8, 1992. The updates were removed on Sept. 24, 1994 and were re-implemented on Oct. 21, 1992. A summary of affected orbits is listed below.

Between October 21, 1992 and Nov. 15, 1994, the orbital elements (Keplerian and Cartesian) were in IBM floating point format. A conversion routine is included in Appendix H.

The Dataset Header record for GAC and LAC/HRPT data has the format shown in Table L-1. The orbital parameters which were included in the Dataset Header record were written using a standard FORTRAN write as an 8 byte floating point number on an IBM mainframe. The year, Julian day and milliseconds of day are stored as integers (in 2, 2 and 4 bytes, respectively). The TOVS Dataset Header record was not changed.

Table L-1. Format of the AVHRR dataset header record between October 21, 1992 and November 15, 1994.

Byte #	# of Bytes	Contents
1	1	Spacecraft ID
2	1	Data Type
3-8	6	Start Time
9-10	2	Number of Scans
11-16	6	End Time
17-23	7	Processing Block ID (ASCII)
24	1	Ramp/Auto Calibration
25-26	2	Number of Data Gaps
27-32	6	DACS Quality
33-34	2	Calibration Parameter ID
35	1	DACS Status
36-40	5	Zero-filled
41-82	42	42 character dataset name (EBCDIC)
83-84	2	Blank-filled
85-86	2	Year of Epoch for orbit vector
87-88	2	Julian Day of Epoch

89-92	4	Millisecond UTC epoch time of day
Keplerian Orbital Elements		
93-100	8	Semi-major axis in kilometers
101-108	8	Eccentricity
109-116	8	Inclination in degrees
117-124	8	Argument of Perigee in degrees
125-132	8	Right Ascension of the Ascending Node in degrees
133-140	8	Mean Anomaly in degrees
Cartesian Inertial True of Date Elements		
141-148	8	X component of position vector in kilometers
149-156	8	Y component of position vector in kilometers
157-164	8	Z component of position vector in kilometers
165-172	8	X-Dot component of the velocity vector in km/second
173-180	8	Y-Dot component of the velocity vector in km/second
181-188	8	Z-Dot component of the velocity vector in km/second
189-end	variable	Spares - Zero filled to the size of the data record (3220 or 7400)

The format of the GAC Level 1b data between Oct. 21, 1992 and Nov. 15, 1994 is contained in Table L-2.

Table L-2. Format of the GAC data record between October 21, 1992 and November 15, 1994.

Byte #	# of Bytes	Contents
1-2	2	Scan line number from 1 to n
3-8	6	Time code - year, Julian day, milliseconds
9-12	4	Quality indicators
13-52	40	Calibration coefficients
53	1	Number of meaningful Solar Zenith angles and Earth location points appended to scan (n)
54-104	51	Solar Zenith angles
105-308	204	Earth location
309-448	140	Telemetry (HRPT minor frame format)
449-3176	2728	GAC video data
3177-3196*	20	Additional decimal portion of 51 Solar Zenith angles
3197-3220	24	Spares

* Note: Additional data use 19 bytes and 1 bit (3 bits per angle); the first bit in 3196 is used; all others are spares.

Previously, the Solar Zenith angle was multiplied by 2, truncated, and only the integer portion saved, giving a precision of 0.5. In order to store the angle to a precision of 0.1, an integer ranging from 0 to 4 must be added to this value. The binary representation of this integer requires 3 bits. For the 51 values of Solar Zenith angles stored per scan line, 153 bits (19 bytes and 1 bit) are necessary to store the extra precision bits. These bits are stored in the same order

as the angles beginning with byte 3177 in GAC data records (and byte 14105 in LAC and HRPT data records.)

To use the extra precision, unpack the normal zenith angle field as usual. Take the 8-bit part, convert to decimal, and divide by 2. To add in the extra precision, take the 3 bit part from the corresponding field, convert it to decimal, divide by 10, and add it to the original number.

For example: The solar zenith angle of 85.7 will be stored in the original byte as 171. The extra 3 bits will contain 2. To restore the angle divide 171 by 2 to get 85.5 as normal. Then take the 2 from the 3-bit area and divide by 10 giving .2. Add .2 to 85.5 to restore the angle to 85.7.

With the new precision, an angle of 85.79 will be rounded instead of truncated. It will be restored as 85.8.

The format of the LAC/HRPT data records between Oct. 21, 1992 and Nov. 15, 1994 are contained in Table L-3.

Table L-3. Format of the LAC/HRPT data records between October 21, 1992 and November 15, 1994.

Record #	Byte #	# of Bytes	Contents
1	1-2	2	Scan line number
	3-8	6	Time code
	9-12	4	Quality indicators
	13-52	40	Calibration coefficients
	53	1	Number of meaningful Solar Zenith angles and Earth location points appended to scan
	54-104	51	Solar Zenith angles
	105-308	204	Earth location
	309-448	140	Telemetry (header)
	449-7400	6952	LAC/HRPT video data
2	1-6704	6704	LAC/HRPT video data
	6705-6724	20	Additional decimal portion of 51 Solar Zenith angles
	6725-7400	676	Spares

* Note: The additional data use 19 bytes and 1 bit (3 bits per angle); the first bit in 14,124 is used; all others are spares.

The new system functioned properly for TOVS Level 1b data. However, problems with the data record time codes in the GAC Level 1b data forced NESDIS to remove the updates from the AVHRR process. Initially, NESDIS tried turning the clock drift corrections off, but time codes were still incorrect so the old process was resumed. TOVS Level 1b continues to run under the new process without clock drift corrections in the data. The AVHRR data will be processed with the old on-line earth location software until updates can be reinstalled. A list of affected orbits is provided below.

Enhancements began with the following TOVS orbits:

NOAA-12

clock corrections on

S1359.E1539.B1722526.GC

clock corrections off

S1723.E1900.B1722728.GC

S1534.E1727.B1722627.GC

NOAA-11

clock corrections on

S1542.E1719.B3068687.GC

S1353.E1547.B3068586.GC

clock corrections off

S1904.E2026.B3068889.WI

S1715.E1908.B3068788.WI

The following AVHRR data was processed under the enhanced system (only GAC data showed timecode errors produced by the software changes):

NOAA-12

clock corrections on

HRPT - S1542.E1550.B1722626.GC

LHRR - S1402.E1402.B1722525.GC ***time sequence errors**

GHRR - S1359.E1539.B1722526.GC

LHRR - S1359.E1411.B1722525.GC

LHRR - S0934.E0946.B1722222.GC

HRPT - S1902.E1914.B1722828.GC

clock corrections off

GHRR - S1723.E1900.B1722728.GC

GHRR - S1534.E1727.B1722627.GC

LHRR - S1729.E1738.B1722727.GC

LHRR - S1652.E1658.B1722627.GC

LHRR - S1532.E1543.B1722626.GC

NOAA-11

clock corrections on

HRPT - S1722.E1734.B3068787.GC

GHRR - S1542.E1719.B3068687.GC

GHRR - S1353.E1547.B3068586.GC

LHRR - S1516.E1527.B3068686.GC

LHRR - S1511.E1521.B3068586.GC

LHRR - S1342.E1353.B3068585.GC

NOAA-9

clock corrections on

GHRR - S0825.E1019.B5019596.WI

GHRR - S0128.E0321.B5019092.WI

Note that orbit parameters in the TOVS data header records are now scaled integers. The same parameters in the AVHRR data header records are still IBM real numbers.

Initial Update on September 8, 1992:

	JDAY	Start time	End time	Orbit
NOAA-12 GAC	252	1823Z	2006Z	B0686566.GC
NOAA-11 GAC	252	1719Z	1749Z	B2039394.WI
NOAA-11 HRPT	252	1756Z	1805Z	B2039393.GC

All updates were removed from the operation on Thursday, September 24, 1992.

Reinstallation on October 21, 1992:

The update was implemented but system restrictions prevented the addition of the orbital parameters in the header. The following orbits were processed adding only the extra precision bits.

	JDAY	Start time	End time	Orbit
NOAA-12 GAC	295	1945Z	2130Z	B0747778.GC
NOAA-12 HRPT	295	2133Z	2142Z	B0747878.GC
NOAA-12 HRPT	295	2312Z	2320Z	B0747979.GC
NOAA-11 GAC	295	1858Z	2044Z	B2100002.WI
NOAA-11 LAC	295	2030Z	2041Z	B2100101.WI
NOAA-11 GAC	295	2039Z	2233Z	B2100103.GC
NOAA-11 HRPT	295	2238Z	2249Z	B2100303.GC

Final update on October 21, 1992:

The operational JCL was modified to correct the system problems and add the orbit parameters to the header data. Beginning with the following orbits all updates were available within the data.

	JDAY	Start time	End time	Orbit
NOAA-12 GAC	295	2126Z	2309Z	B0747879.GC
NOAA-12 LAC	295	1622Z	1634Z	B0747575.GC
NOAA-11 GAC	295	2229Z	0016Z	B2100304.GC
NOAA-11 LAC	295	2040Z	2048Z	B2100102.GC
NOAA-11 HRPT	296	0018Z	0030Z	B2100404.GC