NIMBUS 7

TEMPERATURE HUMIDITY INFRARED RADIOMETER (THIR)

DATA USER'S GUIDE

May 1982

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and
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FOREWORD

This document provides users with background information on the Nimbus 7 mission and spacecraft, the temperature humidity infrared radiometer (THIR) instrument, and the availability and quality assessment of THIR data products in the archive.

The THIR instrument on board Nimbus 7 is identical to the THIR instruments flown on Nimbus 4 through 6. However, because the Nimbus 7 THIR has been regarded as a "facility subsystem" rather than an "experiment system," the THIR data have been validated differently. The Nimbus 4 through 6 THIR data system was analog to the ground and converted to digital in Goddard Space Flight Center's (GSFC's) Meteorological Operations Control Center (MetOCC). Nimbus 7 performs analog-to-digital conversion on the spacecraft and transmits digital data to the ground. Other instruments, such as the coastal-zone color scanner (CZCS), were backed up by a small group of scientists named the "Nimbus Experiment Team" (NET) who validated the data and devised and tested the algorithms that produced any "derived products." The THIR instrument, however, was not backed up by such a scientific NET.

Realizing that Nimbus 7 THIR data users would take little comfort in this situation, the Nimbus Experiment and Algorithm Team (NEAT), formed a "pseudoNET" in late 1980 to address the issue of THIR data quality. This ad hoc THIR Instrument Science Team (TIST), under the chairmanship of Dr. Larry Stowe of the National Oceanic and Atmospheric Administration/National Earth Satellite Service (NOAA/NESS) Earth Sciences Laboratory, was comprised of experienced users of Nimbus 7 THIR data, data specialists, and production processing personnel. (See Appendix A.) Knowing the pitfalls of using someone else's data the users attempted to relate, through the User's Guide, the lessons learned from the past.

The THIR data from Nimbus 7 are used in the Nimbus 7 Earth Radiation Budget (ERB) and Total Ozone Measurement System (TOMS) experiments. Therefore, the quality assessments in Section 3 are based wholly on these applications. Users wishing to discuss their application of Nimbus 7 THIR data or the assessments of data quality herein may contact Dr. L. Stowe/NOAA or Dr. P. Hwang/NASA.

Section 1 (i.e., The Nimbus 7 Spacecraft System) and Section 2 (i.e., The Temperature Humidity Infrared Radiometer Subsystem) have been taken from the now out-of-print Nimbus 7 User's Guide where they appeared as Section 1 and Section 9, respectively. This was done so that potential users would become familiarized with the Nimbus 7 spacecraft, the Nimbus 7 mission, and the THIR instrument well enough to judge for themselves whether the THIR data would be of any interest. A list of Nimbus 7 THIR acronyms and abbreviations have been included for assisting investigators unfamiliar with THIR terminology. The information regarding the THIR data processing and its quality assurance specification are presented in Appendixes B and D. The reader will also find the tape specification for the THIR's calibrated-located data type (CLDT), clouds-TOMS tape (CLT), and clouds-ERB-tape (CLE) in Appendixes E through G. While validating THIR data products, various problems occurred, some of which provided insight about the quality of data. These problems were included in Appendixes G through I. Appendixes J and K list the THIR data processing software documents and THIR data tape specifications and are available upon request from the NEAT office, Code 910.2, NASA/GSFC.

THIR data are mapped into a matrix format on the magnetic tape cloud matrix (CMAT). In addition, cloud amounts on the CLT are merged with the TOMS/SBUV data to become cloud raw-units (CRUT) tape. For further information, the user is referred to the NEAT office.

The quality of THIR data will be continuously monitored by the TIST. Quality statements in this document should not be viewed as final. A revision will be issued when a significant event is encountered that will impact on the data quality. In this regard the user should contact Dr. Paul Hwang NASA/GSFC.

CONTENTS

CONTENTS (Continued)

ILLUSTRATIONS

TABLES

ACRONYMS

ACS	Attitude Control Subsystem
A/D	Analog to digital
ALGO	Algorithm
BOT	Beginning of Tape
bpi	Bits per inch
CCT	Computer compatible tape
CDHS	Command and data handling subsystem
CDIU	Command and data interface unit
CLDT	THIR calibrated-located data tape
CLE	THIR-clouds-ERB tape
CLT	THIR-clouds-TOMS tape
CRUT	Cloud raw-unit tape
CZCS	Coastal-zone color scanner
DAPS	Data processing system
DCPC	Data capture processing computer
DCS	Data capture system
DCT	Data computer tape
DDPS	Digital data processing system
DIP	Digital information processor
DPS	Digital processing system
EDIS	Environmental Data Information Service (NOAA)
EOF	End of file
EOT	End of tape
EPHEM	Ephemeris
ERB	Earth Radiation Budget
FDHE	Flight data handling equipment
FM	Frequency modulation
FOV	Field of view
GARP	Global Atmospheric Research Program
GMT	Greenwich mean time
GSFC	Goddard Space Flight Center
GSTR	Goddard standard tape recorder
HDT	High-density tape
HRFR	High-resolution film recorder
IFOV	Instantaneous field of view
ILT	Image location tape
ILTC	Image location tape for cloud
ILTT	Image location tape for THIR
I/O	Input/Output
IPD	Information Processing Division (GSFC)
IPF	Image Processing Facility (GSFC)
IR/OR	Input/Output routers

ACRONYMS (Continued)

LaRC	Langley Research Center
LIMS	Limb Infrared Monitoring of the Stratosphere
MetOCC	Meteorological Operations Control Center (GSFC)
NAPPS	Nimbus Applications Preprocessor System
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NDAS	Nimbus Data Acquisition System
NASA	National Aeronautics and Space Administration
NEAM	Nimbus Experiment Algorithm Management
NEAT	Nimbus Experiment Algorithm Team
NET	Nimbus Experiment Team
NMC	National Meteorological Center
NMRT	Nimbus meteorological radiation tape
NOAA	National Oceanic and Atmospheric Administration
NOCC	Nimbus Observatory Control Center
NOPS	Nimbus Observatory Processing System
NSSDC	National Space Science Data Center
OSP/A	Orbiting Satellite Project/Applications
PCM	Pulse-code modulation
PDF	Project data format (code)
PDFC	Project data format code
PM	Phase modulation
PSK	Phase-shift keying
QA	Quality assurance
QC	Quality control
RMS	Root-mean square
rpm	Revolutions per minute
SACC	Science and Applications Computing Center (GSFC)
SAM II	Stratospheric Aerosol Measurement (II)
SAMS	Stratospheric And Mesospheric Sounder
SASC	Systems and Applied Sciences Corporation
SBUV	Solar Backscattered Ultraviolet
S/C	Spacecraft
SDT	Sensor data tape
SMMR	Scanning multichannel microwave radiometer
STDN	Space Tracking and Data Network
STT	Stripped THIR tape
TDF	Training documentation file
THIR	Temperature Humidity Infrared Radiometer
TM	Telemetry
TOMS	Total Ozone Mapping Spectrometer
UFO	User-formatted output

ACRONYMS (Continued)

USB	Unified S-band
VIP	Versatile information processor
WTR	Western Test Range
ZIP	CZCS information processor

SECTION 1

THE NIMBUS 7 SPACECRAFT SYSTEM*

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1.1 INTRODUCTION

The purpose of this section is to present the Nimbus mission, the Nimbus objectives, and the scientific objectives of the Nimbus 7 experiments, to outline the component subsystems and experiments of the spacecraft, and to present information on data products and their availability.

The Nimbus 7 spacecraft was launched from the Western Test Range (WTR) at Vandenberg Air Force Base, California, by a thrust-augmented Delta vehicle. The satellite was placed in a 955 kilometer, Sun-synchronous polar orbit, having local noon (ascending) and midnight (descending) Equator crossings, with 26.1 degrees of longitude separation. The orbital period was approximately 104.16 minutes.

Figure 1 shows the Nimbus 7 as it appears in orbit with its solar panels unfolded. The Earth-viewing sensors are mounted below the torus structure, and the attitude control system (ACS) and the solar array are supported above the torus by a truss.

1.2 NIMBUS 7 MISSION OBJECTIVES

The Nimbus 7 mission affords the opportunity to conduct a variety of experiments in the pollution, oceanographic, and meteorological disciplines. In addition, the Nimbus 7 mission provides an opportunity to assess each instrument's operation in the space environment and to collect a sizable body of data with the global and seasonal coverage needed for support of each experiment. This mission also extends and refines the sounding and atmospheric structure measurement capabilities demonstrated by experiments on previous Nimbus observatories. The mission objectives of the Nimbus 7 are:

a. To determine the feasibility of mapping sources, sinks, and dispersion mechanisms of atmospheric pollutants by observing gases and particulates in the atmosphere (SBUV/TOMS - SAM II - SAMS-LIMS).

b. To observe ocean color, temperature, and ice conditions, particularly in coastal zones, with sufficient spatial and

*Extracted from the Nimbus 7 User's Guide, NASA/Goddard Space Flight Center, August 1978 (out of print).

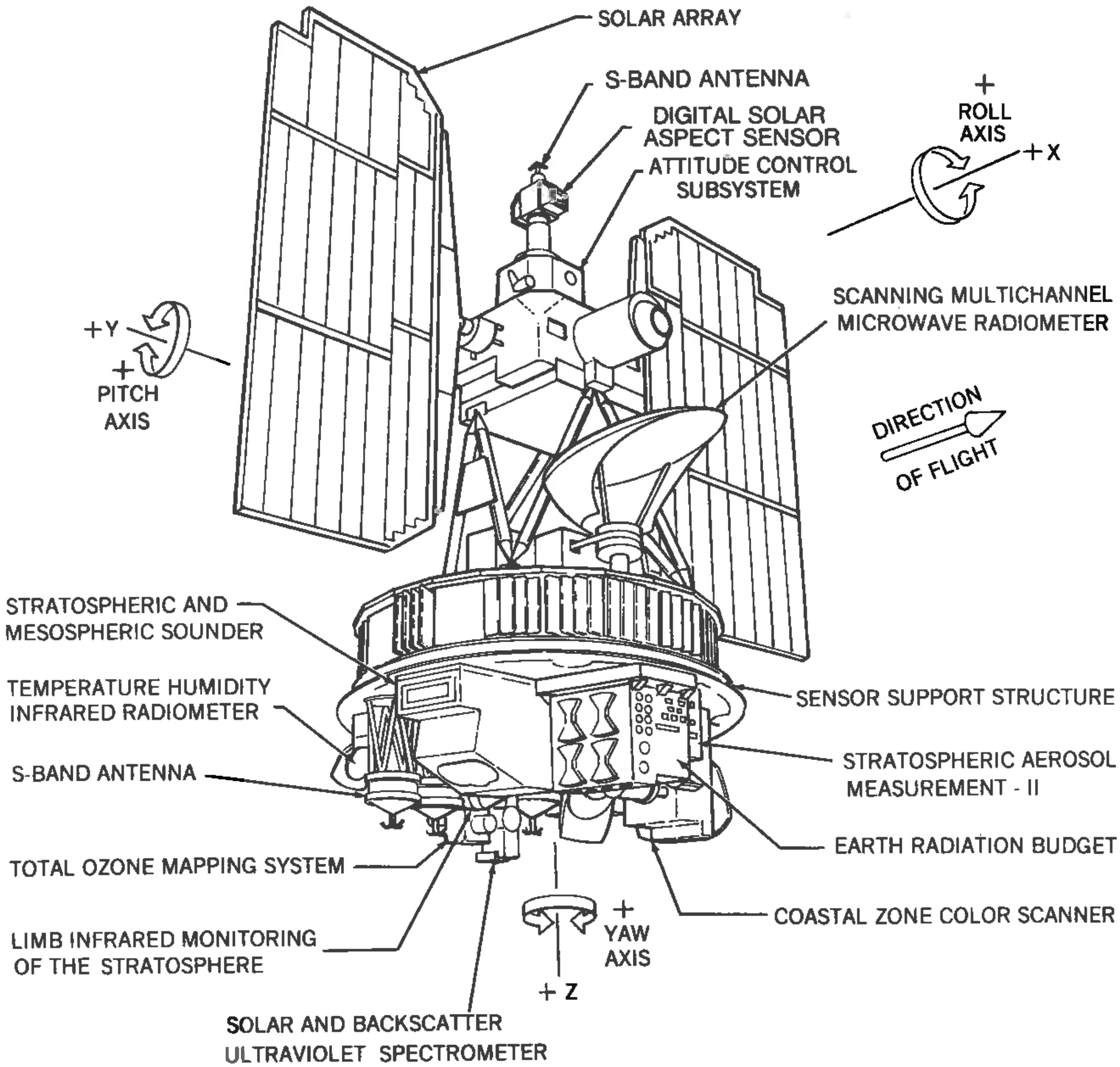


Figure 1. Nimbus 7 Observatory

spectral resolution to determine the feasibility of applications such as:

- Detecting pollutants in the upper level of the oceans
- Determining the nature of materials suspended in the water
- Applying the observations to the mapping of sediments, biologically productive areas, and interactions between coastal effluents and open ocean waters (CZCS)
- Demonstrating improvement in ship route forecasting (SMMR)

c. To make quantitative measurements of air-surface boundary conditions (e.g., soil moisture, snow and ice cover, seasurface temperature and roughness, and albedo) or of precipitation, and to improve long-range weather forecasting in support of the Global Atmospheric Research Program (SMMR-ERB).

d. To continue to make baseline measurements of variations of long-wave radiation fluxes outside the atmosphere and atmospheric constituents for determining the effect of these variations on the Earth's climate (ERB-SBUV/TOMS-LIMS).

1.3 SPACECRAFT COMPONENTS

The Nimbus 7 spacecraft components, the integrated subsystems that provide power, attitude control, and information flow for support of the payload in orbit--are contained within the three major structures of the spacecraft. These three structures consist of a hollow torus-shaped sensor mount, the solar paddles, and a control housing unit that is connected to the sensor mount of a tripod truss structure.

The spacecraft, which weighs 965 kilograms and has a configuration similar to an ocean buoy, is 3.04 meters tall, 1.52 meters in diameter at the base, and 3.96 meters wide with its solar paddles fully extended. The sensor mount that forms the satellite base houses the electronics equipment and battery modules. The lower surface of the torus provides mounting space for sensors and antennas. A box-beam structure mounted within the center of the torus provides support for the larger sensor experiments. The control housing unit is located on top of the spacecraft and above this unit are the Sun sensors, horizon scanners, and a command antenna.

1.3.1 Experiments

Seven experiments and one subsystem (THIR) are on board the Nimbus 7 spacecraft. These experiments and a brief description of their scientific objectives are as follows:

- Coastal Zone Color Scanner (CZCS): The CZCS maps chlorophyll concentration, sediment distribution, Gelbstoffe concentrations as a salinity indicator, and the temperature of coastal waters and the open ocean.

- Earth Radiation Budget (ERB): The ERB instrument, which is similar to the ERB of Nimbus 6, determines the Earth's radiation budget (ERB) for 1 year on both synoptic and planetary scales, by simultaneously measuring incoming solar radiation and outgoing Earth-reflected (shortwave) and emitted (longwave) radiation. To determine outgoing radiation, both fixed-wideangle sampling of terrestrial fluxes at satellite altitude and scanned-narrow-angle sampling of radiance components dependent on angle are used.

- Limb Infrared Monitor of the Stratosphere (LIMS): The LIMS obtains vertical profiles and maps of ozone temperature and concentration, water vapor, nitrogen dioxide, and nitric acid for the region of the stratosphere bounded by the upper troposphere and the lower mesosphere.

- Stratospheric Aerosol Measurement II (SAM II): The SAM II maps the concentration and optical properties of stratospheric aerosols as a function of altitude, latitude, and longitude. The SAM II also maps the tropospheric aerosols but only when clouds are not present in the instrument's instantaneous field of view (IFOV).

- Stratospheric and Mesospheric Sounder (SAMS): The SAMS observes the limb of the atmosphere through various pressure modulator radiometers to measure vertical concentrations of H_2O, CH_4, CO, and NO. In addition, the SAMS observes resonant scattering of solar radiation in spectral bands H_2O, CO_2, CO, and NO, measures the temperature of the stratosphere and mesosphere to 90-kilometers altitude, investigates source function and departure from the thermodynamic equilibrium between 80 and 130 kilometers associated with CO_2 emission bands, and measures the zonal-wind velocity component along the line of sight.

- Solar Backscattered Ultraviolet/Total Ozone Mapping (SBUV/TOMS): The SBUV/TOMS determines the vertical distribution of ozone, maps the total ozone and 200-mb height fields, and monitors the incident solar ultraviolet irradiance and ultraviolet radiation backscattered from the Earth.

- Scanning Multichannel Microwave Radiometer (SMMR)--The SMMR obtains and uses ocean momentum and energy-transfer parameters on an all-weather operational basis. Derived low-altitude parameters are wind, water vapor, liquid-water content, and mean cloud-droplet size.

- Temperature Humidity Infrared Radiometer (THIR): The THIR measures the infrared radiation from the Earth in two spectral bands during day and night portions of the orbit. In addition, the THIR provides pictures of cloud cover, three-dimensional mappings of cloud cover, temperature mappings of cloud, land, and ocean surfaces, cirrus-cloud content, atmospheric contamination, and relative humidity.

1.3.2 Attitude Control Subsystem

The ACS stabilizes the spacecraft's roll, pitch, and yaw axis and controls the solar paddles orientation by maintaining them perpendicular to the nominal Sunline.

The ACS consists of four attitude control loops and associated switching logic, telemetry, test modes, electrical manifolding, and thermal environmental control. This system maintains spacecraft alignment with the local orbital reference axes to within 0.7 degree of the pitch axis and 1.0 degree of the roll and yaw axis. The system keeps the instantaneous angular rate changes about any axis to less than 0.01 degree per second.

The three-axis active ACS uses horizon scanners for roll and pitch error sensing. The rate gyros sense yaw rate and, in a gyro compassing mode, sense yaw attitude. A torquing system combines reaction jets to provide spacecraft momentum control and large control torques when required; flywheels are used for fine control and residual momentum storage.

1.3.3 Instrument Power

The spacecraft power subsystem consists of solar arrays, nickel-cadmium batteries, charge and discharge regulators, and voltage regulators to operate all spacecraft support subsystems and to provide maximum power for the instrument payload.

The orbit average regulated power provided by the observatory power subsystem will be approximately 300 watts, of which 123 watts are allocated to the spacecraft subsystems. If all the instruments were on full-time, the power requirements would exceed the available supply. Because of this power limitation, the subsystems will operate for approximately the percentage of time given in Table 1. Only THIR is scheduled to operate on a full-time basis. This schedule is in accordance with the specific objectives of the Nimbus Project (now named the Orbiting Satellite Project/Application (OSP/A)).

1.3.4 Communications and Data Handling Subsystem

The communications and data handling subsystem (CDHS), which includes the S-band communications system and tape recorder subsystem, handles all spacecraft information flow. The S-band communication system comprises the S-band command and telemetry system, the data processing system (DAPS), and the command clock. The S-band command and telemetry system consists of two S-band transponders, a command

Table 1
Instrument Power Requirements for the Percentage of Operational Time Allotted Each Sensor

Instrument	Power Requirements (watts)	Operational Mode (%)
CZCS	11.4	30
ERB	36.3	80
LIMS	24.5	80
SAM II	0.8	8
SAMS	23.0	80
SBUV/TOMS	20.0	80
SMMR	61.6	50
THIR	8.5	100
Subsystem total	= 186.1	
Basic spacecraft	= 123.6	
Observatory total	= 309.7	

and data interface unit (CDIU), four Earth-view antennas, a sky-view antenna, and two S-band transmitters (2211 MHz). Commands are transmitted to the observatory by pulse-code modulation (PCM) and phase-shift keying (PSK)/frequency modulation (FM)/phase modulation (PM) of the assigned 2093.5 MHz S-band uplink carrier. Stored command capability provides for command execution at predetermined times. Figure 2, a diagram of the spacecraft data handling system, shows the routing of the sensor data to the versatile information processor (VIP), the digital information processor (DIP), and the CZCS information processor (ZIP).

1.3.4.1 <u>Telemetry and Ranging</u>--Command, telemetry, and ranging signals are handled by a unified S-band (USB) transponder. Stored data are played back to the ground station using the S-band links (Figure 2). The telemetry system includes two transponders that are interlocked to prevent simultaneous transmission and two wideband transmitters that are interlocked to prevent dual transmission. Single or dual downlink transmissions may be commanded at the transponder downlink frequency of 2273.5 MHz or the wideband transmitter downlink frequency of 2211.0 MHz. Additionally, any combination of signals may be used to modulate one transponder and one wideband transmitter. One combination is an 800-kbps biphase PCM playback from any of the three onboard tape recorders. When using this combination, the playback data may be either recorded digital information processor data or CZCS-sensor data. Another combination is an 800-kbps biphase PCM of real-time CZCS-sensor data.

The transponder modulation is baseband PCM/PM multiplexed with the VIP telemetry subcarrier. The wideband transmitter modulation is PCM/FM. The transponder can be phase modulated by ranging tones, by 800-kbps biphase PCM data, or by 25-kbps biphase PCM real-time DIP

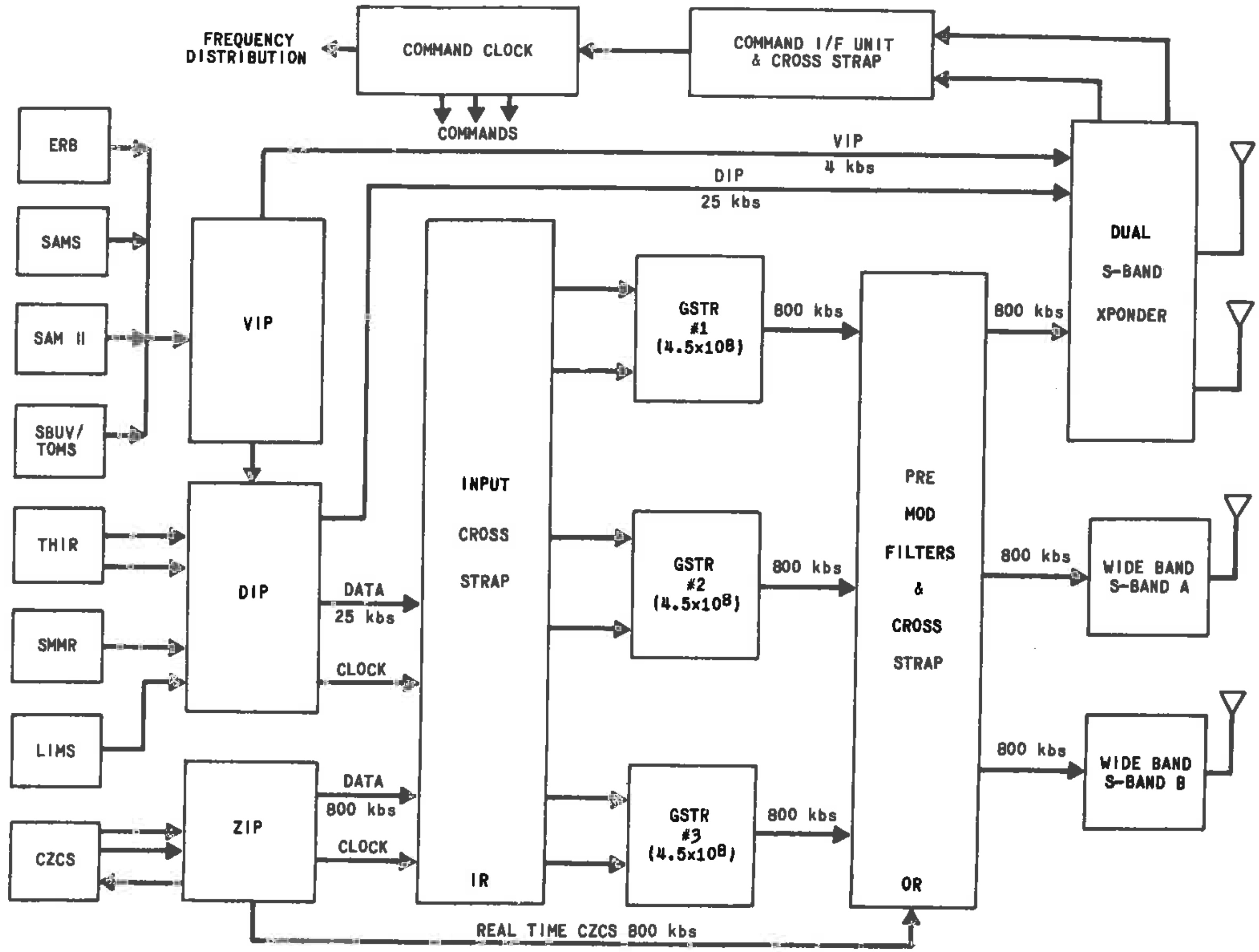


Figure 2. Nimbus 7 Spacecraft Data Handling System

data on a mutually exclusive basis, selected by command. Simultaneous commanding, range tracking, and VIP telemetry transmission are possible with the selected baseband modulation signal.

1.3.4.2 Data Processing System (On Board)--The DAPS on board the Nimbus 7 spacecraft processes analog data, digital data, housekeeping data, and sensor data. The low-rate housekeeping and sensor data (up to 400 bps) are processed, formatted, multiplexed with medium rate sensor data (2 to 12 kbps), and stored for a full orbit on a multispeed (Goddard Space Flight Center (GSFC) standard) tape recorder at 25 kbps. The high-data rate ocean color sensor data (800 kbps) are processed and stored for a portion of the orbit.

Input and output (I/O) cross-strapping provides alternate signal routing should a tape recorder or transmitter fail. (See Figure 2.)

The VIP subsystem monitors the observatory housekeeping data and low-data rate sensor data using three types of input gates: 576 analog, 320 digital B, and 16 digital A. The VIP digitizes the analog data, formats it into a 6400-word major frame (each word contains 10 bits), and then outputs it at 4000 bps. These outputted data can be transmitted to the ground in real time or stored on an observatory tape recorder for later playback to the ground. The format consists of an 80-by-80 matrix (major frame) that repeats every 16 seconds. Each row of the matrix contains 80, 10-bit words and is called a minor frame. The VIP output pulses are coherent with the beginning of each major frame and are available to sensors for synchronization to the VIP sampling sequence.

The DIP and ZIP are part of the DAPS, which is the primary communication system for observatory data. The flight data-handling equipment (FDHE) consists of the spacecraft tape recorders, and the input and output routers (I/OR) for cross-patching major elements. The DIP, a four-channel time-division multiplexer, accepts synchronous, serial digital data from predetermined sources and combines them into a synchronous, serial output bit stream at a 25-kbps rate. The common denominator used for Nimbus 7 is 2 kbps, therefore, all inputs to the DIP must be an exact multiple of 2 kbps. The resulting 25-kbps output is decommutated on the ground, where each digital input is extracted from the composite and is available in its original format.

The ZIP is a special-purpose processor that handles CZCS sensor data. Specifically, the ZIP multiplexes the six channels of CZCS digital radiometric data, removes nonsensible data, gates in calibration and synchronization data, and compresses the resulting output to a rate compatible with the spacecraft tape recorders and S-band transmission systems.

1.3.4.3 Tape Recorder Subsystem--The Nimbus 7 Observatory carries three identical tape recorders, one classified as a redundant unit that can record either DIP or ZIP data, but not both simultaneously.

In a normal recording operation, one recorder records 25-kbps data from the DIP for periods of 100 to 257 minutes and then reproduces it in reverse direction at a rate of 800 kbps. Usually, one recorder will record DIP data and another will record ZIP data. Each recorder is capable of recording 305 minutes of DIP data at 25 kbps or 9.56 minutes of ZIP data at 800 kbps.

DIP and ZIP data are played back at a rate of 800 kbps with a lapse rate of 9.56 minutes for a full tape. Less time is required if less than a full tape has been recorded. A fast-rewind mode (3 minutes) allows 500 feet of active tape to be moved from beginning of tape (BOT) to end of tape (EOT) at a high-speed rate. This is accomplished without record, playback, or erasure of previously recorded data. In normal operation, one recorder is played back to a receiving station while the other is recording; thus avoiding loss of data. A summary of operating modes is presented in Table 2.

Table 2
Tape Recorder Modes Summary

Mode	Data Rate (kbps)	Tape Speed (in/sec)	Maximum Continuous Operating Time (minute)
Record DIP	25.0	0.327	305.0
Record ZIP	800.0	10.45	9.56
Playback (DIP or ZIP)	800.0	10.45	9.56
Rewind		35.0	3.0

1.3.5 Thermal Control Subsystem

The thermal control subsystem is designed to provide a controlled environment of 25°C ($\pm$10°C) within the observatory to promote long life for subsystem and instrument components. Thermal control is accomplished by both semipassive (i.e., shutter and heaters) and passive (i.e., radiators, insulation, and coatings) elements. Shutters are located on most of the peripheral compartments on the sensory ring and are actuated by fluid-filled bellow assemblies. The assemblies are fastened to a sensor plate which is in contact with the dissipating components that position the shutter blades to the correct heat-rejection level. Heaters are bonded at various locations in the sensory ring to prevent temperatures from falling below minimum levels during extended periods of low equipment duty cycles. The heaters are energized selectively by ground command when the temperature level at these locations falls below a predetermined value. The upper and lower surfaces of the sensory ring are insulated to prevent gain or loss of heat through those areas. External structure and radiating surfaces are coated to provide the required values of emission and absorption. Passive radiators, coated with a low-absorptivity high-emissivity finish, assist the shutters in rejecting heat from the sensory ring.

1.4 DATA HANDLING AND PROCESSING COMPLEX

The OSP/A at GSFC is responsible for processing the observations from all eight instruments on board the Nimbus 7 spacecraft. Data processing for several sensors continues at GSFC where they are processed into archived tape and film products. Data from some sensors are sent to intermediate processing facilities outside of GSFC and these centers return the data to GSFC for final processing and archival.

This procedure is a departure from the traditional method of making the data processed from each experiment the responsibility of each principal investigator. For the OSP/A to meet this new responsibility, a data handling and processing complex was established at GSFC and designated the Nimbus Observation Processing System (NOPS). The purpose of NOPS (Figure 3) is to organize and oversee the processing of payload data (except SAMS) into scientific investigations. See Figure 4 for a graphic view of the relationship between the NOPS and the NEAT.

Since data handling and processing are a major task not easily handled in a single facility at GSFC, a plan was devised to distribute the processing among several facilities while converting the computational results into the data products in one facility (GSFC). This plan affords the opportunity to have a broader range of display equipment available for all instrument data products than if the computational and display efforts were both distributed. The specific responsibilities of the NOPS are:

- To calibrate, quality check, and geographically locate the raw-sensor observations

- To convert the observations into meaningful parameters through the application of scientific algorithms

- To establish a broad data base by correlating observations from related sensors

- To display the derived parameters in the most useful forms (products) for scientific investigations and correlations

- To distribute the generated products to Nimbus Experiment Teams (NETs) and selected investigators on a limited basis

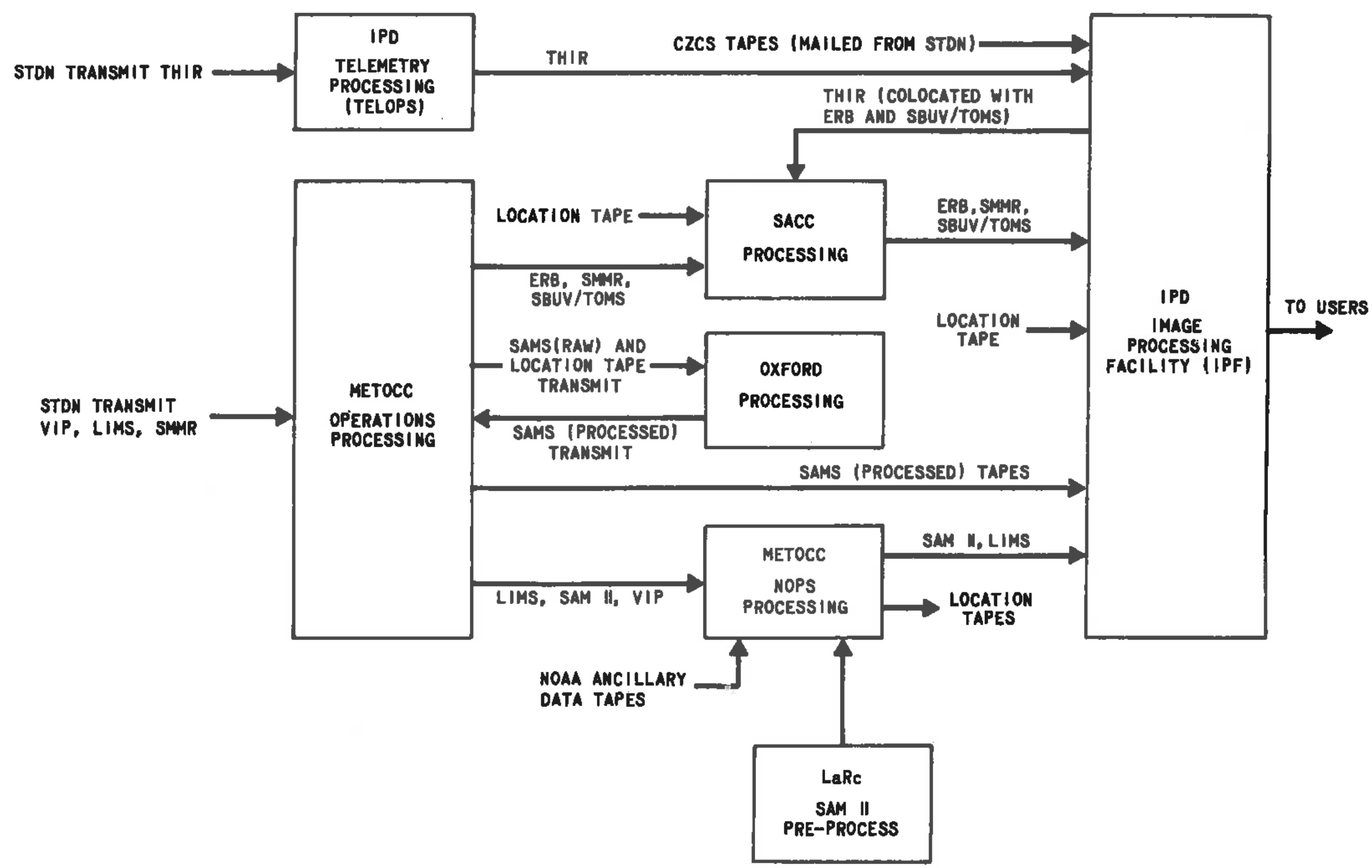


Figure 3. NOPS Data Flow and Facility Plan

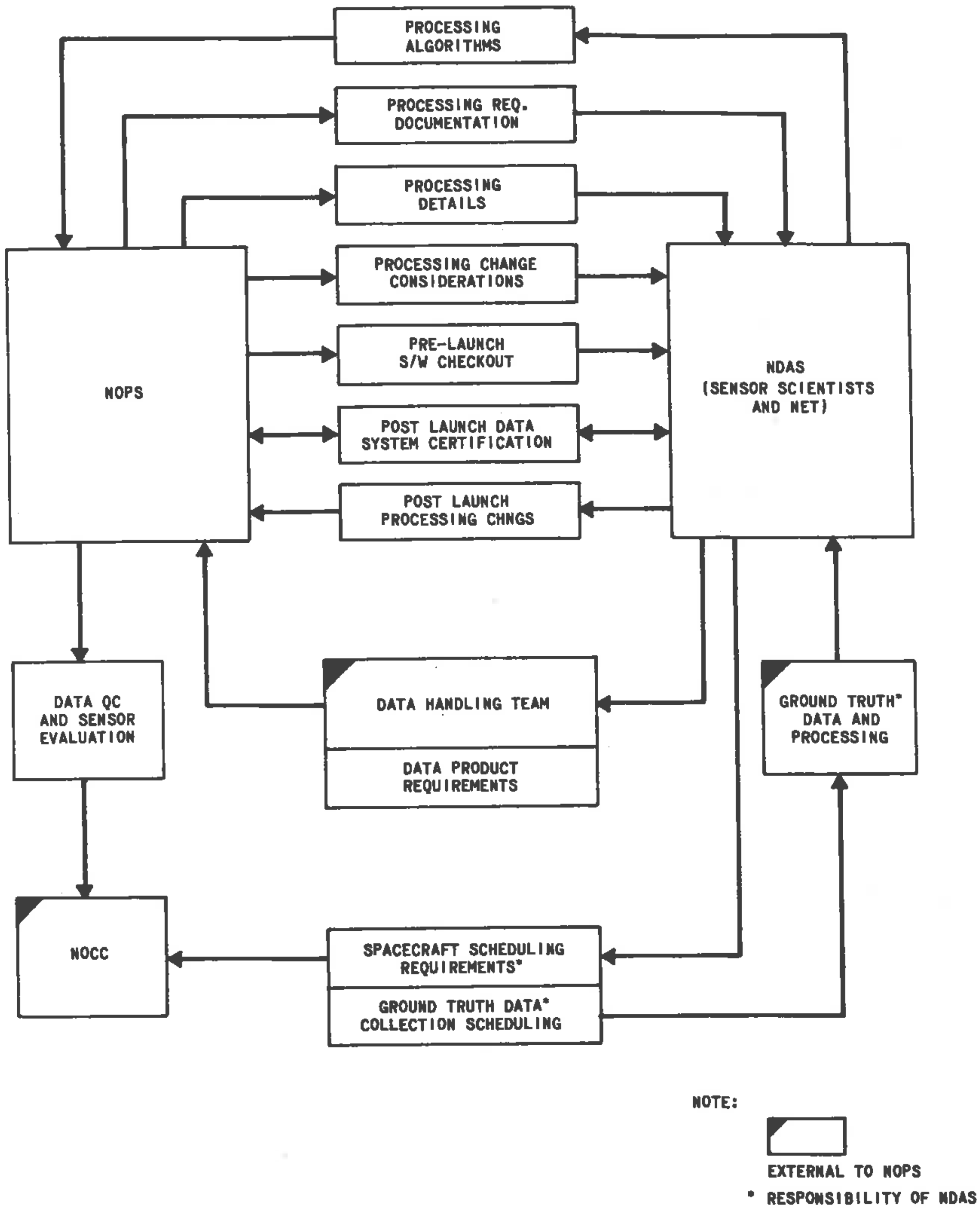


Figure 4. Relationship Between the Nimbus Observation Processing System and the Nimbus Experiment Algorithm Team

- To distribute archival quality tapes and film products to archive centers for their dissemination to all interested users

The Information Processing Division (IPD) at GSFC is the central data products generation and distribution facility. IPD generates and distributes contoured maps, cross-sections, atmospheric profiles, plots, listings, montages, and images on 16-mm film, 35-mm color slides, color film, 241-mm black-and-white film, and a wide variety of magnetic tapes.

The ERB, SMMR, and SBUV/TOMS data are initially processed in the Science and Applications Computer Center (SACC) at GSFC. Processing ERB data at the SACC is a two-part operation--the second step delayed until information derived from the first step is obtained from the National Oceanic and Atmospheric Administration (NOAA). The THIR and CZCS data, which are initially processed by IPD at GSFC, incorporate the straight-forward calibration science processing requirements within the image generation requirements. Level 2 CZCS data are processed by NEAT (CIPT).

The cloud content in the instantaneous field of view (IFOV) of ERB and SBUV/TOMS are computed from the THIR data and used in the respective processing for these instruments. SAMS data are sent by data-phone lines from GSFC to Oxford, England where they are processed. The LIMS experiment data are processed at the National Center for Atmospheric Research (NCAR) facilities, and the SAM II, experiment data are processed at Langley Research Center (LaRC), Virginia.

A common image location program, based on the Nimbus 6 ERB program for deriving spacecraft attitude, is included in the Meteorological Operations Control Center (MetOCC) processing with the results used in the processing of all the instruments. The image location tapes (ILTs) are sent with the user-formatted output (UFO) tapes or the sensor data tapes (SDT) to the appropriate facility. See Section 2 for details on the processing plans for the individual instruments. These processing plans are based on the currently available algorithms provided by the sensor scientists.

All initial photographic and reproduction services are provided by IPD which distributes the data products to the NET members and archival centers. The film and tape archival plan is presented in paragraph 1.5.

For a composite view of the Nimbus 7 data flow refer to Figures 5a and 5b.

1.4.1 Nimbus Experiment Algorithm Team

The function of the NEAT is to set the requirements for Nimbus 7 products and the processing algorithms. NEAT evaluates submitted proposals for investigations, disseminates data, administers and

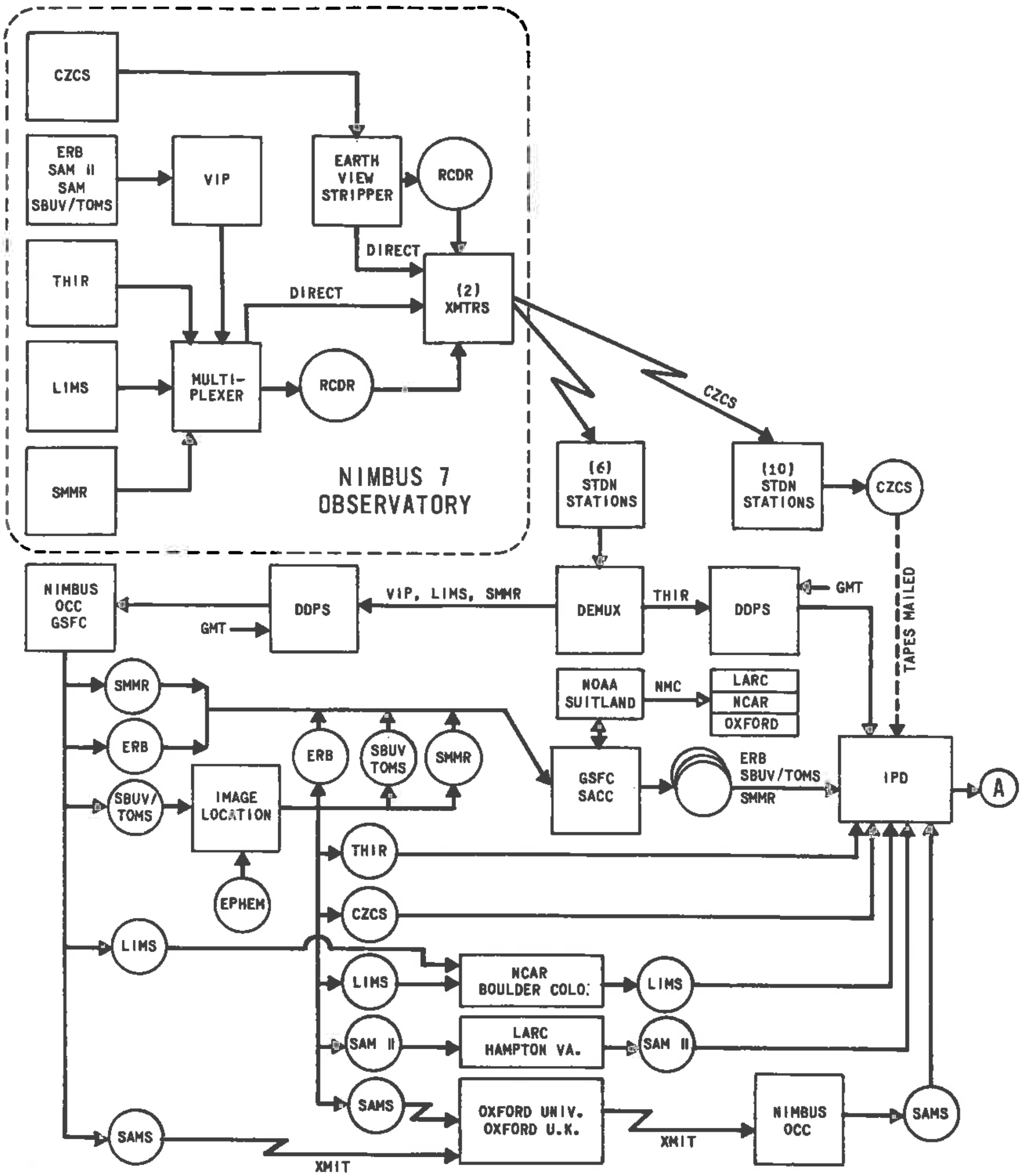
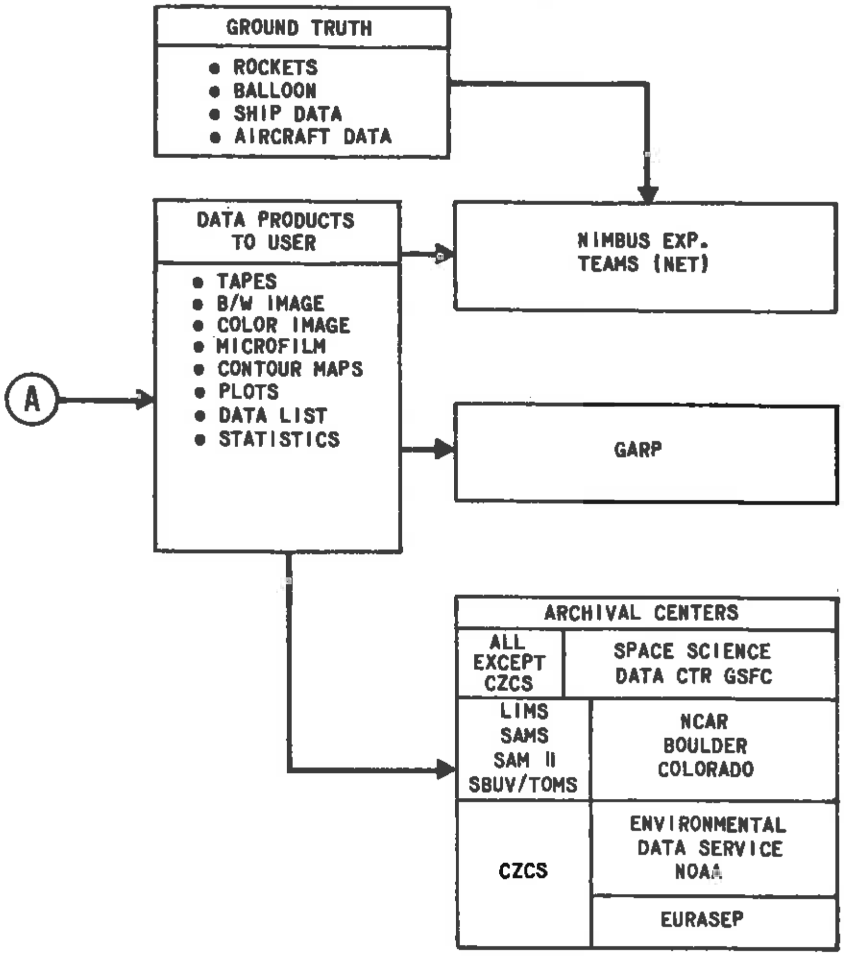


Figure 5a. Nimbus 7 Data Flow



CZCS - COASTAL ZONE COLOR SCANNER
ERB - EARTH RADIATION BUDGET
SAM-II - STRATOSPHERIC AEROSOL MEASUREMENT
SAMS - STRATOSPHERIC & MESOSPHERIC SOUNDER
SBUV/TOMS - SOLAR BACKSCATTER ULTRAVIOLET & TOTAL OZONE MAPPING SPECTROMETER
THIR - TEMPERATURE HUMIDITY INFRARED RADIOMETER
LIMS - LIMB IR MONITORING OF THE STATOSPHERE
SMMR - SCANNING MULTICHANNEL MICROWAVE RADIOMETER
IPD - INFORMATION PROCESSING DIVISION (GSFC)
SACC - SCIENCE AND APPLICATIONS COMPUTING CENTER (GSFC)
VIP - VERSATILE INFOR. PROCESSOR
DDPS - DIGITAL DATA PROCESSING SYSTEM
GARP - GLOBAL ATMOSPHERIC RESEARCH PROGRAM
NMC - NATIONAL MET. CENTER
RCDR - RECORDER
OCC - OBSERVATORY OPERATION CONTROL CENTER
NCAR - NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

Figure 5b. Nimbus 7 Data Flow

monitors contracts related to scientific investigations, and coordinates results with investigators and users. See Figure 4.

1.4.2 Nimbus Experiment Teams

There are seven NETs, one for each of the NASA-provided sensors and one United Kingdom team for the SAMS experiment. The NETs have met at frequent intervals from the initial inception of each committee and have continued to meet periodically since launch. Each team consists of 5 to 10 members and is supported by applications scientists, data processing support personnel, and the NEAT Manager or his appointed representative.

The NET members assist and provide advice on all aspects of their respective sensor program and perform studies or tasks in their areas of expertise during prelaunch and postlaunch activities. They determine the principal research and development requirements of each experiment and perform the required tasks commensurate with priorities and available resources.

A complete list of the NET members is given in Appendix A. A summary of the tasks and study areas for each NET are:

- To develop, use, and test processing and science algorithms
- To define the general content of the film and tape product
- To verify sensor calibration and performance
- To participate in the planning for data acquisition and time schedule sharing of sensor operations
- To certify the quality of data output products by comparison measurements (ground-truth measurements)
- To perform initial postlaunch experiment investigations and to issue appropriate reports and publications

1.5 DATA ARCHIVING

The Nimbus 7 archival data products distribution is accomplished after the individual NETS have validated the data.

Table 3 lists the film-data products available to the users. Table 4 provides the same information for tape-data products. All products, except for CZCS, are archived by the National Space Science Data Center (NSSDC). CZCS data are archived by the Environmental Information Service (EDIS). The address of these agencies are:

- Environmental Data Information Service
World Weather Building
Room 606
Camp Springs, Maryland 20733

Table 3
Film Data Products Available Through EDIS and NSSDC.

Archival Data Center	Sensor	Reproducible Copy	User Copy
EDIS	CZCS	Second generation 241-mm (9.5") black-and-white negative transparency.	a. 241-mm black-and-white positive or negative transparency b. 241-mm black-and-white positive print
NSSDC	ERB, SAM II, LIMS, SBUV/TOMS, SAMS	Second generation 16-mm negative (black background transparency.	a. 16-mm positive transparency b. 241-mm hard copy (in limited quantity)
	SMMR (all data)	Second generation 35-mm color positive transparency and 105-mm color-negative transparency	a. 35-mm color slide b. color prints - maximum size 203 mm by 254 mm (8" by 10")
	THIR (All montage)	Second generation 241-mm black-and-white negative transparency	a. 241-mm black-and-white positive or negative transparency

Table 4
Tape Types Available Through EDIS and NSSDC

Archival Data Center	Sensor	Tape Name	Tape Quantity Per Year	PDFC	Tape Specification
EDIS	CZCS	CRT	6000	ZE	
		CRCST	600	ZB	T749021
		CAT	12	ZC	T749031
NSSDC	ERB	MATRIX-C	12	AH	
		MATRIX	12	AA	T134031
		MAT	263	AC	T134081
		SEFDT	12	AD	T134021
		ZMT	2	AE	T134091
	LIMS*	MATRIX-M	42	EA	T564041
		MATRIX-C	42	EB	T564081
		PROFILE-R	7	EC	T564111
		PROFILE-I	9	ED	T564071
		RAT	207	EE	T564011
		IPAT	35	EF	T564021
		MAT	35	EG	T564051
		CAT	9	EH	T564091
		SMAT	9	EI	T564101
		SCAT	9	EM	T564121
	SAMS	MATRIX	24	HA	T884011
		RAT	180	HC	T884041
	SAM II	MATRIX	4	DA	T454021
		PROFILE	12	DB	T454011
		RDAT	12	DC	T454041
		BANAT	12	DD	T454051
	SBUV/ TOMS	MATRIX	12	FA	T634071
		RUT-S	52	FD	T634111
		OZONE-S	52	FE	T634041
		OZONE-T	120	FF	T634091
		ZMT	2	FH	T634061
		RUT-T	120	FJ	T634121
	SMMR	MAP-30	12	BD	T234051
		MAP-LO	12	BE	T234101
		MAP-SS	12	BF	T234111
		PARM-30	60	BG	T234041
		PARM-LO	30	BH	T234121
		PARM-SS	30	BI	T234131
		TAT	183	BJ	T234021
		CELL-ALL	61	BK	T234071
	THIR	CLDT	730	ID	T344011
		CLE	365/52**	IE	T343031
		CLT	365/52**	IF	T343041

*LIMS 7-month life
**See paragraph 3.2

- National Space Science Data Center
  Goddard Space Flight Center
  Code 601
  Greenbelt, Maryland 20771

In addition to the film and tape data products, EDIS will publish a CZCS catalog of available CZCS data. NSSDC will publish a meteorological catalog listing data from all satellites including tape and film output products from Nimbus 7. To obtain copies write to either NSSDC or EDIS.

All queries from foreign researchers for archived Nimbus 7 data must be specifically addressed to:

- Director, World Data Center A for Rockets and Satellites
  NASA/Goddard Space Flight Center
  Code 601
  Greenbelt, Maryland 20771, USA

When ordering data from either the NSSDC or the World Data Center, a user should specify why the data are needed, the subject of his work, the name of the organization with which he is connected, and any government contracts he may have for performing his study. Of course, each request should specify the experiment data desired, the day and area of interest, plus any other information that would facilitate the handling of the data request. Requests for specific tape types, as listed in Table 4, should specify the tape specification (last column in Table 4). This number references a tape specification document describing the record and file content and word format of each tape type. A user receives a tape specification document for each requested tape type.

A user requesting data on magnetic tapes should provide additional information concerning his plans for using the data, (e.g., what computers and operating systems will be used). In this context, the NSSDC is compiling a library of routines that can unpack or transform the contents of many of the data sets into appropriate formats for the user's computer. NSSDC will provide upon request information concerning its services.

SECTION 2

TEMPERATURE HUMIDITY INFRARED RADIOMETER SUBSYSTEM*

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2.1 INTRODUCTION

The Nimbus 7 THIR is designed and operated identical to the THIR flown on Nimbus 4, 5, and 6, except that is is digitzied on board the spacecraft. The two-channel scanning radiometer measures Earth radiation from two spectral bands during the day and night. A 10.5 to 12.5-μm (11.5-μm) window channel provides an image of the cloud cover and temperatures of the cloud, land, and ocean surfaces. A 6.5 to 7.0-μm (6.7-μm) channel provides information on the moisture and cirrus-cloud content of the upper troposphere and stratosphere and the location of jet streams and frontal systems. The ground resolution at the subpoint is 6.7 kilometers for the 11.5-μm channel and 20 kilometers for the 6.7-μm channel.

2.2 INSTRUMENT DESCRIPTION

2.2.1 THIR Operation

The THIR consists of an optical scanner (Figure 6) and an electronic module (not shown). The optical scanner, which provides the necessary scan motion to produce cross-course scanning, also contains the radiometer optics, detectors, preamplifiers, detector bias supply, scan drive, and scan synchronization pulse generator (pip) amplifiers. In addition, the electronics module provides amplification and data processing of detected radiometric signals for achieving the correct levels and format compatible with the spacecraft's DAPS. The electronics module also contains switching to respond to the spacecraft's commands to the THIR and the appropriate housekeeping telemetry circuits. The THIR specifications are given in Table 5.

The scanner design uses an elliptically shaped plane scan mirror and primary optics that are common to both channels (Figure 7). The scan mirror, set at an angle of 45 degrees to the scan axis, rotates at 48 rpm and scans in a plane perpendicular to the direction of the satellite motion. When the scan-mirror rotation is combined with the velocity vector of the satellite, a right-hand spiral results. Therefore, when traveling northward, the field of view (FOV) scans the Earth from east to west during the day, and when traveling southward, it scans the Earth from west to east during the night.

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*Extracted from the Nimbus 7 User's Guide, NASA/Goddard Space Flight Center, Greenbelt, Maryland, August 1978 (out of print).

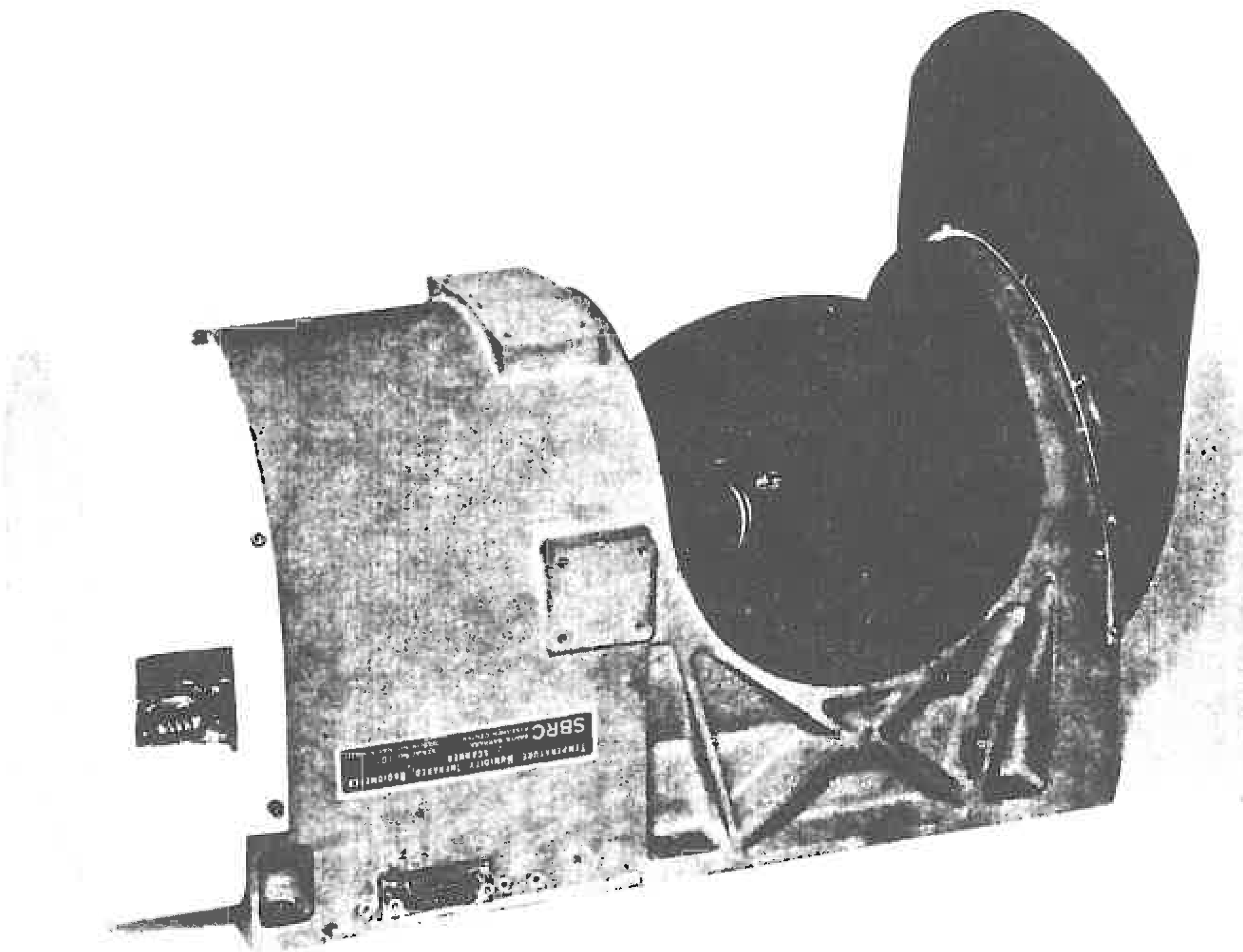


Figure 6. The Temperature Humidity Infrared Radiometer

Table 5
THIR Subsystem Specifications

Design Parameter	Channel 1	Channel 2
Wavelength band of operation (half-power points (microns))	6.5 to 7.0	10.5 to 12.5
Field of view (mrad)	20	7
Ground resolution (subsatellite point at 955 Km) (Km)	20	6.7
Collecting aperture (cm^2)	110	110
Detector (immersed bolometer)		
Size (mm)	0.67 x 0.67	0.22 x 0.22
Time constant (msec)	2.7	1.8
Scan rate (rps)	0.8	0.8
Dwell time (msec)	4.2	1.4
Information bandwidth (Hz)	115	345
Dynamic range (target temperature (°K)	0 to 270	0 to 330
Performance Characteristics	**Channel 1**	**Channel 2**
Noise equivalent irradiance ($watts/cm^2$)	4.35×10^{-10}	3.0×10^{-10}
Noise equivalent temperature differential at indicated scene temperature	5.0°K @ 185°K 0.26°K @ 300°K	1.5°K @ 185°K 0.28°K @ 300°K
Signal-to-noise ratio at indicated scene temperature	3.8:1 @ 185°K 110:1 @ 270°K	19:1 @ 185°K 375:1 @ 330°K
Weight (lbs)	14.0	6.0
Size (in)	7.5 x 7.1 x 15.7 (excluding sun-shield)	7.0 x 6.8 x 6.0
Power Requirements	**Scanner**	**Electronics**
-24.5 vdc (watts)	1.8	5.8
100-Hz two-phase square wave 5.25 V (watts/phase)	0.1	
Operating Temperature Range	0° to 45°C	

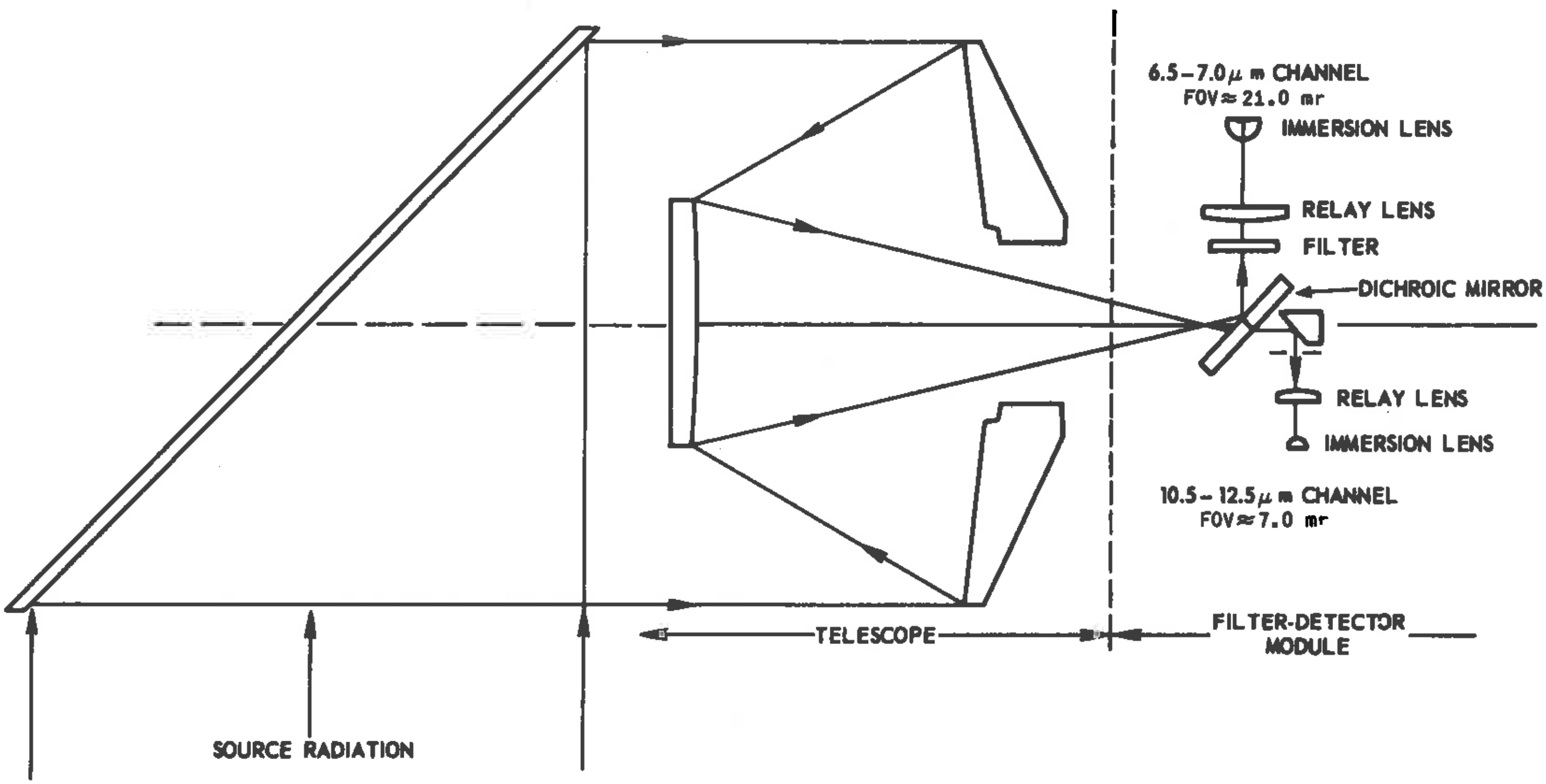


Figure 7. THIR Optical Schematic

The radiation collected by the primary optics is separated into two bands by a dichroic filter that spectrally divides the energy into two channels. The 6.7-μm data are reflected off the dichroic mirror, through field stop and relay lens, onto the immersed detector-bolometer flake. The 11.5-μm data pass through the dichroic (i.e., transmission portion of the dichroic), an Itran-2 relay lens (which also serves as a long-wavelength blocking filter), a folding mirror, and are focused onto a germanium-immersed detector-bolometer flake. The field stops at the image plane of each channel to define the FOV; 20 mr (1.15 degrees) for the 6.7-μm channel and 7 mr (0.40 degrees) for the 11.5-μm channel. The signals from the detectors are capacitor-coupled to the preamplifiers, and amplified and forwarded to the electronics module.

In the electronics module, the signals are further amplified and corrected for detector time constant to provide overall frequency response as required by the subsystem optical resolution. Though the first stages of amplification are capacitor-coupled, the low-frequency cutoff (0.5 Hz) of the data band bandwidth is so low that a dc restore circuit is necessary to provide a zero-signal reference. This frequency cutoff occurs during the portion of the scan when the optics are receiving zero radiation (space). In addition, the dc-restore circuitry provides additional gain to raise the signal to the desired output level and filtering to establish proper frequency characteristics. The signals are then processed out of the electronics module through the buffer amplifiers and into the DIP analog-to-digital (A/D) converter.

The tabulated values of the relative spectral response for each channel are shown in Table 6. Figure 8 shows these data in graph form.

2.2.2 Scan Sequence

The radiometer scan mirror continuously rotates the FOV of the detector through 360 degrees in a plane normal to the spacecraft velocity vector. In sequence, the detector views the in-flight blackbody calibration target (which is part of the radiometer housing), outer space, Earth, outer space, and returns again to view the radiometer housing. Figure 9 shows the radiometer timing sequence in relation to the angular position of the scan mirror for each scan cycle. The radiometer Z-axis is oriented 5 degrees from the spacecraft zenith to ensure that the radiometer dc restoration (i.e., before Earth scan) and space check of calibration (i.e., after Earth scan) events will occur when the radiometer is viewing space. This way the correct radiometric data output voltage reference level and the space check of calibration of the radiometer will be achieved without ambiguity.

At a scan-mirror angle of 5 degrees (referenced to the spacecraft zenith) the radiometer FOV is just beginning to leave the scanner housing. At 48 degrees from spacecraft zenith scan-mirror position pip 1 is generated and the radiometer sync word and calibration

Table 6
Relative Spectral Response for the 6.7 and 11.5-μm Channels

6.7-μm Channel				11.5-μm Channel	
Wavelength (μm)	Relative Response	Wavelength (μm)	Relative Response	Wavelength (μm)	Relative Response
6.20	0.0000	9.9	0.0248	12.4	0.6546
6.25	0.0071	10.0	0.0295	12.5	0.5303
6.30	0.0141	10.1	0.0769	12.6	0.4257
6.35	0.1013	10.2	0.1996	12.7	0.2591
6.40	0.1884	10.3	0.4333	12.8	0.1071
6.45	0.5103	10.4	0.5871	12.9	0.0407
6.50	0.8322	10.5	0.7550	13.0	0.0147
6.55	0.9135	10.6	0.8355	13.1	0.0000
6.60	0.9948	10.7	0.8927		
6.65	0.9373	10.8	0.8580		
6.70	0.8799	10.9	0.8844		
6.75	0.9393	11.0	0.9224		
6.80	0.9987	11.1	0.9890		
6.85	0.9993	11.2	1.0000		
6.90	1.0000	11.3	0.9928		
6.95	0.9597	11.4	0.9575		
7.00	0.9195	11.5	0.9166		
7.05	0.7165	11.6	0.8888		
7.10	0.5135	11.7	0.9379		
7.15	0.2848	11.8	0.9426		
7.20	0.0562	11.9	0.8985		
7.25	0.0312	12.0	0.8657		
7.30	0.0061	12.1	0.8748		
7.35	0.0031	12.2	0.8288		
7.40	0.0000	12.3	0.7758		

sequence is started. At 100 degrees (during the calibration sequence) the radiometer FOV starts to see space fully. At 103.5 degrees the calibration sequence ends and the radiometer dc restore sequence starts. At 110.7 degrees the dc restore sequence ends. The sequence of timing events, beginning with the sync word and ending with the radiometer dc restoration, is initiated by scan-mirror position pip 1 and is timed by electronic logic circuits.

At 120.9 degrees (for a nominal 955-kilometers altitude) the Earth-scan period begins. At 239.1 degrees the Earth-scan period ends and the space check of calibration period begins. At 250 degrees, the radiometer FOV just begins to see the scanner housing and the space check-of-calibration period ends.

At 302 degrees scan-mirror position pip 2 is generated and the gain in the 6.7-μm channel is reduced by a factor of 3. This reduction

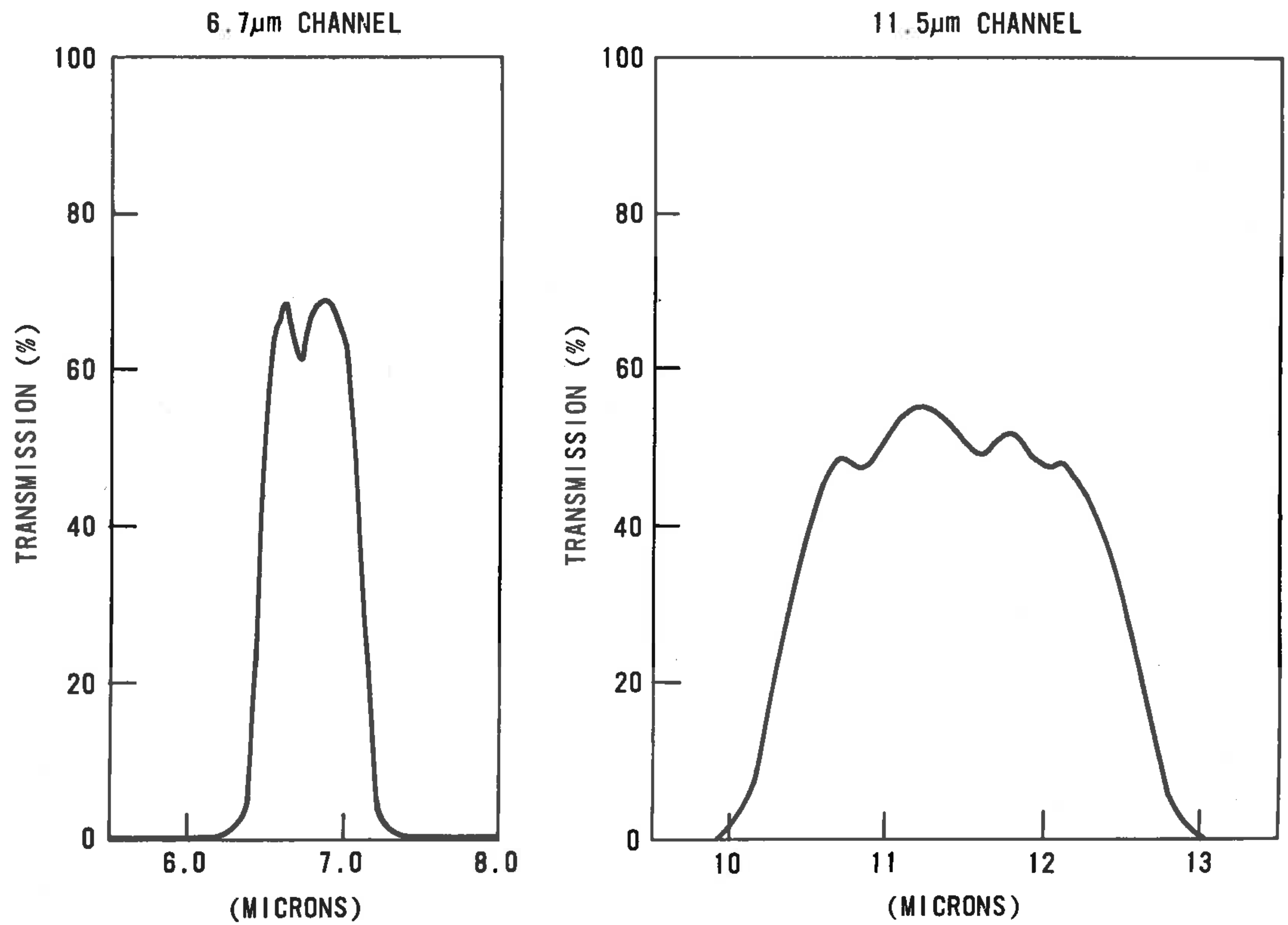
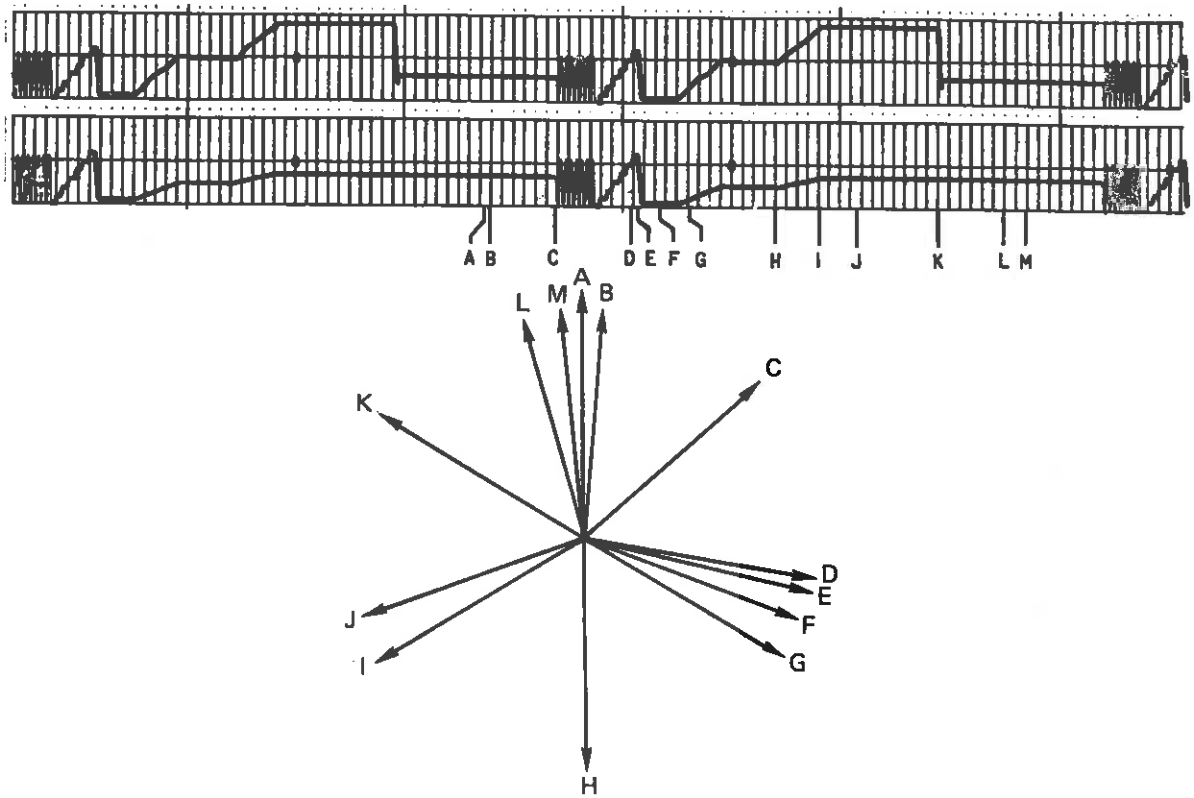


Figure 8. Relative Spectral Response (Transmission) of the 6.7 and 11.5-μm Channels



LEGEND

Reference Letter	Angle (degrees)	Time (ms)	Digital Sample (relative)	Event
A	0	0	0	Spacecraft zenith
B	5	17.4	15	Radiometer IFOV just starting to leave housing
C	48	166.7	142	Scan mirror position pip No. 1 occurs and radiometer sync word calibration signal sequence is started. 6.7-μm channel gain returns to normal
D	100	347.5	295	Radiometer IFOV just starting to see all of space
E	103.5	359.4	305	Calibrate signal sequence ends and restore period starts
F	110.7	384.4	327	Restore period ends
G	120.9	419.8	357	Earth scan period begins (955-km orbit)
H	180	625.0	531	Spacecraft nadir
I	239.1	830.2	706	Earth scan period ends (955-km orbit)
J	250	868.9	738	Radiometer IFOV just starting to see housing
K	302	1048.5	891	Scan mirror position pip No. 2 occurs and 6.7-μm gain is attenuated by a factor of 3
L	345	1197.9	1018	Radiometer IFOV completely filled by housing
M	355	1232.6	1048	Radiometer Z-axis

Figure 9. THIR Scan Angle Information

permits the channel to have a 0° to 270°K dynamic range and to be calibrated with a scanner housing reference surface temperature as high as 323°K. At 345 degrees the radiometer FOV is completely filled by the scanner housing and the second (scan housing) check-of-calibration period begins. At 355 degrees the scan mirror is parallel with the radiometer Z-axis and the gain of the 6.78-μm channel is returned to normal.

2.2.3 Scan Geometry

For the 11.5-μm channel the scan rate of 48 rpm, combined with the satellite motion, produces nearly contiguous scan-line coverage along the subpoint track. As the scan angle from nadir increases there is increasing overlap between consecutive scan lines, reaching 350-percent overlap at the horizon. There is an even greater increase in ground coverage along the scan line (i.e., perpendicular to the line of motion of the satellite) as the angle from nadir increases.

Figure 10 shows the relationship between the scan sample and ground resolution for the 11.5-μm channel. At nadir the IFOV of 7 mr (0.40 degrees) for the 11.5-μm channel provides a ground resolution of 6.7 kilometers (3.7 nm). At a 50-degree nadir angle the ground resolution element is approximately 24-kilometers long (east to west) by 15 kilometers (north to south).

For the 6.7-μm channel the IFOV of 20 mr (1.15 degrees) at nadir provides a ground resolution of 20 kilometers (10.8 nm). At a 50-degree nadir angle the ground resolution element is approximately 75-kilometers long by 36-kilometers wide.

2.2.4 THIR Data Flow

A simplified block diagram of the THIR/spacecraft data system is shown in Figure 11. The analog-video signals from both THIR channels are input to an A/D converter that is part of the DIP. The housekeeping data are input to the VIP, which multiplexes them with data from other sensors and inputs them into the DIP. The DIP passes the composite data stream to one of three GSFC standard tape recorders (GSTR) or to the 25-kbps channel of the dual S-band transponder (for real-time transmission only). When commanded to play back, the GSTR passes the data at a 32-to-1 increased rate (800 kbps) to one of two S-Band transmitters on the high-rate channel of the dual S-Band transponder which broadcasts it to Earth.

Figure 12 shows the ground-data flow in simplified form. The ground station receives, demultiplexes, and routes the S-band data stream into the digital data processing system (DDPS) where the THIR data are sent to the data capture processing computer (DCPC) of the IPD. A digital tape of THIR data is output and delivered to the THIR processing computer where the video signal (both channels) is blocked into single-scan lines; the Earth-view samples are stripped out and

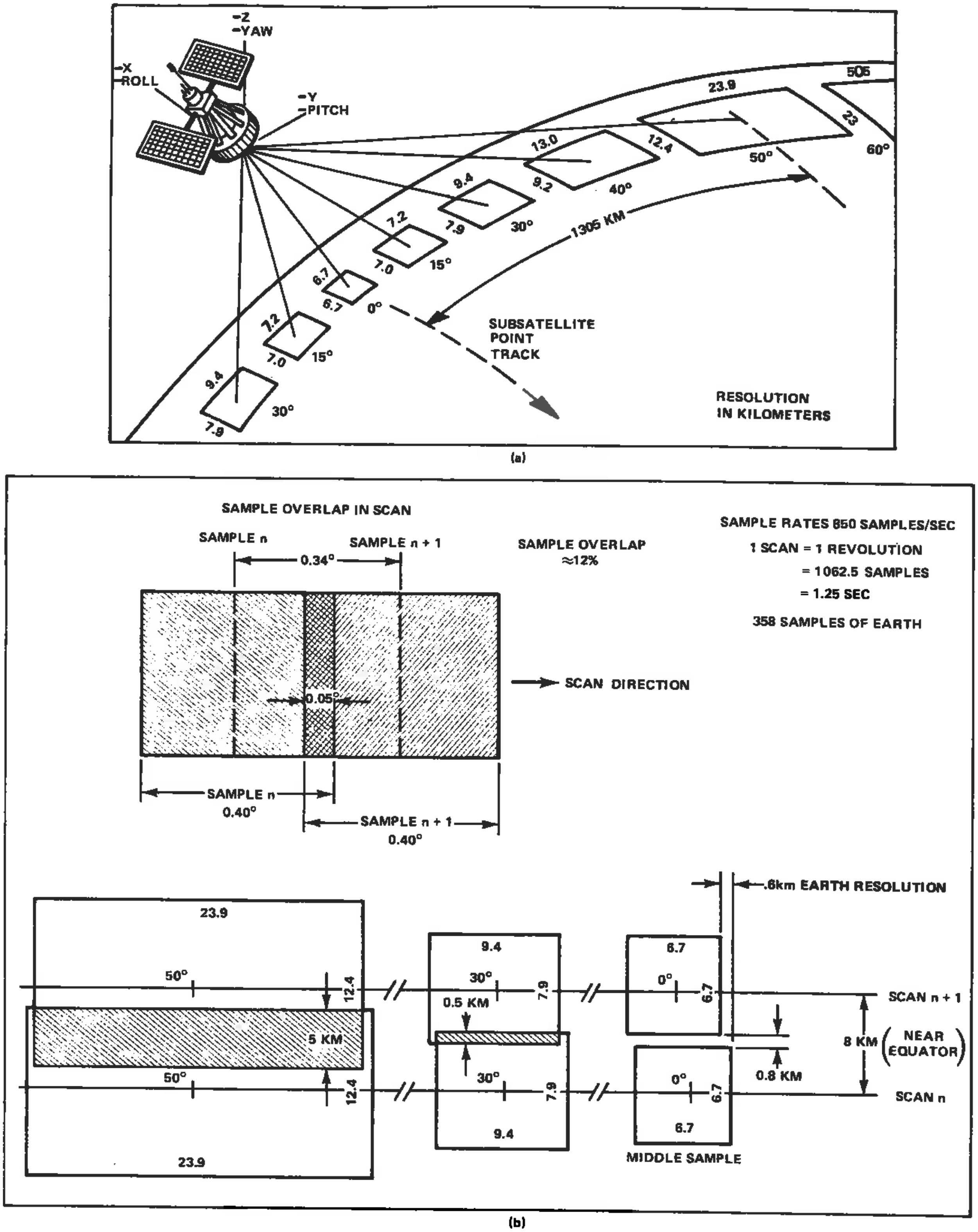


Figure 10. Relationship Between Ground Resolution and a Scan Sample with a 0.4-by-0.4 degree FOV for the THIR 11.5-μm Channel at 955 Kilometers

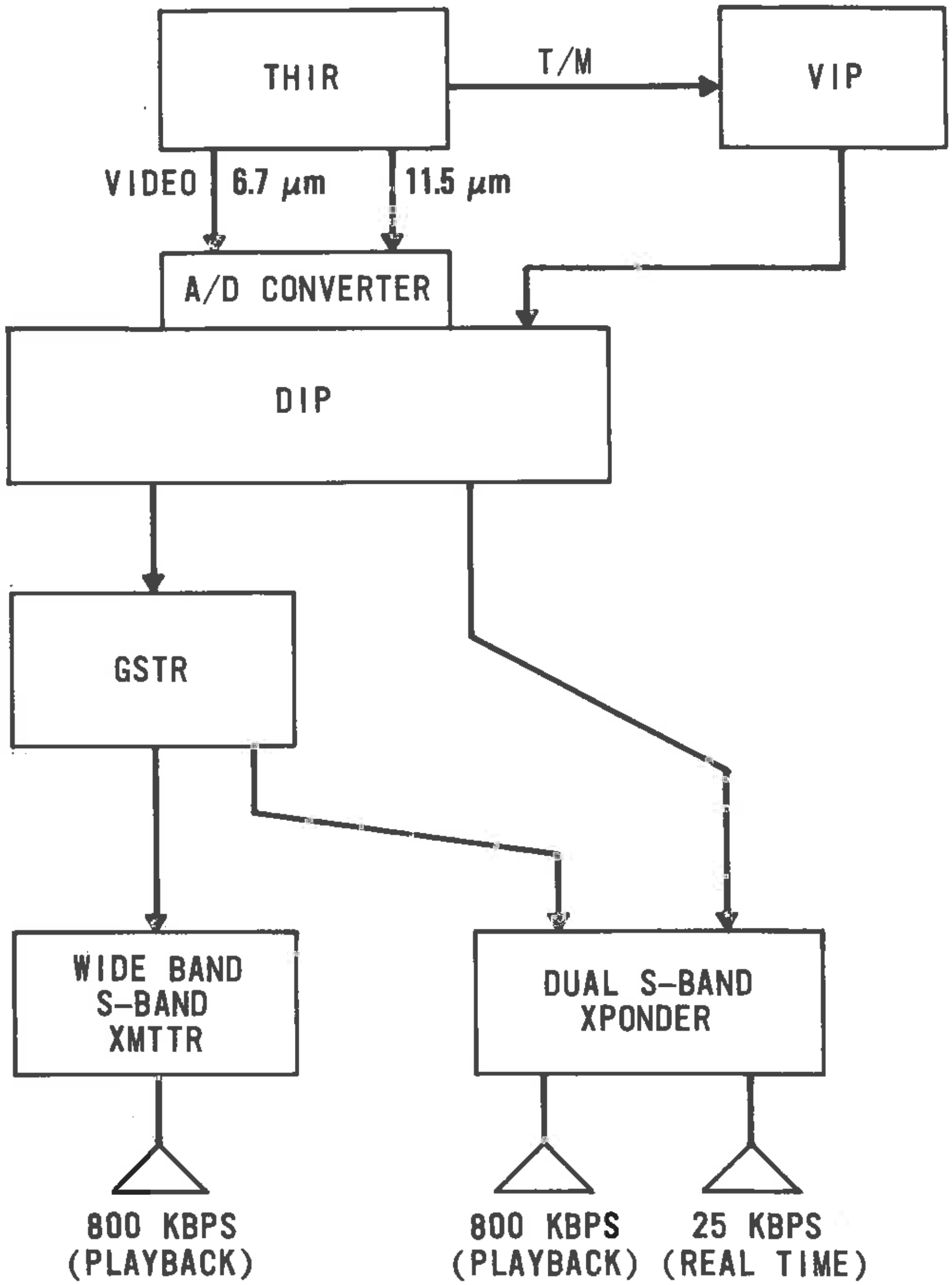


Figure 11. Spacecraft/THIR Data Flow

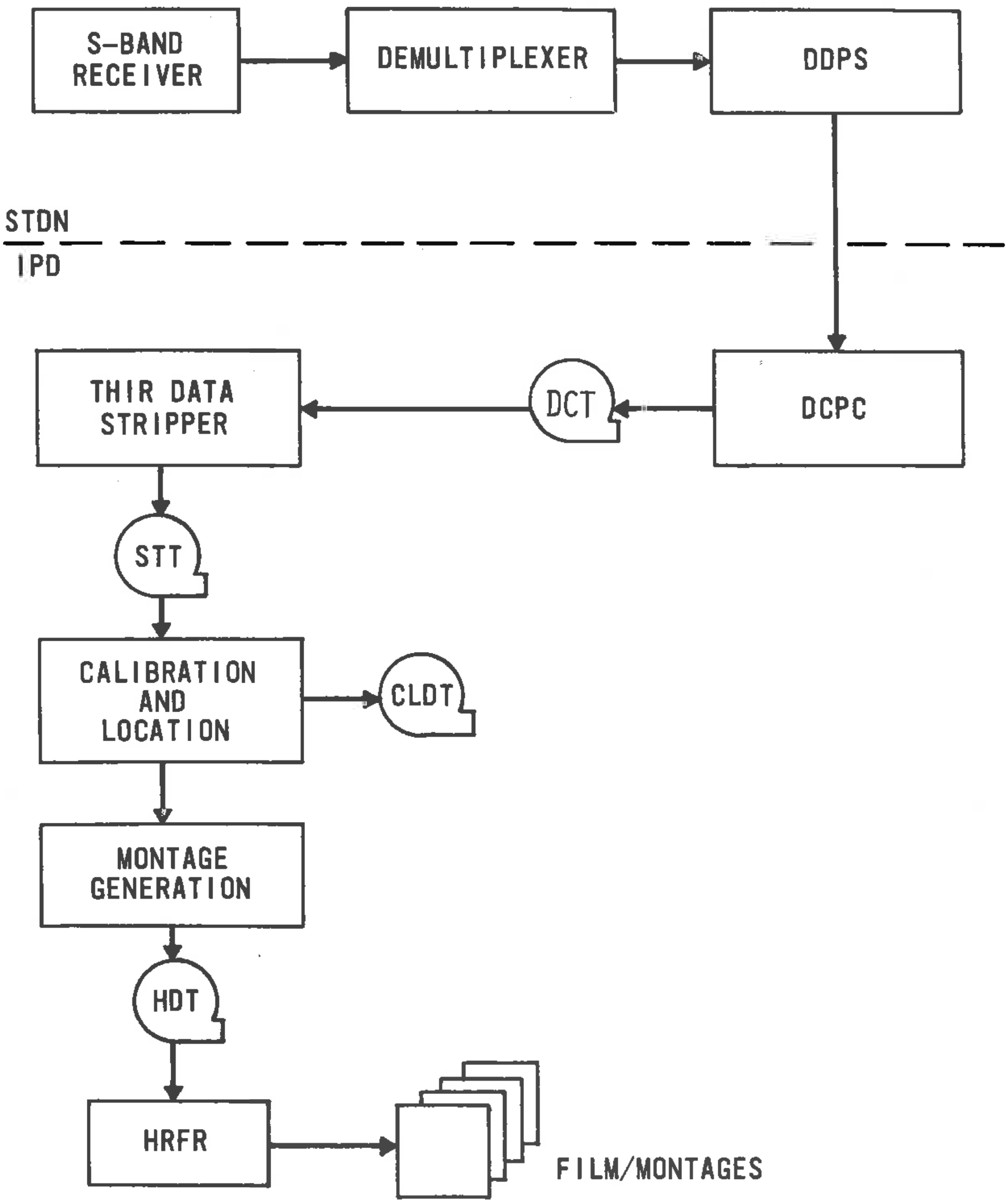


Figure 12. Ground/THIR Data Flow

written on the stripped THIR tape (STT). The data are calibrated, located, and written on the calibrated-located data tape (CLDT). The scan lines, which are separated by channel and daytime or nighttime, are then merged into world montages on a high-density tape (HDT). The HDT is then input to the high-resolution film recorder (HRFR) where the four daily world montage film products are generated.

The CLDTs and world montage film products are sent to NSSDC for archiving and distribution to the user community.

2.3 CALIBRATION

2.3.1 Laboratory Calibration

The main parameters for calibration of all electromagnetic radiation detection devices are essentially the same. Three fundamental quantities must be defined: the effective spectral response, 0_2; the effective radiance, $\bar{N}$; and the equivalent blackbody temperature, T_B. Here, 0_2 is a composite function involving all of the factors which contribute to the spectral responsivity of the detector.

The effective radiance, $\bar{N}$, is defined as

$$\bar{N} = \int_{\sigma}^{\infty} N_\lambda \; \varnothing_\lambda \; d\lambda \tag{1}$$

where N_λ represents the nonLanckian radiation from the Earth and its atmosphere.

Because the THIR has a narrow FOV, it essentially measures beam radiation or radiances toward the satellite along the optical axis. In the preflight laboratory calibration, the radiometer's FOV was filled by a blackbody target with a temperature that could be varied and accurately measured over a range of 150° to 340°K. From the temperature of the blackbody target, T_B, the spectral radiance of the target is determined by the Planck function B_2. The integration of this function over the effective spectral response, 0_2, yields that portion of the radiance of the target to which the radiometer responds, the "effective radiance," $\bar{N}$, given by

$$\bar{N} = \int_{\sigma}^{\infty} B_\lambda \, \varnothing_\lambda \, d\lambda \tag{2}$$

2.3.2 Equivalent Blackbody Temperature

The effective radiance to which the orbiting radiometer responds may be expressed by

$$\bar{N} = \int_{\sigma}^{\infty} N_\lambda \, 0_\lambda \, d\lambda \tag{3}$$

where N_λ is the spectral radiance in the direction of the satellite from the Earth and its atmosphere. It is convenient to express the measurement from the orbit in terms of an equivalent temperature of a blackbody filling the FOV which would cause the same response from the radiometer. From Equations 2 and 3 it is seen that this "equivalent blackbody temperature" corresponds to the target temperature, T_B, of the blackbody used in the laboratory calibration. Therefore, the radiometer measurements can be expressed either as values of effective radiance, N, or as equivalent blackbody temperatures, T_B. The N versus T_B function from equation 2 is given in Table 7 for both channels.

2.4 DATA FORMATS AND AVAILABILITY

2.4.1 World Montage

The individual swaths of THIR data are electronically stored until a day and a night (separately) of data are assembled. The data are then exposed on 241-mm (9.5-inch) film as a world montage (Figure 13).

Each display contains appropriate title information that identify the satellite, the data channel displayed (11.5 or 6.7 μm), whether the montage contains daytime or nighttime data, and the date the data were recorded. The 13 or 14 orbits of daytime or nighttime data are in the center of each display. Beneath each daytime orbital swath is its data-orbit number plus an ascending node longitude and Greenwich mean time (GMT). Beneath each nighttime orbital swath is its data-orbit number plus a descending node longitude and GMT. (See Figure 13.)

Beneath the data orbit reference information is a nine-step gray scale. The gray scale is calibrated with the imagery and allows a user to estimate cloud, ocean, and land temperatures within each data swath. To the right of center at the bottom of each display is information for cataloging the data. This information is the physical tape number the data are stored on (TXXXXX), the algorithm reference number that processes the data (ALGO XXX), the film specification number (F342140), the project data format code (IP), and the film frame number (XXXXXX).

Four daily THIR montage displays are displayed using the format described in this section. These four displays are an 11.5- or 6.7-μm nighttime display and an 11.5- or 6.7-μm daytime display.

2.4.2 Tape Data

Data on magnetic tape should be used whenever observations are required of the THIR. The CLDT is generated the same time that the data base produces the world montage film products. The CLDT replaces the THIR Nimbus meterological radiation tape (NMRT) produced

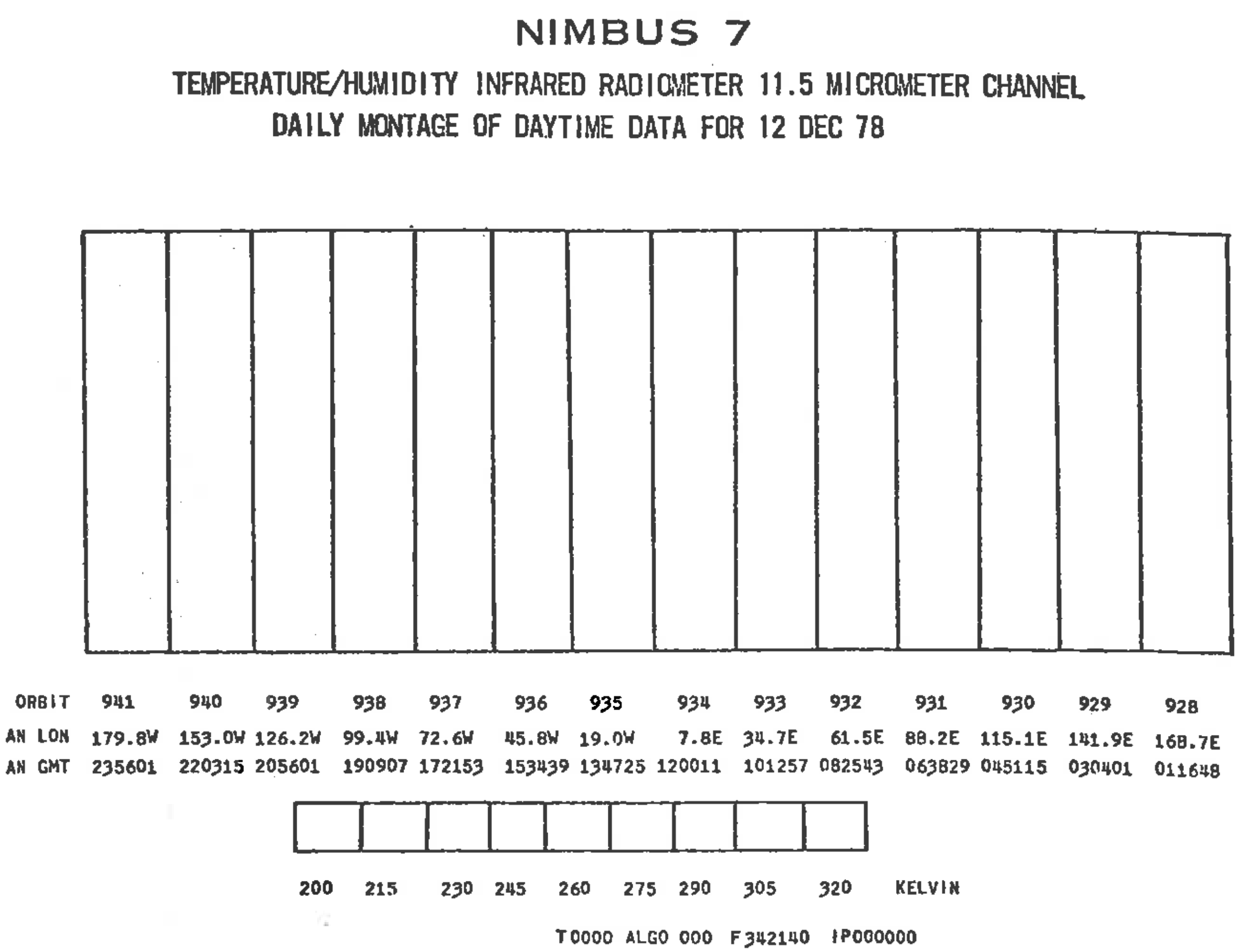


Figure 13. THIR Montage Film Display Format

Table 7
Effective Radiance ($\bar{N}$) Versus Equivalent Blackbody Temperature (T_B)

Blackbody Temperature (°K)	Effective Radiance (w/m^2 ster)	
	6.7-μm Channel	11.5-μm Channel
150	0.0039	0.2827
160	0.0094	0.4758
170	0.0204	0.7536
180	0.0407	1.135
190	0.0755	1.639
200	0.1317	2.281
210	0.2180	3.079
220	0.3446	4.046
230	0.5236	5.194
240	0.7685	6.532
250	1.094	8.070
260	1.516	9.813
270	2.050	11.71
280	2.714	13.93
290	3.524	16.31
300	4.498	18.90
310	5.652	21.70
320	7.002	24.71
330	8.563	27.92
340	10.35	31.35
350	12.38	34.96

for the Nimbus 4, 5, and 6 THIRs, however, it does not resemble the NMRT in format. The CLDT:

- Records on a 9-track 1600 bpi format
- Expresses data in 8-, 16-, and 32-bit word sizes
- Records bispectral data (6.7 and 11.5 μm)
- Expresses measurements in radiance values (i.e., conversion table to temperature (K) included in header record)
- Covers half a GMT day on one tape
- Covers one data orbit on one file
- Gives the GMT for each nadir sample of every scan
- Shows the latitude and longitude values for each sixth data point

THIR CLDTs are generated for all THIR data that are collected and considered satisfactory.

The 11.5-μm channel THIR data are formatted on tape to supply cloud-cover statistics for the ERB and the SBUV/TOMS experiments. These tape formats were designed specifically for these experiments, but users might find other applications. The THIR clouds-ERB tapes (CLE) contain mean radiances and rms deviations of clouds at each of four altitude levels for each ERB subtarget area. The THIR clouds-TOMS tapes (CLT) contain the same information for each SBUV and/or TOMS IFOV. (Conversion from radiances to temperatures is available in the CLDT documentation record at the beginning of each tape.)

2.4.3 Data Availability

THIR data are available from the NSSDC as computer-produced daily world montage film products and as computer compatible digital tapes. Users requesting THIR data should read paragraph 1.5 of this document for general tape and film ordering information.

The world montage displays (paragraph 2.4.1) are available as 241- by 241-mm positive or negative black-and-white transparencies or as 241-mm black-and-white positive prints.

When requesting THIR montages, a user should specify the display medium (i.e., film or print), the channel desired (i.e., 6.7 or 11.5 μm), the diurnal requirement (i.e., daytime, nighttime, or both), and the user's start-and-stop dates for data.

Digital tapes (paragraph 2.4.2) are available on a 9-track 1600 bpi tape format. Each tape type is furnished with a tape specification document describing the record-and-file content and word format of each tape type. Table 4 in paragraph 1.5 of this document provides tape specification numbers for the THIR tapes. Request these documents by tape specification number and tape name (acronym).

SECTION 3
ASSESSMENT OF THIR DATA QUALITY

3.1 INTRODUCTION

The ERB and the SBUV/TOMS experiments on Nimbus 7 use calibrated and geographically located data from the THIR, which is also flown on Nimbus 7. A special tape product made for each of these experiments from the CLDT is produced by merging THIR data with the THIR ILT.

The CLE tape is made by binning THIR data into the fixed geographic subtarget areas used for binning other ERB data products. The CLT tape is made by binning the THIR data into time-coincident SBUV/TOMS IFOVs. The algorithms that produce the CLE and CLT tapes are similar except for this difference in bin boundaries.

Thus, the analytical testing performed at NOAA/NESS on the CLE tape and at NASA/GSFC on the CLT tapes is complementary and serves to reinforce the quality assessments made at both locations for each of the products.

3.2 THIR MAGNETIC DATA TAPES

The three forms of THIR data that are available from the archive at the NSSDC (paragraphs 2.4.2 and 3.1) are: the CLDT, the CLE, and the CLT. The project data format (PDF) codes for these tapes and their tape specification numbers appear in Table 4 and Appendix C. One day's data is contained in two CLDT tapes, one CLT tape, and one CLE tape. However, beginning from June 22, 1980 the CLEs and CLTs are staked 7 days per tape.

These digital data tapes are produced by NASA/GSFC IPD in accordance with the tape specifications cited in Table 4. Copies are available on request. The THIR data flow is charted in Figure 11 and detailed in Appendix B. Appendix D.4 lists the quality control checks that are made on all output tapes produced by IPD and Appendix D.1 lists the quality assurance criteria applied to the ILT. The overall Nimbus 7 quality assurance specification is detailed in Appendix D.

3.2.1 Tape Formatting

All magnetic data tapes in the archive (NSSDC) that are produced by NOPS are formatted for easy identification and use. The format consists of four elements: the NOPS standard header file, the documentation record, the data record, and the dummy record. The following descriptions of these elements are taken from the tape s-pecification for the CLDT tape (T344011) and are considered typical of Nimbus 7 THIR data tapes. Each element is detailed in Appendix E, which is the tape specification (T344011) for the CLDT. However, users are reminded that tapes shipped from the archive will be accompanied by a specific tape "spec" which will be the only authoritative key to the particular data tapes shipped.

3.2.1.1 Standard Header File--All magnetic tapes used as interfaces within NOPS require some form of self-identification. A standardized series of records in the initial file of each tape will be used for this purpose, and will be called a NOPS standard header file. Some tapes used within a NOPS facility that do not pass an interface will be exempt from this requirement--although it is a recommended procedure.

A standard header file consists of two types of physical records--standard header records--that are followed by an end-of-file mark. Each standard header record is 630 8-bit characters in length and contains information written in EBCDIC for easy printing and quick identification of the tape. To ensure accurate identification in the file, the second standard header record duplicates the first.

The format and contents of a NOPS standard header record are given in Appendix E.

3.2.1.2 Documentation Record--The first record of each data file is always the documentation record that contains all of the documentation information for the file. The format and contents of this record appear in Appendix E.

3.2.1.3 Data Record--Appendix E gives the format and contents of the THIR CLDT data record for 32-bit word machines. The format was designed to accommodate slight variations in orbital altitude that would affect the number of THIR samples in the Earthview of each scan. Each data record contains 10 scans of THIR data and each scan contains 92-THIR words of located Earth-view data. The nadir-view sample of the scan is always placed in the 47th THIR word, and the remaining samples are centered around that position. Each THIR word consists of a latitude value, a longitude value, and six THIR samples (i.e., radiance measurements). The latitude and longitude are applicable to the first 11.5- and 6.7-μm samples in the THIR word. The location of the other samples in the THIR word can be obtained by interpolation.

3.2.1.4 Dummy Record--The last physical record of each data file is always a dummy record. This permits the generating software to properly set the last-record-in-file bit of the record ID field without having to know *a priori* the point of data termination. The format and contents of this record appear in Appendix E.

3.2.1.5 Trailing Documentation File--The trailing documentation file (TDF), which is always the last file of the data tape, is followed by double EOFs (end of tape data mark). In addition, the TDF consists of all NOPS standard header records that relate to products used for making the current product. Every TDF is 630 bytes in length.

3.2.2 THIR Calibrated-Located Data Tape

The THIR CLDT is a 9-track 1600-bpi tape generated by a MODCOMP IV or Univac 1100/82 computer. The first file of a CLDT contains a NOPS standard header record written twice. Each subsequent file contains one orbit of data, defined as beginning at one descending node and ending at the next descending node. Nominally, there are either six or seven orbital files (1/2 day of data) on a CLDT, terminated by double end-of-file marks.

Within each orbital file there may be as many as 5000 THIR scans of data. The THIR scans are arranged in ascending time order. Only the Earth-view portion of the scan is written to the CLDT. Each physical record in an orbital file can contain 10 THIR scans. Thus, including a single documentation record at the beginning of the file and a single dummy record at the end of the file, as many as 502 physical records may be written for each orbit.

A CLDT data record contains the following information: data quality flag, latitude and longitude, THIR radiance measurements (11.5 and 6.7 micron), and engineering and housekeeping data.

3.2.2.1 Assessment of THIR CLDT Data Quality--To check the quality of the tape data during the first 2 years of instrument operation the THIR CLDT tapes have been subjected to a random sampling procedure. A total of 22 days of CLDT tapes have been examined and analyzed and found to contain all the specified information on the NOPS header and the documentation record.

An internal data quality-information keeping procedure is set up for each THIR scan on the CLDT tape by setting 16 data quality bit flags based on the quality of data used to locate and calibrate each THIR scan. Information about missing scan data is also passed on through two of these bits. For a detailed description of these bits, see page 20 of the CLDT tape specification in Appendix E. Bit 13, the most important bit, contains information about the scan data compromise caused by information contained in bits 1 through 12. Bit 12 contains information about the availability of the housing temperature. Measurements are taken every 16 seconds using three thermisters. Bits 10 and 11 contain information about the availability of the location of the satellite (i.e., orbit and attitude). Bit 5 indicates whether real or estimated values of the backscan or the housing scan data are used. Similar information about the spacescan is carried by bit 6. The results of random sampling done for 22 days are summarized in Table 8. These results show that the extent of compromise caused by lack of real location data is minimal. The average value being set for bit 13 is about 18 percent. This is an order of magnitude over-estimation of the compromise of the scan data. Table 8 shows that the biggest contributers to bit 13 value are bits 5 and 6, which are set whenever estimated values are used for backscan and spacescan. Table 9, which lists the values of these counts for 22 days, shows that spacescan counts remain

Table 8
CLDT Validation: Percentage of Compromise
Data Quality Flags

Day	15	14	13	12*	11	10	7	6	5	4	0
78319	0.00	0.02	21.06	1.15	0.00	2.58	0.01	3.68	15.87	0.02	50.01
78349	0.00	0.02	18.69	1.28	0.00	0.32	0.04	3.48	15.48	0.05	50.07
78351	0.00	0.00	18.95	0.90	0.00	0.00	0.02	3.70	15.88	0.02	50.02
79015	0.00	0.01	19.84	1.79	0.00	0.57	0.04	4.13	15.90	0.05	50.04
79046	0.00	0.01	19.91	1.54	0.00	0.29	0.02	4.01	16.29	0.03	50.02
79074	0.00	0.04	19.36	1.28	0.00	0.30	0.00	3.71	16.02	0.00	50.06
79105	0.00	0.03	23.71	6.66	0.00	6.16	0.00	3.86	15.50	0.00	50.00
79134	0.00	0.05	18.40	1.15	0.00	0.00	0.00	3.79	15.21	0.00	50.03
79166	0.00	0.10	21.07	2.69	0.00	3.89	0.00	3.53	14.92	0.00	50.04
79196	0.00	0.06	18.14	1.54	0.00	0.36	0.00	3.30	15.06	0.01	49.99
79227	0.00	0.02	30.06	0.77	0.00	0.00	0.03	10.78	23.48	0.05	50.03
79258	0.00	0.03	17.93	1.54	0.00	0.55	0.05	3.26	14.78	0.08	49.99
79288	0.00	0.03	17.18	0.90	0.00	0.00	0.05	3.06	14.57	0.05	50.00
79311	0.00	0.02	18.31	8.79	0.00	0.61	0.00	3.32	14.69	0.01	49.82
80172	0.00	0.01	17.62	0.90	0.00	0.25	0.02	3.24	14.71	0.10	50.14
80175	0.00	0.01	18.46	1.41	0.00	0.64	0.04	3.15	15.27	0.05	50.04
80189	0.00	0.01	18.08	0.90	0.00	0.38	0.01	3.27	15.01	0.01	50.29
80194	0.00	0.02	17.51	1.15	0.00	0.27	0.03	3.13	14.68	0.04	50.24
80202	0.00	0.01	21.42	1.15	0.00	0.44	0.02	4.96	18.36	1.87	50.13
80204	0.00	0.01	17.46	0.64	0.00	0.11	0.00	3.21	14.66	0.01	50.12
80209	0.00	0.01	18.02	0.51	0.00	0.17	0.01	3.36	15.01	0.04	50.28
80264	0.00	0.02	17.30	0.38	0.00	0.21	0.05	3.30	14.26	0.09	50.14
Average	0.00	0.03	17.91	1.77	0.00	0.82	0.20	3.87	15.71	0.12	50.06

*Scaled for frequency of setting flag 12 as compared to the number of scans, (i.e., flag 12 is multiplied by 12.8)

Table 9
CLDT Validation: Temperature and Count Summary

	Housing Temperature Mean (°C)			Housing Temperature Standard Deviation			Space Level Counts Mean		Space Level Counts S.D.		Backscan Level Counts Mean		Backscan Level Counts S.D.	
Day	1	2	3	1	2	3	11.5 μm	6.7 μm	11.5 μm	6.7 μm	11.5 μm	6.7 μm	11.5 μm	6.7 μm
78319	17.4	17.8	17.6	1.56	1.55	1.54	15	18	0.00	0.32	129	119	0.57	1.05
78349	17.8	18.2	18.0	1.23	1.24	1.16	15	18	0.00	0.32	129	119	0.56	1.05
78351	18.2	18.6	18.4	1.07	1.08	1.06	15	18	0.00	0.33	129	120	0.66	1.13
79015	18.4	18.8	18.6	1.43	1.46	1.41	15	18	0.00	0.31	130	121	0.60	1.05
79046	18.6	19.0	18.8	1.58	1.59	1.57	15	18	0.00	0.34	130	121	0.65	1.21
79074	18.6	19.0	18.8	1.88	1.83	1.84	15	18	0.00	0.28	129	121	0.68	1.21
79105	19.2	20.0	19.8	5.27	6.48	5.23	15	18	0.00	0.32	129	119	0.80	1.39
79134	18.0	18.6	18.2	2.17	2.16	2.17	15	18	0.00	0.33	129	119	0.92	1.68
79166	18.0	18.6	18.2	2.61	2.65	2.57	15	18	0.00	0.33	128	119	0.97	1.66
79196	17.6	18.2	18.0	2.37	2.34	2.32	15	18	0.00	0.35	128	118	0.88	1.57
79227	17.6	18.2	17.8	1.81	1.76	1.75	15	18	0.00	0.41	128	118	0.87	1.55
79258	17.8	18.4	18.0	3.08	2.80	2.53	15	18	0.03	0.37	128	118	0.82	1.34
79288	17.0	17.8	17.4	2.10	2.01	1.91	15	18	0.00	0.35	127	116	0.74	1.22
79311	17.6	18.2	17.8	0.54	0.58	1.01	15	18	0.00	0.35	128	118	0.63	1.00
80172	17.4	18.2	17.8	2.22	2.20	2.22	15	18	0.00	0.39	128	117	1.03	1.64
80175	17.8	18.6	18.0	2.70	2.69	2.70	15	18	0.00	0.37	128	118	0.96	1.65
80189	17.8	18.6	18.2	2.46	2.48	2.45	15	18	0.00	0.39	128	118	0.96	1.67
80194	17.6	18.4	17.8	2.55	2.52	2.50	15	18	0.00	0.39	128	117	1.00	1.68
80202	17.6	18.4	18.0	2.39	2.31	2.33	15	18	0.13	0.46	128	117	0.99	2.18
80204	17.4	18.2	17.6	2.17	2.18	2.20	15	18	0.00	0.38	127	117	1.03	1.60
80209	17.6	18.4	18.0	2.42	2.40	2.37	15	18	0.00	0.34	128	117	0.99	1.73
80264	16.8	17.6	17.2	1.61	1.57	1.57	15	18	0.00	0.41	127	115	0.82	1.32

constant for both channels and that use of its estimated value should not cause any real loss in scan data quality. The backscan counts show a slight fluctuation, because the housing temperature itself is fluctuating (Table 9). In the actual calibration procedure, the backscan count calculates the slope of the calibration line. Table 10 lists the values of this slope and shows that the slope's value remains stable. These considerations clearly show that an estimated value of the backscan should cause very little loss of data quality because bits 5, 6, and 13 will always overestimate the extent of the scan data compromise.

The third significant contributor to the loss of data quality is the use of housing temperature estimated values when VIP telemetry data are missing. Figures 14a and 14b show that the housing temperature, which has a range between 17° to 19.5°C, remained stable during the first 1 1/2 years. Housing temperature values change very little during a short interval (i.e., a few VIP frames), if properly estimated values of temperature are used it should not lower the quality of the scan data. Unfortunately, during the first 2 years of the THIR data processing, some unanticipated fill patterns on the magnetic tape were treated as noisy, but real data, instead of as no data. During these time intervals, depending on the size and type of the fill pattern, very large values of housing temperatures were created. This problem was identified in February 1981 and a correct smoothing algorithm was implemented in the THIR processing on August 1, 1981. In the mean time, more than 2 years of data were processed containing poor quality calibrated scan data caused by a housing-temperature fill-data problem for many intervals per day. As indicated by bit 12 the main impact of the fill problem has been to generate poor quality scan data. Table 8 shows that the extent of data quality loss attributed to this problem is on the order of 2 percent of the 2-year period examined. This number is substantially over-estimated, because all scan data that were contaminated by a contiguous "fill" data greater than 750 seconds, were recalibrated, that is, the CLDTs were remade with the corrected algorithm.

The first and second THIR data years were analyzed to obtain the percentage of data affected by the fill problem each year. The first data year, excluding 1 week of data, had an average of 1.1 percent of bad data. The second year data had an average of 0.67 percent of bad data. Table 11 and Table 12 contain frequency distributions of the "fill" based on the event size (i.e., contiguous length of the "fill") for the total number of affected days, total number of affected VIP frames, and total number of events.

All contaminated scan data have been flagged by setting flag bit 3 on the CLDT tape. Users should reject or carefully examine these data's reliability (e.g., spatial continuity) before using them.

A "wavy-line pattern" appears on some of the montage pictures because a regular pattern of zero- or low-radiance value is superimposed on the original scan value. See Figure 15 for an example of

Table 10
CLDT Validation: Temperature and Count Calibration

Day	Mean Housing Temperature		THIR 11.5-μm Channel					THIR 6.7-μm Channel				
			Backscan Level Count	Space Level Count	Slope	Radiance R_H	Slope	Backscan Level Count	Space Level Count	Slope	Radiance R_H	Slope
	°C	°K	C_H	C_C	$T_H/(C_H-C_C)$	$(W/M^2\ Ster)$	$R_H/(C_H-C_C)$	C_H	C_C	$T_H/(C_H-C_C)$	$(W/M^2\ Ster)$	$R_H/(C_H-6)$
78319	17.6	290.8	129	15	2.55	16.62	0.146	119	18	2.88	3.61	0.036
78349	18.0	291.2	129	15	2.55	16.75	0.147	119	18	2.88	3.64	0.036
78351	18.4	291.6	129	15	2.56	16.88	0.148	120	18	2.86	3.69	0.036
79015	18.6	291.8	130	15	2.54	16.88	0.147	121	18	2.83	3.70	0.036
79046	18.8	292.0	130	15	2.54	16.88	0.147	121	18	2.83	3.72	0.036
79074	18.8	292.0	129	15	2.56	16.88	0.148	121	18	2.83	3.72	0.036
79105	19.7	292.9	129	15	2.57	17.13	0.150	119	18	2.90	3.80	0.038
79134	18.3	291.5	129	15	2.56	16.38	0.144	119	18	2.89	3.67	0.036
79166	18.3	291.5	128	15	2.58	16.38	0.145	119	18	2.89	3.67	0.036
79196	17.9	291.1	128	15	2.58	16.75	0.148	118	18	2.91	3.64	0.036
79227	17.9	291.1	128	15	2.58	16.75	0.148	118	18	2.91	3.64	0.036
79258	18.1	291.3	128	15	2.58	16.75	0.148	118	18	2.91	3.64	0.036
79288	17.4	290.6	127	15	2.60	16.63	0.148	116	18	2.97	3.59	0.037
79311	17.9	291.1	128	15	2.58	16.75	0.148	118	18	2.91	3.64	0.036
80172	17.8	291.0	128	15	2.57	16.62	0.147	117	18	2.94	3.63	0.037
80175	18.1	291.3	128	15	2.58	16.75	0.148	118	18	2.91	3.64	0.036
80189	18.2	291.4	128	15	2.58	16.75	0.148	118	18	2.91	3.64	0.036
80194	17.9	291.1	128	15	2.58	16.75	0.148	117	18	2.94	3.64	0.036
80202	18.0	291.2	128	15	2.58	16.75	0.148	117	18	2.94	3.64	0.037
80204	17.7	290.9	127	15	2.60	16.62	0.148	117	18	2.94	3.63	0.037
80209	18.0	291.2	128	15	2.58	16.75	0.148	117	18	2.94	3.64	0.037
80264	17.2	290.4	127	15	2.59	16.50	0.147	115	18	2.99	3.63	0.037

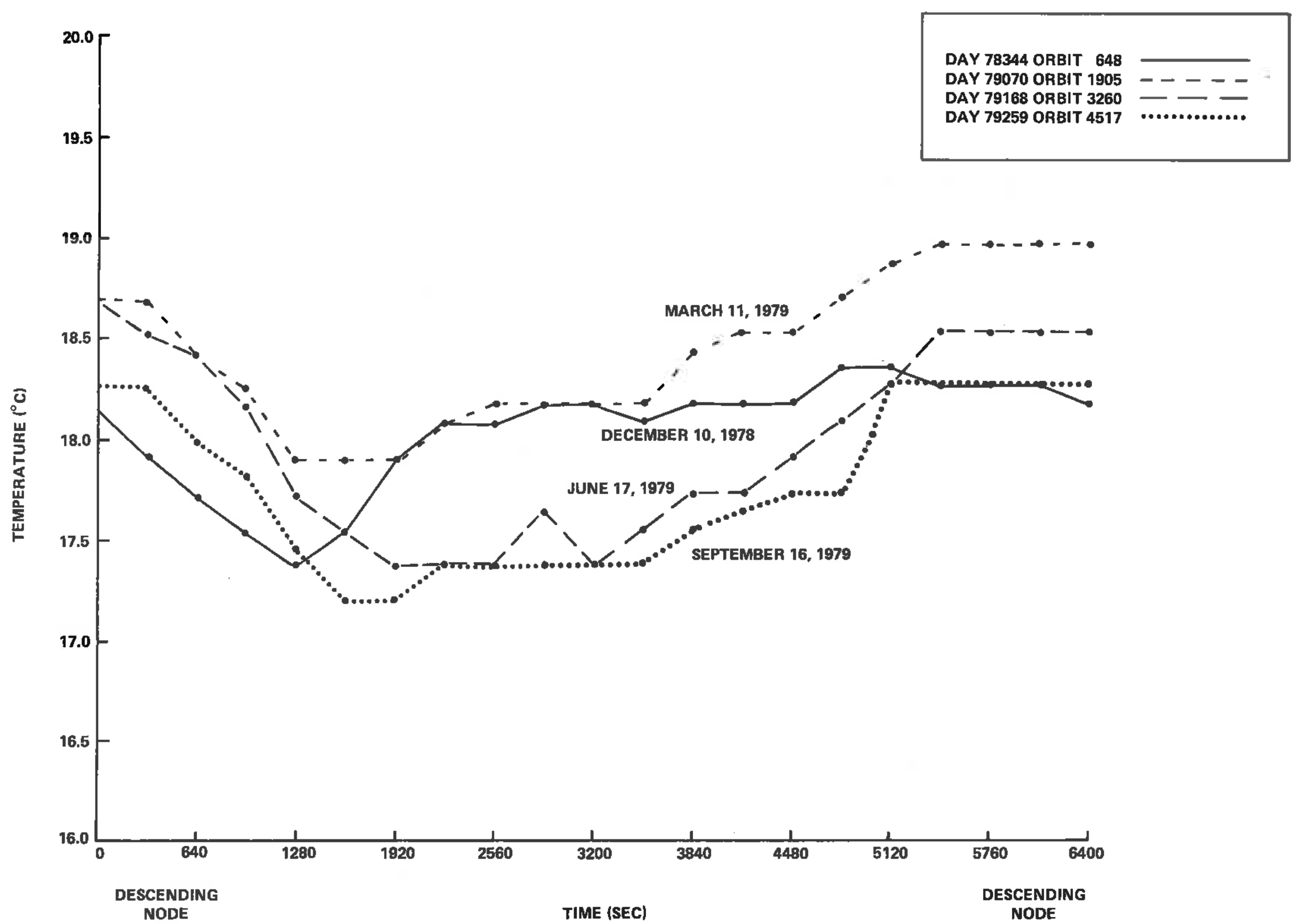


Figure 14a. Variation of Housing Temperature During an Orbit

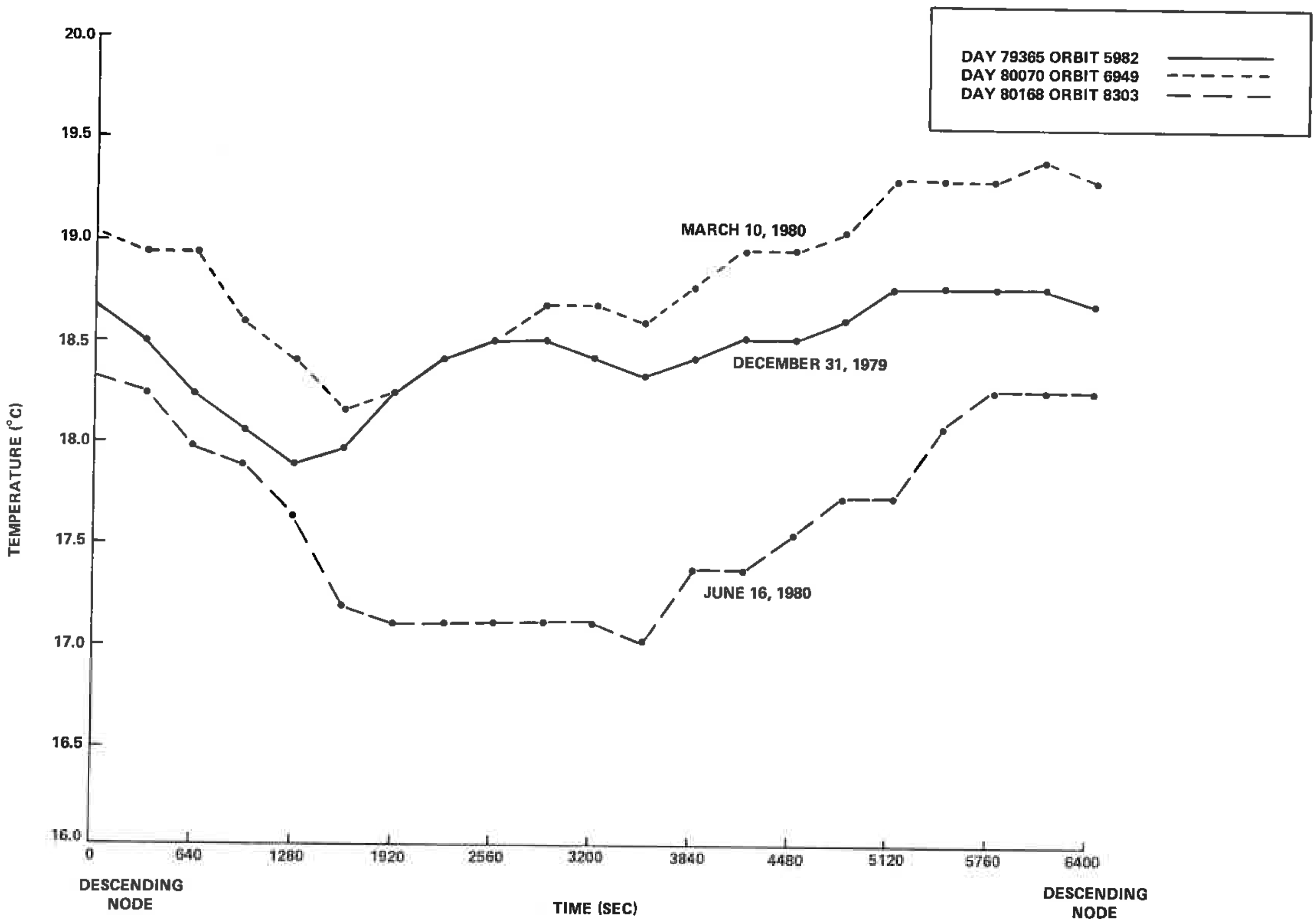


Figure 14b. Variation of Housing Temperature During an Orbit

Table 11
Impact of Housing Temperature Fill Problem on the First Year THIR Data--Frequency Distribution

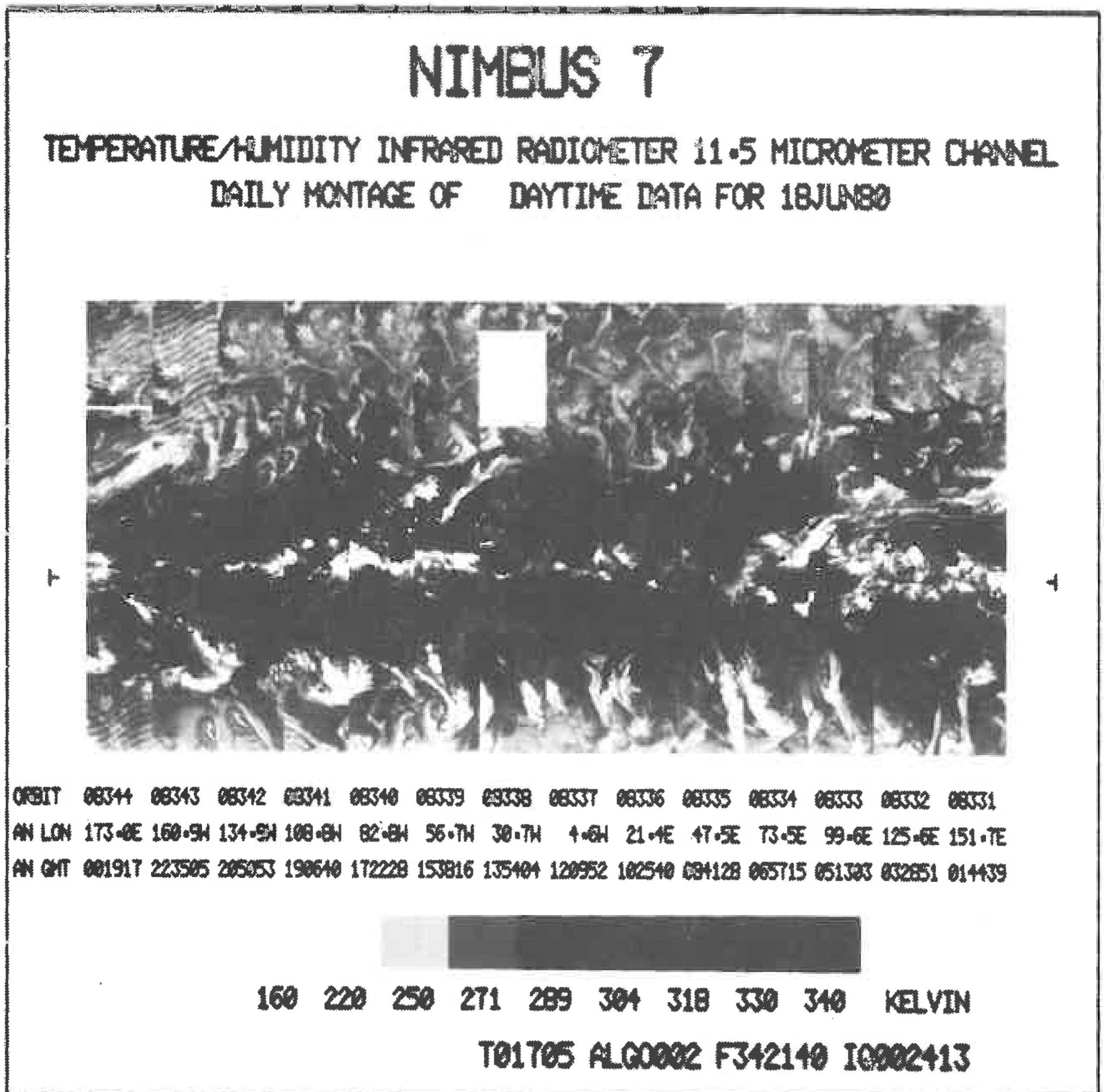
Event Size in Seconds	$0 < \Delta t \leq 150$	$150 < \Delta t \leq 300$	$300 < \Delta t \leq 450$	$450 < \Delta t \leq 600$	$600 < \Delta t \leq 750$
Total Number of Affected Days	264	192	87	52	32
Total Number of Affected VIP Frames	9753	5327	2358	2772	1555
Total Number of Events	4401	397	106	84	38
Total Amount of "fill" (%)	1.1				

Where Δt, event size, is the length (in second) of contiguous "fill". Note, each VIP frame is 16 seconds; total number of days analyzed is 364.

Table 12
Impact of Housing Temperature Fill Problem on the Second Year THIR Data--Frequency Distribution

Event Size in Seconds	$0 < \Delta t \quad 100$	$150 \leq \Delta t \leq 300$	$300 < \Delta t \leq 450$	$450 < \Delta t \leq 600$	$600 < \Delta t \leq 750$
Total Number of Affected Days	258	118	50	16	5
Total Number of Affected VIP Frames	978	2150	1248	586	209
Total Number of Events	4256	162	56	18	5
Total Amount of "fill" (%)	0.67				

Where Δt is the event size (in second).



Note that the "wavy-line pattern" problem appears on the last two orbits.

Figure 15. Example of a THIR Montage

the THIR montage. This situation may be caused by a telemetry synchronization problem that cannot be corrected after it has happened. An analysis of data acquired during a few randomly selected sampling days, indicated that the amount of data contaminated was less then 1 percent for a wavy-pattern day. However, the contamination was always concentrated in a few orbits and the occurrence of bad data for these orbits was estimated to range from 1.0 to 4.7 percent. The contaminated data will be excluded from the statistical computation, in generating the fourth-year CLT and the CLE. Investigation is still in progress. For further information, contact Dr. Paul Hwang at NASA/GSFC.

3.2.3 THIR-Clouds-ERB Tape

The THIR CLE tape is a 9-track, 1600-bpi tape generated by a MODCOMP IV or Univac 1180/82 computer. The first file contains a NOPS standard header written twice. Each subsequent file contains 1 day of data. There type contains seven daily data files (1 week of data) terminated by a double end of file. However, before June 22, 1980 (data day), the tape contained only one daily file. CLE tapes are generated whenever the THIR sensor is on.

Within a daily file there may be as many as 14 orbits of data. Each orbit of THIR data is processed so that the THIR samples are placed into ERB subtarget area bins by location. (See the tape specification for details). After accumulating all possible THIR samples for the orbit, the subtarget area bins are written to the tape in ascending time sequence of the initial THIR sample placed into the bin. As many as 32 physical records may be written for each data orbit. Briefly, for each subtarget area observed, a four-level histogram of the 11-μm radiances is recorded. The three histogram boundaries are chosen to represent climatological temperature boundaries between the Earth's surface and low-altitude clouds, between low and middle-altitude clouds, and between middle- and high-altitude clouds. For each of the four bins and for each low, medium, and high cloud, the following are recorded: the population of 11-μm samples, the mean and rms deviation of the 11- and 6.7-μm radiances, the satellite-zenith angle, and the fraction of land in the subtarget area.

A dummy data record, consisting of all 1's except for the first 32 bits, may be used either as the last record in a file or as the only record in the last file.

The tape specification for the THIR CLE tape is presented in Appendix G.

3.2.3.1 Assessment of THIR CLE Data Quality--The data in the THIR CLE tape have been subjected to continuous checking procedures and to special intercomparison studies and evaluations at NOAA/NESS since the beginning of production in April 1979.

A number of problems have been encountered in the intervening period, and with the exception of two, all have been eliminated from the first year THIR CLE database. These two problems, which concern FOV location errors, are described in Appendixes H and I.

All tapes have been generated from the latest version of the ILT. The FOV locations, with the exception of the two problems previously mentioned, are accurate to within 10 kilometers at spacecraft nadir.

This conclusion has been determined from special analysis of scanline displays of THIR data, which identify and check coastal features for location accuracy.

Quality assessment at NOAA/NESS was accomplished in two stages. In the first stage, checks were made of data taken from each of two different target areas. These checks involved the following: analysis of mean radiance at 6.7 and 11 μm for different coud-height levels; analysis of the three boundary temperatures for consistency with preadjusted observed climatological temperatures; assessment of the magnitude of the atmospheric attenuation adjustment for the viewing angle; and a rough check of cloud amount* against enhanced GOES photos.

The second stage quality check was performed using the output data from an algorithm that extracted additional cloud information from the CLE input tape and permitted a more complete comparison of clouds information with the GOES satellite data than was possible in the first stage assessment.

Having performed these quality checks on more than 200 days of CLE data, the following general statements of validity can be made. The histogram boundary temperatures agree with the observed climatological temperatures to within 0.3°K. Cloudiness for a given location matches well with the GOES images.

Regression analyses based on 246 concurrent estimates of THIR cloud amounts, cloud amounts derived by human analysis of GOES images, and other meteorological data from November and December 1978 and April and June 1979 have been performed. The results of these analyses suggest that for daytime observations (near local noon): (1) high-cloud, middle-cloud, and low-cloud amounts have random errors of 9, 24, and 26 percent, respectively, (2) total-cloud amount has a random error of 19 percent, and (3) some systematic error on the order of 5 percent exists overestimating total-cloud amount when it is large and underestimating it when small. For nighttime observations (near local midnight): (1) when over the oceans, the errors are comparable with daytime observation errors, and (2) when over land, the errors are unacceptably large except for high-cloud amount, which is about 10 percent and these cloud amounts should not

*The percent of coverage by any one of the four cloud histogram categories is computed by dividing the population of 11- m pixels in that category by the total population for the subtarget area and multiplying by 100.

be used. Methods for correcting these errors over land are being studied and will be proposed for future modification of the THIR cloud products.

The conclusion analysis indicated that the CLE tapes are of good quality, contain data useful for cloud studies, and correspond with tape specification T343031.

Data for year 1 through year 3 have been effected by the wavy-line pattern problem (paragraph 3.2.2.1). The degree to which the data are impacted and the way in which this problem is handled will be presented in a future update of this document.

3.2.4 <u>THIR Clouds-TOMS Tape</u>

The THIR CLT is a 9-track, 1600-bpi tape generated by either a MODCOMP IV or Univac 1180/82 computer. The CLT contains the number

of THIR pixel population, their mean radiance of 11.5 and 6.7 m, and their rms deviation for surface low, medium, and high clouds for each of the TOMS/SBUV's FOVs. The first file contains a NOPS standard header record written twice. Each following file contains data from 1 GMT day (in whole orbits). There are up to seven tapes per week generated, each containing a daily file. However, after June 22, 1980 (data day) there will be seven daily data files (1 week of data) on the tape. Clouds-SBUV/TOMS tapes are generated whenever the SBUV/TOMS sensor is "ON."

Within a daily file there may be up to 14 orbits of data. Each orbit of THIR data is processed scan by scan so that THIR samples can be placed into SBUV/TOMS IFOV histogram bins by location.

Appendix F, "CLT Tape Specification T343041," contains further details.

3.2.4.1 <u>Assessment of THIR CLT Data Quality</u>--The analytical testing performed at NOAA/NESS in connection with the THIR CLE tape is directly applicable to the THIR CLT (paragraph 3.1). In addition, similar and complementary tests of the CLT have been performed in GSFC's Laboratory for Atmospheric Sciences and by members of the SBUV/TOMS Algorithm Development Team with results similar to those produced at NOAA/NESS in connection with the CLE tapes.

Data for year 1 through year 2 have been contaminated by the wavy-line pattern problem (paragraph 3.2.2.1). The degree to which the data are impacted and the way in which this problem is handled will be presented in a future update of this document.

3.3 THIR WORLD DAILY MONTAGE DISPLAYS

The THIR world daily montage display is described in paragraph 2.4.1 and shown in Figure 13. Using the format described, four daily montages are available from the archive at NSSDC. It will be necessary for each user to determine which of the four daily montages (i.e., 6.7 or 11.5 μm, daytime or nighttime) will best suit his intended use. A sample THIR montage is shown in Figure 15.

The THIR montages are produced by NASA/GSFC's Image Processing Facility (IPF) montage generation system in accordance with film specification F342140. Copies are available upon request from the NSSDC. Appendix D includes the inspection criteria for THIR montages and details the inspection procedure for THIR and TOMS archival imagery.

3.3.1 Quality Assessment of THIR Montages

The THIR world daily montages are made from data generated by the 2-channel THIR on the Nimbus 7 spacecraft. Montages are formatted and produced in NASA/GSFC's IPF in accordance with the film specification and inspection criteria in paragraph 3.3. No THIR montage products (i.e., third generation positive transparencies and prints) are shipped without meeting these requirements. In some cases, it is necessary to produce and distribute a "nonstandard product," that is labeled as such.

APPENDIX A

THIR INSTRUMENT SCIENCE TEAM

APPENDIX A

THIR INSTRUMENT SCIENCE TEAM

Larry L. Stowe, Chairman--NOAA/NESS

P. K. Bhartia--SASC

Tom Charrix--NASA/GSFC/Code 910.2

A. J. Fleig--NASA/GSFC/Code 910.2

George Fleming--NASA/GSFC/Code 563.2

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Ed Hurley--NASA/GSFC/Code 910.2

Paul Hwang--NASA/GSFC/Code 910.2

John Jackson--NASA/GSFC/Code 563.2

Orbie Jones--NASA/GSFC/Code 563.1

Gail McConaugh--SASC

Paul McKowan--NASA/GSFC/Code 563.1

Shirley Reed--SASC

David Short-NASA/GSFC/Code 915

John Sissala--GE/MATSCO/Code 415.9

Walter Sullivan--NASA/GSFC/Code 902.2

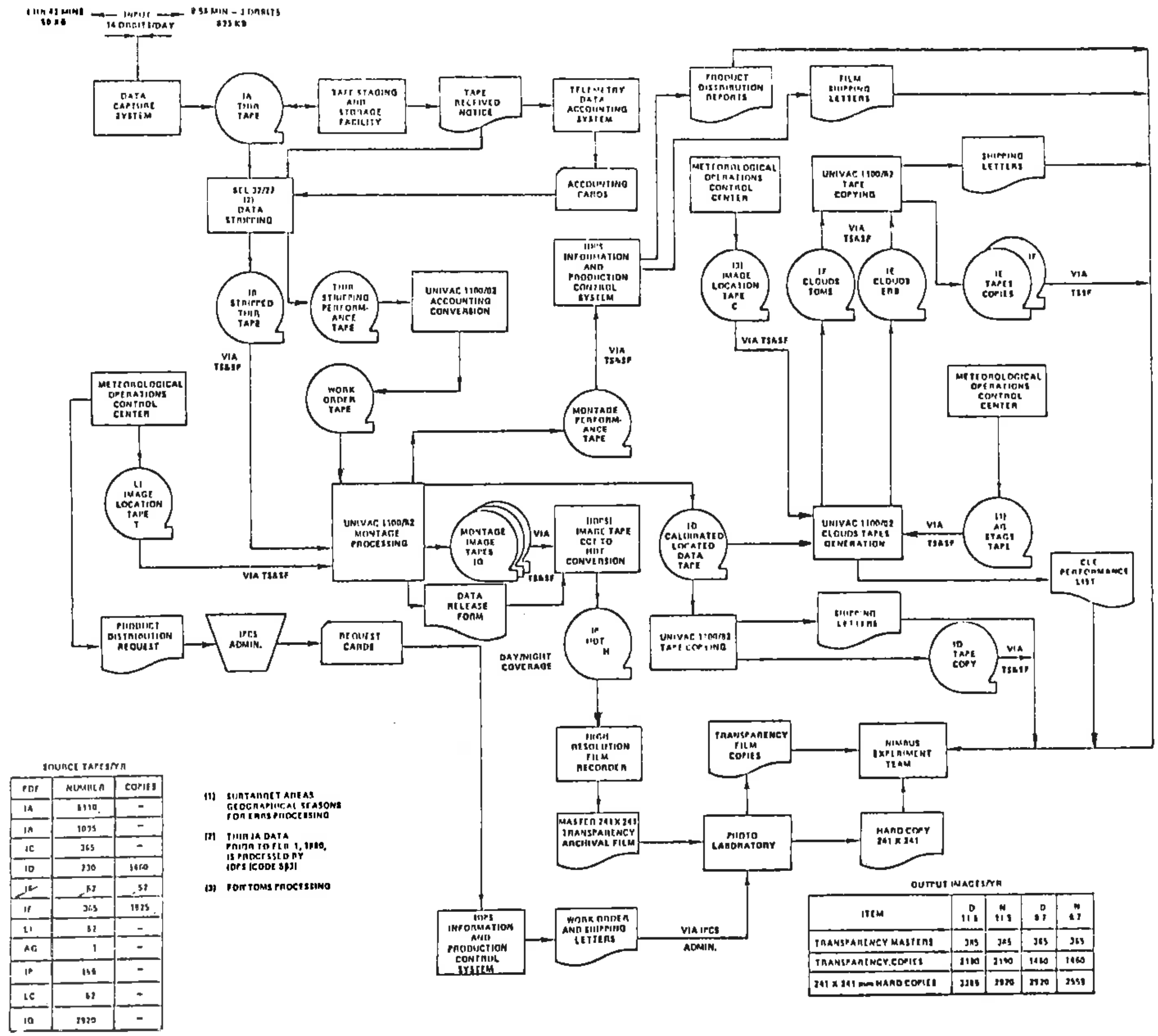
APPENDIX B

INFORMATION PROCESSING DIVISION (IPD - CODE 560)

NIMBUS 7 EXPERIMENT DATA PROCESSING SUPPORT

(FLOW CHART)

February 1981



SOURCE TAPES/YR

PDF	NUMBER	COPIES
IA	8110	-
IB	1095	-
IC	365	-
ID	730	1460
IE	52	52
IF	365	1825
LI	52	-
AG	1	-
IP	156	-
LC	52	-
IQ	2920	-

OUTPUT IMAGES/YR

ITEM	D 11.5	N 11.5	D 6.7	N 6.7
TRANSPARENCY MASTERS	365	365	365	365
TRANSPARENCY COPIES	2190	2190	1460	1460
241 X 241 mm HARD COPIES	3285	2920	2920	2555

Figure B-1. Nimbus 7 Experiment Data Processing Flow Chart

APPENDIX C

NIMBUS G PROJECT DATA FORMAT CODES

THIR

APPENDIX C
NIMBUS G PROJECT DATA FORMAT CODES
THIR

Sensor	Tape ID	Orig.	Copies	PDF	Data Type	Horizontal Label	/Vertical Colors
THIR	Source	5110	-	IA	SOIA	D ORAN	/ D ORAN
	STT	1095	-	IB	STIB	D ORAN	/ YELLOW
	CLDT	730	-	ID	CLID	D ORAN	/ D GRN
	CLE	365	1825	IE	CLIE	D ORAN	/ D PINK
	CLT	365	730	IF	CLIF	M ORAN	/ GREY
	ILT-T	52	-	LI	ILLI	L ORAN	/ L PINK
	ILT-C	52	-	LC	ILLC	L ORAN	/ L BRWN
	MONTIM	2920	-	IQ	MOIQ	DK ORAN	/ DK ORAN

APPENDIX D

NIMBUS 7 QUALITY ASSURANCE SPECIFICATION

APPENDIX D

NIMBUS 7 QUALITY ASSURANCE SPECIFICATION

The current Nimbus 7 THIR quality assurance specification allows up to 1.5 orbits of data to be missing, which means that 1.5 orbits of data can be missing or be bad data. If the combination of missing or bad data is less than 1.5 orbits a problem defect report (PDR) is not required. These data will be shipped to the various users.

Quality assurance specifications for various products are presented in Appendixes D.1 through D.5.

D.1 THIR IMAGE LOCATION TAPE QUALITY ASSURANCE CRITERIA

Quality assurance criteria have been established as a basis for accepting or rejecting THIR image location tapes (ILT-T) that are input to the montage system. ILT-Ts will be rejected for any of the following reasons:

- Detecting incorrect start-or-stop times in the standard header file
- Detecting the time range of the data files, which is not completely included within the range of the time correction file
- Lacking less than 90 percent of VIP or orbit data for any orbit because of time gaps between records or fill data that are within a record
- Detecting time backups of more than 30 seconds between records
- Detecting differences of more than 60 seconds between GMT and spacecraft clock start times in any record
- Detecting incorrect orbit numbers in any record
- Detecting Greenwich-hour angle, Sun ascension, or Sun-Declination values that are inconsistent with corresponding spacecraft location coordinates within any record

D.2 INSPECTION CRITERIA FOR 241-mm (+3) BLACK-AND-WHITE TRANSPARENCY

a. Internal gray scale

Step	Specification	Tolerance
1	2.30	+0.10
9	0.22	±0.10

b. Cosmetic rejection criteria

Reject the image for the following defects within the image area:

- One obvious defect such as a large Newton ring, emulsion tear, physical defect, or any similar defect
- Any emulsion scratch ≥ 0.1 mm in width
- Six or more scratches, each < 0.1 mm, but > 0.05 mm in width and oriented longitudinally
- Six or more emulsion scratches in other than the longitudinal direction 0.1 mm in width and ≤ 50 mm in length, but > 1 mm in length
- Two or more dirt or lint spots ≥ 2 mm in diameter
- Five or more dirt or lint spots ≤ 1.9 mm but > 0.1 mm in diameter
- Six or more pinholes ≥ 0.5 mm in diameter
- Ten or more pinholes < 0.5 mm but > 0.1 mm in diameter

c. Frame must contain full image and annotation data.

d. Defects on the master reproducible that are within specifications shall not be additive and cause for rejection of this product.

D.3 INSPECTION CRITERIA FOR 241-mm (+3) BLACK-AND-WHITE PAPER PRINT

Reject the image for the following defects in the image area:

- One obvious defect such as Newton rings, dirt, and lint
- Two or more dirt or lint spots ≥ 2 mm in diameter as detectable using 8X magnification
- Five or more dirt or lint spots < 1.9 mm but > 0.5 mm in diameter as detectable using 8X magnification
- Overall picture exposure: No criteria is to be applied to individual paper prints with respect to radiometric quality. The QA inspector and supervisors subjective judgment should

determine whether or not a paper print is correctly exposed. The following points should be considered when making this determination:

- Time of year
- Which sensor band was ordered
- Is the image area so dark as to blot out ground detail (i.e., overexposed)
- Ground scene reflective characteristics
- Is the image area so light as to wash out ground detail (i.e., underexposed)

D.4 THIR AND TOMS ARCHIVAL IMAGERY INSPECTION PROCEDURE

a. General Requirements

- Attach head and tail end-of-roll targets to all archived rolls.
- Read and uniformity and resolution on all archived rolls.
- Inspection will consist of a 100-percent evaluation of each image on the archival roll.
- Frame must contain full image and annotation data.
- All Nimbus archival rolls will be first and second inspected.

b. Sensitometry Inspection--End-of-roll target specifications.

- Uniformity +0.05
- Resolution 6/6

c. Image Gray Scale--read and record image gray-scale values. When the values do not meet specifications, the roll will be PDR S.O.P. 3.06.

d. Size Requirement--thir and toms imagery will be measured for correct size, and each image will have a black-line border around it. The X- and Y-size will measure 8 inches (±0.040 inches) (203.2 ±0.1 mm). Measure one image per roll. If the image exceeds the size specification, or a black line is missing PDR that W.O. per S.O.P.

e. Cloud-Cover Assessment--None.

f. Elecronic Inspection Criteria

- Two quality codes will be used when assessing Nimbus THIR and TOMS imagery.

  - Good--G
  - J-Code--J-2 Electronic/HRFR problems
J-1 Photo problems
J-6 Partial image
J-4 Missing

- Line drops are not to exceed five lines per image. Code J-2 is used when there are more than five lines per image.

- HRFR light leaks are rerun in the HRFR.

- HRFR Sync Loss.

  (1) Major-sync loss--Code J-2 and rerun in the HRFR.

  (2) Minor-sync losses will be acceptable and coded good provided that:

    (a) The sync loss does not distort the image area.
    (b) The image meets size specification.
    (c) The sync loss in a cloud-cover area is acceptable.

- Bit slips--Five or more inches image area rerun on the HRFR.

- Partial image--PDR for investigation of cause.

- Missing gray scale--PDR for investigation of cause.

- Data shifts (any PDR for investigation).

- Pixel errors--Rerun on the HRFR after problem on tape deck is resolved.

- Missing orbits--Half or more PDR for investigation.

- Image gray scale must be large enough to handle a 3-mm densitometer aperture.

g. Cosmetic Inspection Criteria--Reference ICD.

h. Labeling and Canning Procedures--Label the head and the tail of each Nimbus archive with the following information:

- Roll number
- Image count

- Date
- Inspection code number
- Sensor (i.e., THIR and TOMS)

D.5 QUALITY CONROL CHECKS FOR TPUTIL-COPIED TAPES

a. Two equal header records are guaranteed.

b. The tape-sequence number in the header must match the paper label-sequence number.

c. Headers will have valid tape ID and user ID; the generation date will be that of the new copy.

d. Tapes will be made from masters (-2 copies, in this case) that have no more than three severe I/O errors.

e. All records will have correct record IDs for that type of tape, identified by the PDF code in the header; and, the record length associated with that record ID and PDF code will be correct.

f. Record numbers must montonically start at and increase by 1 for each data file. Up to three record number jumps differing by 1 will be accepted. More than three such errors may be allowed by TRUTIL under special request by the user of the MetOCC.

g. Last record in file, last file on tape flags, except cathode-ray tube, and calibrated radiance, chlorophyll, sediment and temperature tapes must be correct, or the entire tape will be rejected.

h. No I/O errors are allowed on copies produced from TPUTIL.

APPENDIX E

TAPE SPECIFICATION FOR THE CALIBRATED-LOCATED DATA TAPE (CLDT, T344011)

SENSOR/INSTRUMENT: THIR

TAPE SPEC. NO. T344011, REVISION E DATE 7/15/81

SPEC. TITLE CALIBRATED--LOCATED DATA TAPE

CLDT

REVIEWED BY: Gail R. McConaughy DATE 7/8/80

Gail R. McConaughy SASC

APPROVED BY: DATE

Gary Wolford
NOPS Manager

Revision ~~A~~ D (11/1/78)
Revision E 07/15/81

NIMBUS-G

NIMBUS OBSERVATION PROCESSING SYSTEM (NOPS)

REQUIREMENTS DOCUMENT #NG-5

TAPE SPECIFICATION NO. T344011 - THIR CLDT

THIR CALIBRATED-LOCATED DATA TAPE

PREPARED BY: Edward Stoner Shaffer DATE: 8/1/78
E. S. Shaffer (699-5400)

CHANGES:

- Gross Output Format
  - Addition of Dummy Record to End of each Data File.
- Major Revisions to Documentation Record Format.
- Minor Revisions to Data Record Format.
- Inclusion of Dummy Record Format Description.
- Revision A (11/1/78)
  - Change of time units in Documentation Record Format. pp. 13
  - Change of time units in Data Record Format. pp. 19
- Revision E adds new standard header

ABSTRACT

The THIR Calibrated-Located Data Tape (CLDT) is a 9-track, 1600 BPI tape generated by a MODCOMP IV computer. The first file of a CLDT contains a NOPS Standard Header record written twice. Each subsequent file contains one orbit of data. (An orbit is defined as beginning at one descending node and ending at the next descending node.) Nominally, there are either six or seven orbital files (½ day of data) on a CLDT, terminated by double end-of-file marks.

Within each orbital file, there may be as many as 5000 THIR scans of data. The THIR scans are arranged in ascending time order. Only the earth-view portion of the scan is written to the CLDT. Each physical record in an orbital file can contain ten THIR scans. Thus, including a single Documentation Record at the beginning of the file and a single Dummy Record at the end of the file, as many as 502 physical records may be written for each orbit.

I. REQUIREMENT IDENTIFICATION

THIR Calibrated - Located Data Tape: Project Data Format Code ID; NOPS Specification No. T344011.

II. INPUT DATA SOURCES

1. Stripped THIR Tape (STT), PDF Code IB, NOPS Specification No. T344081.

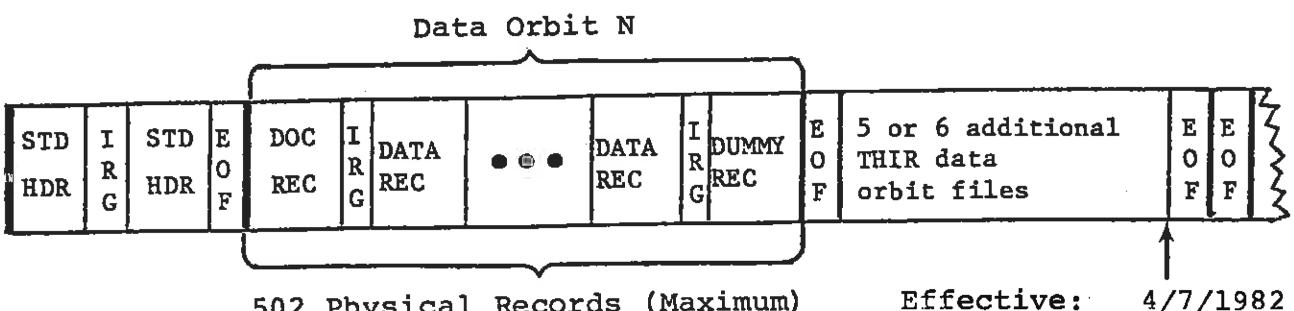
2. THIR Image Location Tape (ILT-T), PDF Code LI, NOPS Specification No. T324021.

III. OPERATING MODE

THIR data is available on the CLDT only when the THIR sensor is on.

When a CLDT has accumulated ½ day of data (6 or 7 orbits), the tape is terminated. If further THIR data is available for the day, a new CLDT is then initiated. CLDT sequence numbers are assigned sequentially in correspondence with the date of the THIR data, with two consecutive numbers being reserved for each day of S/C operation.

IV. GROSS OUTPUT FORMAT



Effective: 4/7/1982 (Data generation date) a trailing document file was added here. See Appendix E, page E-47 of this document.

V. STANDARD HEADER

All magnetic tapes used as interfaces within NOPS will require some form of identification. A standardized series of records in the initial file on each tape will be used and will be called a NOPS "Standard Header File." Some tapes used within a NOPS facility which do not pass an interface will be exempt from this requirement - although it is a recommended procedure.

The STD HRD will contain the spec number of the tape generated. The interface spec numbering system is shown in Table V-1.

Each STD HDR will be written in EBCDIC so that it can be easily printed for quick identification of the tape. Figure V-1 shows the standard header format using 24 bit words.

Because of the real possibility of an original tape being damaged in handling (resulting in the loss of many computations), each processing facility within NOPS will generate duplicate copies of master tapes. These duplicates will be delivered to IPD for data product generation or user copy generation and will be indicated by the characters "-2" added to the sequence number in the STD HDR. The original will be indicated by the characters "-1" and will be retained in a secure environment at the originating facility. When IPD returns copy no. 2 due to tape errors, a new copy will be sent to IPD with the same copy number, but identified on the tape canister as "-2A", then "-2B" for a subsequent redo, etc.

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the STD HDR on the tape. In the case of copies made from tapes not generated in IPD, a new set of 126 characters reflecting IPD as the source, and the Nimbus experimenter to whom the tape is being sent, as the destination, is produced. This new 126 character set is put at the start of the header and the second through fifth blocks of 126 characters are the first through fourth blocks from the original copy 2 tape (the first block of the copy 2 will be 1).

The format of a NOPS Standard Header Record is shown in Figure V-1. The contents of the record are as follows:

1. TAPE SPECIFICATION NUMBER (6 Characters) - Each distinct NOPS tape format is identified by an unique Tape Specification Number. The specification numbering system for NOPS interface tapes is shown in Table V-1.

2. PROJECT DATA FORMAT CODE (2 Characters) - Each distinct NOPS tape format is also identified by an unique Project Data Format (PDF) Code. PDF Codes for NOPS interface tapes are shown in Table V-2.

3. TAPE SEQUENCE NUMBER (5 Characters) - This number uniquely identifies a particular tape of a given PDF Code. Each processing facility within NOPS is responsible for deciding how to assign sequence numbers to the tapes that it generates. A sequence number of zero indicates that the tape is not a finished product (e.g., non-definitive ephemeris used, artificial VIP data used, etc.).

4. TAPE COPY NUMBER (1 Character) - This number distinguishes different copies of a tape having a given PDF Code and Sequence Number. Because of the real possibility of an original tape being damaged in handling, resulting in the loss of many computations, each NOPS processing facility generates duplicate

copies of master tapes. These duplicates are delivered to IPD for data product generation or user copy generation, and are distinguished by a Tape Copy Number of 2. The original tape is identified by a Tape Copy Number of 1, and is retained in a secure environment at the originating facility. If IPD returns a duplicate tape due to tape errors, a new copy is sent to IPD with the Tape Copy Number incremented by one.

5. <u>SUBSYSTEM ID</u> (4 characters) - This field identifies the NOPS Subsystem responsible for the generation of the tape. A list of these Subsystem ID's is included in Table V-1.

6. <u>SOURCE FACILITY ID</u> (4 Characters) - This field identifies the NOPS processing facility that generated the tape. A list of NOPS processing facilities is included in Table V-1.

7. <u>DESTINATION FACILITY ID</u> (4 Characters) - This field identifies the NOPS processing facility that is the primary user of the tape. A list of NOPS processing facilities is included in Table V-1.

8. <u>DATA START YEAR, DAY OF YEAR, AND TIME OF DAY</u> (4 Characters, 3 Characters, and 6 Characters respectively) - These three fields are used to record a lower bound for the time associated with any data written on the tape. The Year is given as a four-digit number, and Day of the Year as a three-digit number. The Time of the Day is given in Hours, Minutes, and Seconds, with

two digits allowed for each. Leading blanks or zeroes may be used where necessary to pad out these fields.

9. <u>DATA END YEAR, DAY OF YEAR, AND TIME OF DAY</u> (4 Characters, 3 Characters, and 6 Characters respectively) - These three fields are used to record an upper bound for the time associated with any data written on the tape. The Year is given as a four-digit number, and the Day of the Year as a three-digit number. The Time of the Day is given in Hours, Minutes, and Seconds, with two digits allowed for each. Leading blanks or zeroes may be used where necessary to pad out the fields. (Some facilities may not include end date and time in the header, in which case these fields will be left blank.)

10. <u>TAPE GENERATION YEAR, DAY OF YEAR, AND TIME OF DAY</u> (4 Characters, 3 Characters, and 6 Characters respectively) - These three fields are used to record the date and time of the tape's generation at the NOPS source facility. The Year is given as a four-digit number, and the Day of the Year as a three-digit number. The Time of Day is given in Hours, Minutes, and Seconds, with two digits allowed for each. Leading blanks or zeroes may be used where necessary to pad out these fields.

11. ORIGINAL HEADER DATA (126 Characters) - This field will be used by IPD, when generating user copies of NOPS interface tapes, to record the first 126 characters of Standard Header information from the original tape. This will assist the user in correctly identifying the original source of the data. If unused for this purpose, this field will be blank filled.

12. SUBSYSTEM DATA 1, 2, and 3 (126 Characters each) - These three fields are available for the use of the Subsystem Analysts for further identification of the tape's data. If unused, these fields will be blank filled.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16 mm microfilm. The NOPS Standard Header File on the tape which IPD receives would contain two of the following records.

$_b$NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T134031$_b$SQ$_b$NO

AA00027-2$_b$ERB$_{bb}$SACC$_b$TO$_b$IPD$_{bb}$START$_b$1979$_b$

032$_b$000432$_b$TO$_b$1979$_b$059$_b$235742$_b$GEN$_b$

1979$_b$104$_b$094500$_b$(followed by 504 blanks)

MSB 7 ... LSB 0	BYTES
"NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T" (24 Characters)	1-24
TAPE SPECIFICATION NUMBER (6 Characters)	25-30
"$_b$SQ$_b$NO$_b$" (7 Characters)	31-37
PDF CODE (2 Characters)	38-39
TAPE SEQUENCE NUMBER (5 Characters)	40-44
"-" (1 Character)	45
TAPE COPY NUMBER (1 Character)	46
BLANK (1 Character)	47
SUBSYSTEM ID (4 Characters)	48-51
BLANK (1 Character)	52
SOURCE FACILITY ID (4 Characters)	53-56
"$_b$TO$_b$" (4 Characters)	57-60
DESTINATION FACILITY ID (4 Characters)	61-64
"$_b$START$_b$" (7 Characters)	65-71
DATA START YEAR (4 Characters)	72-75
BLANK (1 Character)	76
DATA START DAY OF YEAR (3 Characters)	77-79
BLANK (1 Character)	80
DATA START HOURS, MINUTES, SECONDS (6 Characters)	81-86
"$_b$TO$_b$" (4 Characters)	87-90
DATA END YEAR (4 Characters)	91-94
BLANK (1 Character)	95
DATA END DAY OF YEAR (3 Characters)	96-98
BLANK (1 Character)	99
DATA END HOURS, MINUTES, SECONDS (6 Characters)	100-105

Figure V-1. NOPS Standard Header Record Format

Field	Characters
"$_b$GEN$_b$" (5 Characters)	106-110
TAPE GENERATION YEAR (4 Characters)	111-114
BLANK (1 Character)	115
TAPE GENERATION DAY OF YEAR (3 Characters)	116-118
BLANK (1 Character)	119
TAPE GENERATION HOURS, MINUTES, SECONDS (6 Characters)	120-125
BLANK (1 Character)	126
ORIGINAL HEADER DATA (126 Characters)	127-252
SUBSYSTEM DATA #1 (126 Characters)	253-378
SUBSYSTEM DATA #2 (126 Characters)	379-504
SUBSYSTEM DATA #3 (126 Characters)	504-630

105 48-BIT WORDS

140 36-BIT WORDS

210 24-BIT WORDS

315 16-BIT WORDS

630 8-BIT BYTES

FIGURE V-1. NOPS STANDARD HEADER RECORD FORMAT (Concluded)

A six digit number, prefixed with a "T" to denote TAPE, will be used.

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)

Tape number in sequence for subsystem (code to be derived)

Denstination Facility:
1 = NOC$_b$ (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD$_b$
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = USER

Source Facility (Same codes as listed for Destination Facility)

Subsystem
1 = ERB$_b$
2 = SMMR
3 = THIR
4 = SAM 2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT$_b$

TABLE V-1. NOPS TAPE SPECIFICATION NUMBERING CODE

SUBSYSTEM	TAPE ID	PDF	SUBSYSTEM	TAPE ID	PDF
ERB	MATRIX	AA	LIMS	MATRIX-M	EA
	TABLES	AB		MATRIX-C	EB
	MAT	AC		PROFILE-R	EC
	SEFDT	AD		PROFILE-I	ED
	ZMT	AE		RAT	EE
	STAGS	AG		IPAT	EF
				MAT	EG
SMMR	MATRIX-30	BA		CAT	EH
	MATRIX-LO	BB		SMAT	EI
	MATRIX-SS	BC		NMCT	EK
	MAP-30	BD		SCAT	EM
	MAP-LO	BE			
	MAP-SS	BF			
	PARM-30	BG	SBUV/	MATRIX	FA
	PARM-LO	BH	TOMS	TABLES	FB
	PARM-SS	BI		MONTAGE	FC
	TAT	BJ		RUT-S	FD
	CELL ALL	BK		OZONE-S	FE
	CELL-LO/SS	BL		OZONE-T	FF
				ZMT	FH
THIR	SOURCE	IA		RUT	FJ
	STT	IB			
	BSHT	IC	CZCS	SOURCE	ZA
	CLDT	ID		CRCST	ZB
	CLE	IE		CAT	ZC
	CLT	IF		CRCST-L	ZD
	HDT	IP		HDT	ZQ
SAM II	MATRIX	DA	SAMS	MATRIX	HA
	PROFILE	DB		RAT	HC
	RDAT	DC			
	BANAT	DD			
	NMCT	DE			
ILT	ILT/ERB	LA	USER	UFO/ERB	UA
	ILT/SMMR	LB		UFO/SMMR	UB
	ILT/THIR	LI		UFO/LIMS	UE
	ILT/SAM II	LD		UFO/SBUV	UF
	ILT/LIMS	LE		UFO/ILT	UL
	ILT/SBUV	LF			
	ILT/CZCS	LZ			
	ILT/SAMS	LH			
	ILT/CLOUDS	LC			
	ILT/LANNION	LL			

TABLE V-2. NIMBUS-G PROJECT DATA FORMAT CODES.
(as of 1 May 1978)

The following new standard header specification was added to this document on July 15, 1981.

All of these tape types with a generation date after June 22, 1980 will conform to this standard header.

Tapes processed before this date will conform to the preceeding standard header documentation.

EFFECTIVE DATE:__________

STANDARD HEADER SPECIFICATION AND TAPE DOCUMENTATION

V.1 GENERAL

All computer compatible tapes (CCT's) that are used as interfaces within NOPS require some form of identification. This applies to all CCT's that are currently defined by a NOPS tape specification, and that are also used for distribution or archiving purposes.

In addition to defining a "latest" product, data relating to previous products that went into the making of the "latest" product provides useful information when system problems occur.

The purpose of this revision to existing NOPS tape specifications is to define a scheme that allows the recording of the genealogy of a "latest" product, and in general adheres to existing tape documentation standards.

In brief the system is as follows:

1. A documentation file that consists of a string of physical records follows the data on any tape defined by a current NOPS tape specification. This will be referred to as a Trailing Documentation File (TDF), and be the last file on a tape when it exists.

2. The standard NOPS header file remains as defined, with minor modifications to the standard header record that reflect both the existence of a TDF and adherence to the IPD standard for sequence numbers.

The following sections define the NOPS standard header records and file, and the TDF. Data files as currently defined in NOPS tape specification remain unchanged.

V.2 STANDARD HEADER RECORD (SHR)

The SHR will consist of one physical record that consists of 5 logical records of 126 EBCIDIC characters. The first 126 characters will remain as previously defined with the exception of CHARACTER 1, and those characters that define the sequence number (40-45). CHARACTER 1 will contain an asterisk (*) and serve to notify all systems that a TDF is likely to follow the main data files and that the next logical record contains information relevant to complete identification. As of the implementation date of this specification, all sequence numbers will have the following form that is an IPD standard:[1]

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[1] This does not apply to CZCS Data. For CZCS data, CHARACTERS 40 to 45 represent a 6-digit sequence number.

CHARACTER 40 = The last digit of the year in which the data were acquired.

CHARACTER 41-43 = Julian day of the year in which the data were acquired.

CHARACTER 44 = Sequence number for this particular product (usually a 1) (e.g., CLDT's will have a 1 and 2, as there are 2 products per day).

CHARACTER 45 = The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.

CHARACTER 47 = This will remain as a blank unless it is needed to remove ambiguities in CHARACTER 40. This may occur if data are being acquired on October 24, 1988.

This scheme will uniquely identify any tape when used in conjunction with the tape specification number, the PDFC code, and the subsystem identification.

The second logical record consisting of 126 characters will contain information that is required to complete the history of the product.

CHARACTER 1-12	=	Software program name and version number.
CHARACTER 13-18	=	Program documentation reference number, if it exists.
CHARACTER 20-126	=	User defined comments that may be more relevant to the user than the preceding ones.

The NOPS standard header file will continue to consist of 2 records, the second being a duplicate of the first. Logical records 3 and 4 may be used for anything desired if no remake information is required.[2]

V.3 TRAILING DOCUMENTATION FILE (TDF)

The TDF will consist of all NOPS standard header records (non-duplicated) that relate to products that have gone into the making of the current product. Documentation records will be

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[2] In the case of CZCS these logical records are used to define the genealogy of the image rather than the method of V.3.

sequenced in accordance with their access; that is, first in is the first recorded. Every TDF is 630 bytes in length.

The first record of this file will serve to identify the file as a TDF. This will be accomplished by placing asterisks in CHARACTERS 1 to 10 followed by NOPS TRAILER DOCUMENTATION FILE FOR TAPE PRODUCT T [SPEC NO (6 digits)] GENERATED ON DDD HH MM. The exact spacing of this comment is noncritical as long as it is less than 116 characters. The second physical record will be a repeat of the header file NOPS standard header record for this type with the proviso that data referring to the end-time are correct for the data set. Following physical records will be an accumulation of TDF's of all input tapes. For those products that require more than one tape, the TDF will appear on the last tape only as well as the warning asterisk.

Table V-1

NOPS Specification Numbering Code

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)
6 = 9 Trk 6250 BPI

Tape number in sequence for subsystem (code to be derived)

Destination Facility
1 = NOC (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = LANN

Source Facility (Same code as Destination Facility)

1 = ERB
2 = SMMR
3 = THIR
4 = SAM2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

Rev. D adds 6250 bpi tapes as a possible product

Total 24 bit Words	MSB 24 22 20 18 16 14 12 10 8 6 4 2 1 LSB	Total Bits
1	* Nimbus - 7 $_b$NOPS$_b$SPEC$_b$ NO$_b$T └If TDF exists (24 Characters)	
8		192
9	SPEC NO. (6 Digits)	
10		
	$_b$SQ$_b$NO$_b$ (7 Characters)	
13	PDFC CODE (2 Char.)	
14	5 Digit Sequence No. (5 Characters) YJJJN *For CZCS these characters (40-45) are a six digit sequence # (includes Redo)	
15	REDO CHARACTER	408
16	1 Char..Tape Copy No / Blank Character	
17	(4 Characters) SUBSYSTEM I.D.	
18	Blank Character / SOURCE FACILITY	
19	(4 Characters) / Blank Character	
20	(T) Character / (Ø) Character / Blank Character	
21	(4 Characters) DESTINATION FACILITY I.D.	
22	(23 Characters)	
	START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$	
29		696
	END DATE AND TIME OF DATA (19 Characters) TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ * Some Facilities may not include end time in header	
36	(20 Characters)	
	DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$	
42		1008
84	BLANK (126 Characters) SW Program Name (1-12) Documentation (13-18) Comments (19-126)	2016
126	BLANK (126 Characters)	3024
168	BLANK (126 Characters)	4032
210	BLANK (126 Characters)	5040

EBCDIC TAPE FORMAT

Figure V -1. Standard Header (Physical Record Format)
(1 Character = 8 bits)

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

*NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T	(1 - 24 Character Count)
optional	
XXXXXX (96 digit spec number)	(25 - 30 Character Count)
$_b$SQ$_b$NO$_b$	(31 - 37 Character Count)
AA XXXXX (5 digit sequence No.)	(38 - 44 Character Count)

NOTE: If sequence number is zero, tape is not a finished product (i.e., definitive ephemeris not used, artificial VIP data, etc.) *

redo character	
-X (copy number 1 or 2)	(45, 46 Character Count)
$_b$YYYY$_b$ (4 character subsystem ID)	(47 - 52 Character Count)
YYYY (Generation Facility ID)	(53 - 56 Character Count)
$_b$TO$_b$YYYY (4 Char. Des. Fac. ID)	(57 - 64 Character Count)
$_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (Start year, day of year, hours, minutes, seconds)	(65 - 87 Character Count)

*For CZCS, characters 40 to 45 are a 6-digit sequence number.

${}_b\text{TO}_b\text{19XX}_b\text{DDD}_b\text{HHMMSS}_b$ (88 - 106 Character Count)

(End data and time of data)

$\text{GEN}_b\text{19XX}_b\text{DDD}_b\text{HHMMSS}_b$ (107 - 126 Character Count)

(Date and time tape was generated)

The second group of 126 characters will contain continuation documentation of the original 126 characters when required.

The third, fourth, and fifth groups of 126 characters each are intended for the use of the subsystem analysts for further identifications of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16 mm microfilm. The NOPS STD HDR file on the tape that IPD receives would contain two of the following records.

$\text{*NIMBUS-7NOPS}_b\text{SPEC}_b\text{NO}_b\text{T134031}_b\text{SQ}_b\text{NO}_b$

1st day of time period

AA90321-2$_b$ERB$_{bb}$SACC$_b$TO$_b$IPD$_{bb}$START$_b$1979$_b$

032$_b$000432$_b$TO$_b$1979$_b$059$_b$235742$_b$GEN$_b$

1979$_b$104$_b$094500$_b$followed by 504 blanks

First day of time period may not be first data day in the event of multiday-stacked products that are based in an ILT week.

V.4 TAPE DUPLICATION

It has been determined that the duplication of master tapes is neither time nor cost effective, thus the requirement of duplication implied in the preceding specification is rescinded. However, some tapes that require a great deal of effort to produce in terms of manpower and computer time should be duplicated.

If a redo is required due to tape errors or algorithm changes, this will be noted both on the CCT (HEADER C-45) and on the canister.

V.5 SHIPPING LETTERS

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the first 126 (or 138)

characters of the first physical record of SHF. In the event of copies made from CCT's that are not generated in IPD, a new physical record reflecting IPD as the source and the Nimbus experimenter to whom the tape is being sent as the destination, will be added as the second record of the TDF. All existing records in the TDF will be pushed down, but none will be lost. This record should also replace those in the SHF.

VI- A. DOCUMENTATION RECORD

The first physical record of each data file is always the Documentation Record. All of the documentation information for the file is contained in this record. The format of this record appears in Figure VI-1. The contents of this record are as follows:

1. PHYSICAL RECORD NUMBER (12 Bits) - The number of the physical record within the current file is given as an unsigned binary integer. The Documentation Record always has a Record Number of 1, as it is always the first physical record of a data file.

2. PHYSICAL RECORD ID (8 Bits) - This field identifies the last physical record in a data file, the physical records in the last data file on a tape, and the record type. The MSB is set to "1" if the physical record is the last one in the data file. The second MSB is set to "1" in all physical records in the last data file on the tape. The 6 LSB's are used to identify the type of physical record being read.

   $001010_2 = 10_{10}$ = Documentation Record

   $001011_2 = 11_{10}$ = Data Record

   $001111_2 = 15_{10}$ = Dummy Record (ignore remainder of record)

3. FILE NUMBER (32 Bits) - This number is used as a quick means of locating data on the tape, and recovering from abnormal program runs, power downs, etc. This number is incremented by 1 for each file on the tape.

4. DATA ORBIT NUMBER (32 Bits) - Each CLDT file corresponds to a data orbit, which starts at a descending node and ends at the next descending node. The data orbit number will be the current NASA orbit number at the beginning of the data orbit. (A NASA orbit is defined as beginning at the ascending node.)

5. DATA ORBIT START TIME (96 Bits) - The starting time of the data orbit, expressed as three 32-bit integers: the year, the day of the year, and the GMT of the day.

   a. YEAR (32 Bits) - Year numbers are given as all 4 digits of the calendar year (e.g., 1978).

   b. DAY OF YEAR (32 Bits) - Permissable values range from 1 to 365 (or 366 for leap years).

   c. GMT OF DAY (32 Bits) - The GMT is given in milliseconds of the day. Permissable values will range from 0 to 86399999.

   This time represents the earliest possible time for a THIR scan contained in this CLDT file.

6. DATA ORBIT END TIME (96 Bits) - The ending time of the data orbit, expressed as three 32-bit integers: year, day of year, GMT of day. (See Item 5 for further description.) This time represents the latest possible time for a THIR scan contained in this CLDT file.

7. TERMINATOR CROSSING TIMES (96 Bits each) - The times during the data orbit at which the S/C crossed the Southern terminator and the Northern terminator, as calculated from S/C and Solar ephemeris data. Both times are expressed as three 32-bit integers: year, day of year, GMT of day. (See Item 5 for further description.)

8. NODE LONGITUDES (32 Bits each) - The longitudes of the descending node at the beginning of the data orbit and the ascending node half-way through the data orbit. Longitudes are expressed as non-negative values, measured eastward from the Greenwich meridian. The units of longitude are degrees; LSB weight is 1/10. Permissable values range from 0 to 3599.

9. TIME OF ASCENDING NODE (96 Bits) - The time of the ascending node that occurs half-way through the data orbit. This time is expressed as three 32-bit integers: year, day of year, GMT of day. (See Item 5 for further description.)

NOTE:
The time of the descending node at the beginning of the data orbit is the same as the start time of the data orbit, given previously as Item 5.

10. SOLAR DECLINATION AT ASCENDING NODE (32 Bits) - The solar declination at the time of the ascending node that occurs half-way through the orbit. Solar declination is expressed as a non-negative value, measured northward from the South Pole. The units of solar declination are degrees; LSB weight is 1/1000. Permissable values range from 0 to 180000.

11. RADIANCE-TO-TEMPERATURE TABLES (4096 Bits each) - These tables permit the conversion of the THIR radiance measurements contained in each CLDT file into temperature values. Separate tables are provided for the 6.7 micron channel measurements and the 11.5 micron channel measurements. Each table consists of 256 16-bit temperature values. To perform a radiance-to-temperature conversion, the 8-bit radiance measurement is treated as an integer from 0 to 255 and used as a displacement from the first entry in the appropriate table. The temperature value thus located is the one that corresponds to the given radiance measurement. The units of temperature are degrees Kelvin; the LSB weight is 1/64. All temperature values are non-negative. (See Table VI-1.)

12. SPARES (65440 Bits) - These bits are used to fill out the Documentation Record to the same size as the Data Records. All spare bits will be zeroed.

MSB 31 ... 0 LSB

WORDS	31 – 24 | 23 – 16 | 15 – 8 | 7 – 0		BYTES
1	PHYS. REC. NO (12 bits) | SPARE (4 bits) | RECORD ID (8 bits) | SPARE (8 bits)		1-4
2	FILE NO.	(32 bits)	5-8
3	DATA ORBIT NO.	(32 bits)	9-12
4-6	DATA ORBIT START TIME	(96 bits)	13-24
7-9	DATA ORBIT STOP TIME	(96 bits)	25-36
10-12	SOUTHERN TERMINATOR CROSSING TIME	(96 bits)	37-48
13-15	NORTHERN TERMINATOR CROSSING TIME	(96 bits)	49-60
16	LONGITUDE OF DESCENDING NODE	(32 bits)	61-64
17	LONGITUDE OF ASCENDING NODE	(32 bits)	65-68
18-20	TIME OF ASCENDING NODE	(96 bits)	69-80
21	SOLAR DECLINATION AT ASCENDING NODE	(32 bits)	81-84
22-149	RADIANCE-TO-TEMPERATURE TABLE FOR 6.7 MICRON CHANNEL (256 16-BIT TEMPERATURES)	(4096 bits)	84-596
150-149	RADIANCE-TO-TEMPERATURE TABLE FOR 11.5 MICRON CHANNEL (256 16-BIT TEMPERATURES)	(4096 bits)	597-1108
278-2322	SPARES (All Spare Bits are Zeroed)	(65440 bits)	1109-9288

1548 48-BIT WORDS
2064 36- BIT WORDS
3096 24-BIT WORDS

2322 32-BIT WORDS
4644 16-BIT WORDS
9288 8-BIT BYTES

FIGURE VI-1. THIR CLDT - DOCUMENTATION RECORD FORMAT

RADIANCE-TO-TEMPERATURE CONVERSION TABLES

256 16-bit entries for the 6.7 micron channel.

256 16-bit entries for the 11.5 micron channel.

TABLE VI-1

(To Be Provided)

VI-B. DATA RECORD

Figure VI-2 shows the THIR CLDT Data Record format for 32-bit word machines. The format was designed to accommodate slight variations in orbital altitude that would affect the number of THIR samples in the Earth View of each scan. Each physical Data Record contains 10 scans of THIR data.

Figure VI-3 shows the format of each THIR scan within the physical record. Each scan contains 92 THIR words of located earth-view data. The nadir-view sample of the scan is always placed in the 47th THIR word, and the remaining samples centered around that position.

Figure VI-4 shows the format of each THIR word within the THIR scan. Each THIR word consists of a latitude value, a longitude value, and six THIR samples (radiance measurements). The latitude and longitude are applicable to the first 11.5 micron and 6.7 micron samples in the THIR word. The location of the other samples in the THIR word can be obtained by interpolation.

1. PHYSICAL RECORD NUMBER (12 Bits) - The number of the physical record within the current file is given as a unsigned binary integer. At the start of each new data file, the value of this field is reset to 1. The expected maximum value for a CLDT data file is 502.

2. PHYSICAL RECORD ID (8 Bits) - This field identifies the last physical record in a data file, the physical records in the last data file on a tape, and the record type. The MSB is set to "1" if the physical record is the last one in the data file. The second MSB is set to "1" in all physical records in the last data file on the tape. The 6 LSB's are used to identify the type of physical record being read.

$001010_2 = 10_{10}$ = Documentation Record

$001011_2 = 11_{10}$ = Data Record

$001111_2 = 15_{10}$ = Dummy Record
(ignore remainder of record)

3. THIR SCAN (7392 Bits) - Each THIR scan consists of 92 THIR words. The information from each scan is centered on the 47th THIR word (the nadir-view sample), and contains padded data on either side as necessary.

NOTE:
Scan direction is East-to-West at Ascending Node.
Scan direction is West-to-East at Descending Node.

4. TIME OF NADIR SAMPLE (16 Bits) - The time of the nadir-view sample in the scan is given in quarter (¼) seconds from the start time given in the Documentation Record of the data file.

5. <u>DATA FLAGS FOR THIR SCAN</u> (16 Bits) The data flags indicate various conditions for the data in the THIR scan. In the optimum situation, all flag bits are zero. The meanings of the flag bits are as follows:

2^{15}: 1 = Scan is empty - ignore contents.
0 = Scan contains data.

2^{14}: 1 = One or more scan lines prior to this one are missing - could not be recovered from telemetry stream.

0 = No scan lines missing between this one and the previous one.

2^{13}: 1 = Data quality of this scan line has been compromised due to one or more problems as specifically indicated in flag bits 2^{12} through 2^{1} below.

0 = Data quality of this scan line is satisfactory.

2^{12}: 1 = VIP telemetry not available for this scan line. Had to use interpolated or estimated values for calibration.

0 = VIP telemetry available for this scan line.

2^{11}: 1 = Non-definitive spacecraft ephemeris used to locate data.

0 = Definitive spacecraft ephemeris used to locate data.

2^{10}: 1 = Nominal attitude used to locate data.
0 = Actual attitude used to locate data.

2^9: (Unused)

2^8: (Unused)

2^7: 1 = No stair-step averages were available for voltage calibration of this scan line. Nominal or estimated values used.

0 = Stair-step averages were available.

2^6: 1 = No average space levels were available for radiometric calibration of this scan line. Nominal or estimated values used.

0 = Average space levels were available.

2^5: 1 = No average backscan levels were available for radiometric calibration of this scan line. Nominal or estimated values used.

0 = Average backscan levels were available.

2^4: 1 = Earth-view portion of scan line contains one or more located dummy (i.e., fill-value) samples.

0 = Earth-view portion of scan line contains all valid located samples.

2^3: Miscalculation caused by fill problem (10/8/81)

2^2: (Unused)

2^1: (Unused)

2^0: 1 = Second 11.5 micron sample of the 47th THIR word is the nadir-view 11.5 micron sample.

0 = First 11.5 micron sample of the 47th THIR word is the nadir-view 11.5 micron sample.

6. THIR WORD (80 Bits) - Each THIR word consists of a latitude value, a longitude value, and six THIR radiance measurements in the following channel sequence: 11.5 micron, 6.7 micron, 11.5 micron, 11.5 micron, 6.7 micron and 11.5 micron. The latitude and the longitude given are applicable to the first 11.5 micron and 6.7 micron measurements. The location of the other four measurements in the THIR word can be obtained by interpolating between this position and the position given in the next THIR word in the scan group. This should be done as follows:

- For the location of the 2nd 11.5 micron measurement, interpolate at the one-quarter point.
- For the location of the 3rd 11.5 micron measurement, and the 2nd 6.7 micron measurement, interpolate at the half-way point.
- For the location of the 4th 11.5 micron measurement, interpolate at the three-quarter point.

7. LATITUDE (16 Bits) - The units of latitude are degrees. Values range from 0° to 180°, where 0° indicates the South Pole, 90° the Equator, and 180° the North Pole. Thus, no negative values are used. The 16-bit latitude word is divided into a 9-bit integer part followed by 7-bit fractional part. This provides a resolution of 0.0078125 degrees (1/128°).

8. LONGITUDE (16 Bits) - The units of longitude are degrees. Values range from 0° to 360°, where 0° indicates the Greenwich Meridian, and larger values represent displacements eastward from Greenwich. Thus, no negative values are used. The 16-bit longitude word is divided into a 9-bit integer part followed by a 7-bit fractional part. This provides a resolution of 0.0078125 degrees.

NOTE:

If both the latitude and the longitude words are set to their maximum value ($FFFF_{16} = 65535_{10}$, or 511.9921875 degrees), this indicates that no position is associated with the THIR measurement in this THIR word. This would be the case if the measurements were taken in the atmosphere at the limb, or if the THIR word only represented fill at the beginning or end of the scan.

9. RADIANCE SAMPLES (8 Bits) - The units of radiance are watts/square-meter/steradian. All values are non-negative. For the 11.5 micron channel measurements, the LSB weight is 0.125, with permissable values ranging from 0 to 31.75. For the 6.7 micron channel measurements, the LSB weight is 0.015625, with permissable values ranging from 0 to 3.96875.

9. (continued)

NOTE:

If a radiance sample is set to its maximum value ($FF_{16} = 255_{10}$), this indicates that the sample represents a missing or non-existent measurement.

10. THIR ENGINEERING AND HOUSKEEPING DATA (96 Bits) - The following data items are written in the order listed below for each set of 10 THIR scans. The items are all 8 bits each.

    a. 3 Scan housing temperatures, VIP functions No. 9021, No. 9022 and No. 9023. Units are °C. Representation is unsigned fixed point; LSB weight is 0.2.

    b. Scan motor temperature, VIP Function No. 9024. Units are °C. Representation is unsigned fixed point; LSB weight is 0.2.

    c. Electronics temperature, VIP Function No. 9020. Units are °C. Representation is unsigned fixed point; LSB weight is 0.2.

    d. 2 Bolometer temperatures (11.5 micron and 6.7 micron channels), VIP Functions No. 9019 and No. 9018. Units are °C. Representation is unsigned fixed point; LSB weight is 0.2.

    e. 2 Average space-level counts (11.5 micron and 6.7 micron channels). - Average space-level reading over the 10 scans in the record. Units are raw (uncalibrated) counts. Representation is unsigned fixed point; LSB weight is 1 for the 11.5 micron channel, 1 for the 6.7 micron channel.

f. 2 Average housing-level counts (11.5 micron and 6.7 micron channels). - Average housing-level (backscan) readings over the 10 scans in the record. Units are raw (uncalibrated) counts. Representation is unsigned fixed-point; LSB weight is 1 for the 11.5 micron channel, and 1 for the 6.7 micron channel.

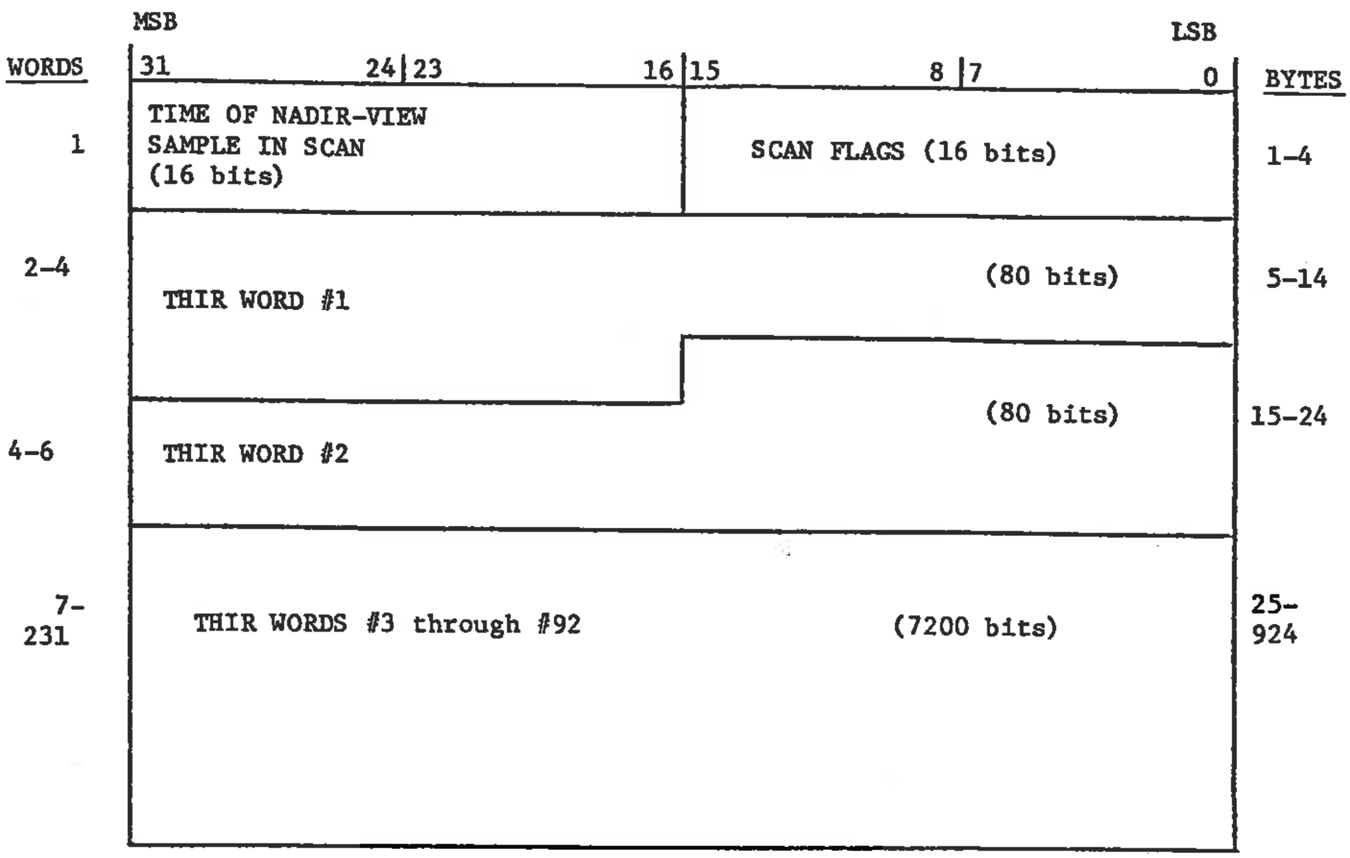
g. Spare. (Unused.)

MSB (bit 31) … LSB (bit 0)

WORDS	31 – 24 | 23 – 16		15 – 8	7 – 0	BYTES
1	PHYSICAL RECORD NO. (12 bits)	SPARES (4 bits)	PHYSICAL REC. ID (8 bits)	SPARES (8 bits)	1-4
2-232	THIR SCAN #1 (7392 bits)				5-928
233-463	THIR SCAN #2 (7392 bits)				929-1852
464-2311	THIR SCANS #3 through #10 (59136 bits)				1853-9244
2312-2314	THIR ENG. & HOUSEKEEPING DATA (96 bits)				9245-9256
2315-2322	SPARES (All spare bits are zeroed) (256 bits)				9257-9288

1548	48-BIT WORDS	2322	32-BIT WORDS
2064	36-BIT WORDS	4644	16-BIT WORDS
3096	24- BIT WORDS	9288	8-BIT BYTES

FIGURE VI-2. THIR CLDT - DATA RECORD FORMAT



231 32-BIT WORDS

462 16-BIT WORDS

924 8-BIT BYTES

FIGURE VI-3. THIR CLDT - THIR SCAN FORMAT

MSB 31–24	23–16	15–8	7–0 LSB	BYTES
LATITUDE (16 bits)		LONGITUDE (16 bits)		1-4
11.5 MICRON SAMPLE #1 (8 bits)	6.7 MICRON SAMPLE #1 (8 bits)	11.5 MICRON SAMPLE #2 (8 bits)	11.5 MICRON SAMPLE #3 (8 bits)	5-8
6.7 MICRON SAMPLE #2 (8 bits)	11.5 MICRON SAMPLE #4 (8 bits)			9-10

5 16-BIT WORDS

10 8-BIT BYTES

FIGURE VI-4. THIR CLDT - THIR WORD FORMAT

VI-C. DUMMY RECORD

The last physical record of each data file is always a Dummy Record. This permits the generating software to properly set the Last-Record-In-File bit of the Record ID field without having to know a priori the point of data termination. The format of this record appears in Figure VI-5. The contents of this record are as follows:

1. PHYSICAL RECORD NUMBER (12 Bits) - The number of this physical record within the current file is given as an unsigned binary integer. At the start of each new data file, the value of this field is reset to 1. The expected maximum value for a CLDT data file is 502.

2. PHYSICAL RECORD ID (8 Bits) - This field identifies the the last physical record in a data file, the physical records in the last data file on a tape, and the record type. The MSB is set to "1" if the physical record is the last one in the data file. The second MSB is set to "1" in all physical records in the last data file on the tape. The 6 LSB's are used to identify the type of physical record being read.

   $001010_2 = 10_{10}$ = Documentation Record

   $001011_2 = 11_{10}$ = Data Record

   $001111_2 = 15_{10}$ = Dummy Record (ignore remainder of record)

3. <u>SPARES</u> (74272 Bits) - These bits are used to fill out the Dummy Record to the same size as the Data Record. All spare bits will be zeroed.

WORDS	MSB 31 … 24 23	… 16	15 … 8	7 … 0 LSB	BYTES
1	PHY. REC. NO. (12 bits)	SPARE (4 bits)	PHY. REC. ID (8 bits)	SPARE (8 bits)	1-4
2-2322	SPARES (74272 bits) (All Spare Bits are Zeroed)				5-9288

1548 48-BIT WORDS	2322 32-BIT WORDS
2064 36-BIT WORDS	4644 16-BIT WORDS
3096 24-BIT WORDS	9288 8-BIT BYTES

FIGURE IV-5. THIR CLDT - DUMMY RECORD FORMAT

APPENDIX A

TAPE LENGTH CALCULATIONS

ASSUMPTIONS:

(1) Tape recording density is 1600 BPI.

(2) Inter-record gap (IRG) length is 0.65".

(3) End-of-file (EOF) gap length is 3.75".

CALCULATIONS:

(1) Standard Header File = 12"

(2) 502 Records/Orbit = 6.5"(including IRG) x 502 = 3263"

(3) 7 Orbits/Tape = 3267"(including EOF gap) x 7 = 22869"

22869" = 1906 Feet for data
1 Foot for Standard Header
1907 Feet, Total Tape Length Used.

EFFECTIVE DATE: __________

APPENDIX B

STANDARD HEADER SPECIFICATION AND TAPE DOCUMENTATION

Mike Foreman
NASA/GSFC

V.1 GENERAL

All computer compatible tapes (CCT's) that are used as interfaces within NOPS require some form of identification. This applies to all CCT's that are currently defined by a NOPS tape specification, and that are also used for distribution or archiving purposes.

In addition to defining a "latest" product, data relating to previous products that went into the making of the "latest" product provides useful information when system problems occur.

The purpose of this revision to existing NOPS tape specifications is to define a scheme that allows the recording of the genealogy of a "latest" product, and in general adheres to existing tape documentation standards.

In brief the system is as follows:

1. A documentation file that consists of a string of physical records <u>follows</u> the data on any tape defined by a current NOPS tape specification. This will be referred to as a Trailing Documentation File (TDF), and be the last file on a tape when it exists.

2. The standard NOPS header file remains as defined, with minor modifications to the standard header record that reflect both the existence of a TDF and adherence to the IPD standard for sequence numbers.

The following sections define the NOPS standard header records and file, and the TDF. Data files as currently defined in NOPS tape specification remain unchanged.

V.2 STANDARD HEADER RECORD (SHR)

The SHR will consist of one physical record that consists of 5 logical records of 126 EBCIDIC characters. The first 126 characters will remain as previously defined with the exception of CHARACTER 1, and those characters that define the sequence number (40-45). CHARACTER 1 will contain an asterisk (*) and serve to notify all systems that a TDF is likely to follow the main data files and that the next logical record contains information relevant to complete identification. As of the implementation date of this specification, all sequence numbers will have the following form that is an IPD standard:[1]

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[1]This does not apply to CZCS Data. For CZCS data, CHARACTERS 40 to 45 represent a 6-digit sequence number.

CHARACTER 40 = The last digit of the year in which the data were acquired.

CHARACTER 41-43 = Julian day of the year in which the data were acquired.

CHARACTER 44 = Sequence number for this particular product (usually a 1) (e.g., CLDT's will have a 1 and 2, as there are 2 products per day).

CHARACTER 45 = The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.

CHARACTER 47 = This will remain as a blank unless it is needed to remove ambiguities in CHARACTER 40. This may occur if data are being acquired on October 24, 1988.

This scheme will uniquely identify any tape when used in conjunction with the tape specification number, the PDFC code, and the subsystem identification.

The second logical record consisting of 126 characters will contain information that is required to complete the history of the product.

CHARACTER 1-12 = Software program name and version number.

CHARACTER 13-18 = Program documentation reference number, if it exists.

CHARACTER 20-126 = User defined comments that may be more relevant to the user than the preceding ones.

The NOPS standard header file will continue to consist of 2 records, the second being a duplicate of the first. Logical records 3 and 4 may be used for anything desired if no remake information is required.[2]

V.3 TRAILING DOCUMENTATION FILE (TDF)

The TDF will consist of all NOPS standard header records (non-duplicated) that relate to products that have gone into the making of the current product. Documentation records will be

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[2]In the case of CZCS these logical records are used to define the genealogy of the image rather than the method of V.3.

sequenced in accordance with their access; that is, first in is the first recorded. Every TDF is 630 bytes in length.

The first record of this file will serve to identify the file as a TDF. This will be accomplished by placing asterisks in CHARACTERS 1 to 10 followed by NOPS TRAILER DOCUMENTATION FILE FOR TAPE PRODUCT T [SPEC NO (6 digits)] GENERATED ON DDD HH MM. The exact spacing of this comment is noncritical as long as it is less than 116 characters. The second physical record will be a repeat of the header file NOPS standard header record for this type with the provison that data referring to the end-time are correct for the data set. Following physical records will be an accumulation of TDF's of all input tapes. For those products that require more than one tape, the TDF will appear on the last tape only as well as the warning asterisk.

Table V-1

NOPS Specification Numbering Code

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)
6 = 9 Trk 6250 BPI

Tape number in
sequence for subsystem
(code to be derived)

Destination
Facility
1 = NOC (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = LANN

Source Facility
(Same code as
Destination Facility)

1 = ERB
2 = SMMR
3 = THIR
4 = SAM2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

Rev. D adds 6250 bpi tapes as a possible product

Total 24 bit Words	MSB 24 · 22 · 20 · 18 · 16 · 14 · 12 · 10 · 8 · 6 · 4 · 2 · 1 LSB	Total Bits
1–8	* Nimbus – 7$_b$NOPS$_b$SPEC$_b$ NO$_b$T └→If TDF exists (24 Characters)	192
9–10	SPEC NO. (6 Digits)	
13	$_b$SQ$_b$NO$_b$ (7 Characters) | PDFC CODE (2 Char.)	
14–15	5 Digit Sequence No. (5 Characters) YJJJN *For CZCS these characters (40-45) are a six digit sequence #(includes Redo) | REDO CHARACTER	408
16	1 Char. Tape Copy No | Blank Character	
17	(4 Characters) SUBSYSTEM I.D.	
18–19	Blank Character | SOURCE FACILITY (4 Characters) | Blank Character	
20	(T) Character | (Ø) Character | Blank Character	
21–22	(4 Characters). DESTINATION FACILITY I.D.	
22–29	(23 Characters) START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$	696
36	END DATE AND TIME OF DATA (19 Characters) TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ * Some Facilities may not include end time in header	
36–42	(20 Characters) DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$	1008
84	BLANK (126 Characters) SW Program Name (1-12) Documentation (13-18) Comments (19-126)	2016
126	BLANK (126 Characters)	3024
168	BLANK (126 Characters)	4032
210	BLANK (126 Characters)	5040

EBCDIC TAPE FORMAT

Figure V -1. Standard Header (Physical Record Format)
(1 Character = 8 bits)

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

*NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T optional	(1 - 24 Character Count)
XXXXXX (96 digit spec number)	(25 - 30 Character Count)
$_b$SQ$_b$NO$_b$	(31 - 37 Character Count)
AA XXXXX (5 digit sequence No.)	(38 - 44 Character Count)

NOTE: If sequence number is zero, tape is not a finished product (i.e., definitive ephemeris not used, artificial VIP data, etc.) *

redo character -X (copy number 1 or 2)	(45, 46 Character Count)
$_b$YYYY$_b$ (4 character subsystem ID)	(47 - 52 Character Count)
YYYY (Generation Facility ID)	(53 - 56 Character Count)
$_b$TO$_b$YYYY (4 Char. Des. Fac. ID)	(57 - 64 Character Count)
$_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (Start year, day of year, hours, minutes, seconds)	(65 - 87 Character Count)

*For CZCS, characters 40 to 45 are a 6-digit sequence number.

$_{b}$TO$_{b}$19XX$_{b}$DDD$_{b}$HHMMSS$_{b}$ (88 - 106 Character Count)

(End data and time of data)

GEN$_{b}$19XX$_{b}$DDD$_{b}$HHMMSS$_{b}$ (107 - 126 Character Count)

(Date and time tape was generated)

The second group of 126 characters will contain continuation documentation of the original 126 characters when required.

The third, fourth, and fifth groups of 126 characters each are intended for the use of the subsystem analysts for further identifications of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16-mm microfilm. The NOPS STD HDR file on the tape that IPD receives would contain two of the following records.

*NIMBUS-7NOPS$_{b}$SPEC$_{b}$NO$_{b}$T134031$_{b}$SQ$_{b}$NO$_{b}$

1st day of time period

AA90321-2$_b$ERB$_{bb}$SACC$_b$TO$_b$IPD$_{bb}$START$_b$1979$_b$

032$_b$000432$_b$TO$_b$1979$_b$059$_b$235742$_b$GEN$_b$

1979$_b$104$_b$094500$_b$followed by 504 blanks

First day of time period may not be first data day in the event of multiday-stacked products that are based in an ILT week.

V.4 TAPE DUPLICATION

It has been determined that the duplication of master tapes is neither time nor cost effective, thus the requirement of duplication implied in the preceding specification is rescinded. However, some tapes that require a great deal of effort to produce in terms of manpower and computer time should be duplicated.

If a redo is required due to tape errors or algorithm changes, this will be noted both on the CCT (HEADER C-45) and on the canister.

V.5 SHIPPING LETTERS

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the first 126 (or 138)

characters of the first physical record of SHF. In the event of copies made from CCT's that are not generated in IPD, a new physical record reflecting IPD as the source and the Nimbus experimenter to whom the tape is being sent as the destination, will be added as the second record of the TDF. All existing records in the TDF will be pushed down, but none will be lost. This record should also replace those in the SHF.

APPENDIX F

TAPE SPECIFICATION FOR THE CLOUDS-SBUV/TOMS TAPE

(CLT, T343041)

SENSOR/INSTRUMENT: THIR

TAPE SPEC. NO. T343041, REVISION D DATED 7/20/81

SPEC. TITLE CLOUDS--SBUV/TOMS TAPE (CLT)

REVIEWED BY: Joseph [illegible] DATE 6/9/1980

APPROVED BY: DATE

Gary Wolford
NOPS Manager

REV. A 9/5/78
REV. B 9/14/78
REV. C 6/9/80
REV. D 7/20/81

NIMBUS-G

NIMBUS OBSERVATION PROCESSING SYSTEM (NOPS)

REQUIREMENTS DOCUMENT NG #8

TAPE SPECIFICATION NO. T343041

THIR CLOUDS-SBUV/TOMS TAPE (CLT)

PREPARED BY: R.A. Stephenson DATE: 7/19/77

REVISED BY: G.T. Cherrix DATE: 9/5/78

REV. A Revision includes major reformatting of all records.

REV. B Changes items on pp. 15,17,19,22,23 & 24

REV. C Changes items on pp, 1,14,15,18,23 & 26

REV. D Minor change on pp.2 and addemdum to Section V (new standard)

ABSTRACT

The THIR Clouds-SBUV/TOMS Tape (CLT) is a 9-track 1600 BPI tape generated by either a MODCOMP IV or UNIVAC 1180 or 1108. The first file contains a NOPS STANDARD HEADER RECORD written twice. Each subsequent file contains data from 1 GMT day (in whole orbits). There are up to 7 tapes per week generated, each containing a daily fill. Clouds-SBUV/TOMS tapes are generated whenever the THIR sensor is "ON" and the SBUV and/or TOMS sensor is "ON".

Within a daily file, there may be up to 14 orbits of data. Each orbit of THIR data will be processed scan by scan such that the THIR samples are placed into SBUV and TOMS IFOV histogram bins by location. After accumulating all possible THIR samples for a TOMS scan line, the data is written on the CLT. After accumulating all possible THIR samples for an SBUV IFOV, that data is saved and written on the CLT at the end of the orbit, of after all TOMS scans for that orbit have been written on the tape.

The CLT uses a logical record format with 8 logical records blocked per physical record. Each orbit begins with an orbital summary logical record at the beginning of the first physical record. All TOMS logical records then follow until the end of the orbit. Finally, the SBUV logical records are written and the physical record filled out with dummy logical records. Each orbit begins with a new physical record. As many as 714 physical records (5712 logical records) may be written in one daily file on a CLT under nominal daytime only operation.

A Dummy Physical Record, consisting of 8 Dummy logical records, may be written as the last record in a file, or as the only record(s) in the last file on a CLT.

I. REQUIREMENT IDENTIFICATION

THIR CLOUDS "T" (SBUV/TOMS) Tape Specification No. T343041.

II. INPUT DATA SOURCE

THIR Calibrated located data tape (CLDT) Specification No. T344011, and

ERB Sub-Target Area Geographical Season Tape (STAGS) Tape Specification No. T173051.

III. OPERATING MODE

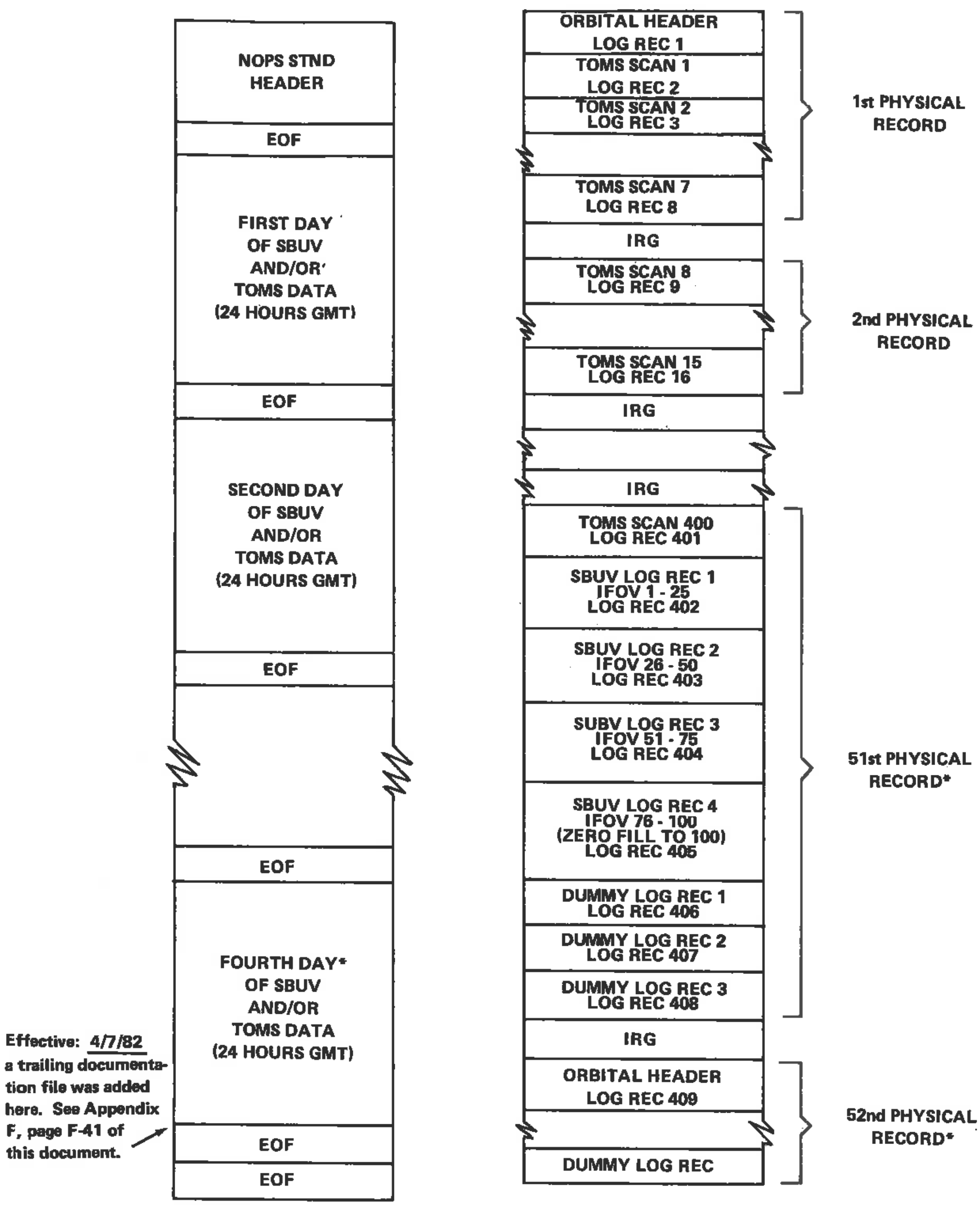
Data will be available based on the THIR Sensor being ON and the SBUV and/or TOMS Sensor being ON.

No physical record contains data from more than one data orbit. An orbit of CLT data may require up to 51 physical records under normal daytime only operation and up to 123 physical records under full time operation (very rare).

Seven days of data which match an ILT (Sunday through Saturday) will be stacked on each CLT commencing with data obtained after 21 June 1980. These stacked outputs will be on 6250 BPI tapes.

IV. GROSS TAPE FORMAT

DAILY FILE



*ASSUMING NORMAL DAYTIME ONLY DUTY CYCLE OF SBUV AND TOMS SENSORS

V. STANDARD HEADER

All magnetic tapes used as interfaces within NOPS will require some form of identification. A standardized series of records in the initial file on each tape will be used and will be called a NOPS "Standard Header File." Some tapes used within a NOPS facility which do not pass an interface will be exempt from this requirement - although it is a recommended procedure.

The STD HRD will contain the spec number of the tape generated. The interface spec numbering system is shown in Table V-1.

Each STD HDR will be written in EBCDIC so that it can be easily printed for quick identification of the tape. Figure V-1 shows the standard header format using 24 bit words.

Because of the real possibility of an original tape being damaged in handling (resulting in the loss of many computations), each processing facility within NOPS will generate duplicate copies of master tapes. These duplicates will be delivered to IPD for data product generation or user copy generation and will be indicated by the characters "-2" added to the sequence number in the STD HDR. The original will be indicated by the characters "-1" and will be retained in a secure environment at the originating facility. When IPD returns copy no. 2 due to tape errors, a new copy will be sent to IPD with the same copy number, but identified on the tape canister as "-2A", then "-2B" for a subsequent redo, etc.

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the STD HDR on the tape. In the case of copies made from tapes not generated in IPD, a new set of 126 characters reflecting IPD as the source, and the Nimbus experimenter to whom the tape is being sent, as the destination, is produced. This new 126 character set is put at the start of the header and the second through fifth blocks of 126 characters are the first through fourth blocks from the original copy 2 tape (the first block of the copy 2 will be 1).

TABLE V -1

NOPS SPECIFICATION NUMBERING CODE

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)

Tape number in sequence for subsystem (code to be derived)

Destination Facility:
1 = NOC$_b$ (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD$_b$
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = USER

Source Facility (Same code as Destination Facility)

Subsystem
1 = ERB$_b$
2 = SMMR
3 = THIR
4 = SAM 2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT$_b$

STANDARD HEADER (PHYSICAL RECORD FORMAT)

MSB 24 22 20 18 16 14 12 10 8 6 4 2 1 LSB

Word	Contents	Bits
1–8	$_b$Nimbus - 7$_b$NOPS$_b$SPEC$_b$ NO$_b$T (24 Characters)	192
9–10	SPEC NO. (6 Digits)	
10–13	$_b$SQ$_b$NO$_b$ (7 Characters)	
13	PDFC CODE (2 Char.)	
14–15	5 Digit Sequence No. (5 Characters	
15	Hyphen (1 Char.)	408
16	1 Char. Tape Copy No / Blank Character	
17	(4 Characters) SUBSYSTEM I.D.	
18	Blank Character / SOURCE FACILITY	
19	(4 Characters) / Blank Character	
20	(T) Character / (Ø) Character / Blank Character	
21	(4 Characters) DESTINATION FACILITY I.D.	
22–29	(23 Characters) START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$	696
29–36	END DATE AND TIME OF DATA (19 Characters) TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ * Some Facilities may not include end time in header	
36–42	(20 Characters) DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$	1008
42–84	BLANK (126 Characters	2016
84–126	BLANK (126 Characters)	3024
126–168	BLANK (126 Characters)	4032
168–210	BLANK (126 Characters)	5040

EBCDIC TAPE FORMAT
FIGURE V -1

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

$_b$NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T	(24 char.)	
XXXXXX (6 digit spec number)	(6 char.)	
$_b$SQ$_b$NO$_b$	(7 char.)	PDFC Designator and 5 digit sequence No.
AAXXXXX (5 digit sequence No.)	(7 char.)	

NOTE: If sequence number is zero, tape is not a finished product (i.e. definitive ephemeris not used, artificial VIP data, etc.)

-X (copy number 1 or 2)	(2 char.)
$_b$YYYY$_b$ (4 char. subsystem ID)	(6 char.)
YYYY (Generation Facility ID)	(4 char.)
$_b$TO$_b$YYYY (4 char. Des. Fac. ID)	(8 char.)
$_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (Start year, day of year, hours, minutes, seconds)	(23 char.)
TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (end data and time of data)	(19 char.)
GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (date and time tape was generated)	(20 char.)
	(126 char.)

The second group of 126 characters will contain blanks (to allow for the original 126 characters when IPD duplicates tape for distribution).

The third, fourth, and fifth groups of 126 characters each are intended for the use of the Subsystem Analysts for further identification of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16 mm microfilm. The NOPS STD HDR File on the tape which IPD receives would contain two of the following records.

$_{b}$NIMBUS-7$_{b}$NOPS$_{b}$SPEC$_{b}$NO$_{b}$T134031$_{b}$SQ$_{b}$NO$_{b}$

AA00027-2$_{b}$ERB$_{bb}$SACC$_{b}$TO$_{b}$IPD$_{bb}$START$_{b}$1979$_{b}$

032$_{b}$000432$_{b}$TO$_{b}$1979$_{b}$059$_{b}$235742$_{b}$GEN$_{b}$

1979$_{b}$104$_{b}$094500$_{b}$followed by 504 blanks

NIMBUS-G PROJECT DATA FORMAT CODES (MAY 5, 1980) REV. FROM MARCH 3, 1980

SENSOR	TAPE ID	ORIG.	COPIES	PDF	DATA TYPE	HORIZ LABEL	/ VERTIC COLORS
ERB ERB	MATRIX	12	72	AA	MAAA	D RED	/ L RED
	TABLES	12	-	AB	TAAB	D RED	/ D PINK
	MAT*	365	2555	AC	MTAC	D RED	/ D RED
	SEFDT*	12	84	AD	SEAD	D RED	/ YELLOW
	ZMT*	2	14	AE	ZMAE	L RED	/ L PINK
	STAGS	1	-	AG	STAG	D RED	/ D ORANGE
TOTALS		*379	2653				
	OTHER	25	72				
SMMR	MATRIX-30	12	-	BA	MABA	L TAN	/ YELLOW
	MATRIX-LO	12	-	BB	LOBB	L BRWN	/ L GRN
	MATRIX-SS	12	-	BC	SSBC	L BRWN	/ L ORAN
	MAP-30*	12	60	BD	MPBD	L BRWN	/ L PINK
	MAP-LO*	12	60	BE	LOBE	L BRWN	/ BLUE
	MAP-SS*	12	60	BF	SSBF	M TAN	/ M TAN
	PARM-30*	60	360	BG	PABG	M TAN	/ YELLOW
	PARM-LO*	30	150	BH	LOBH	M BRWN	/ YELLOW
	PARM-SS*	30	120	BI	SSBI	M BRWN	/ M BRWN
	TAT*	183	732	BJ	TABJ	D BRWN	/ YELLOW
	CELL-ALL*	61	427	BK	DEBK	D BRWN	/ L GRN
TOTALS		*400	1969				
	OTHER	36	-				
THIR	SOURCE	5110	-	IA	SOIA	D ORAN	/ D ORAN
	STT	1095	-	IB	STIB	D ORAN	/ YELLOW
	BSHT	365	-	IC	BSIC	D RED	EXP LABEL
	CLDT	730	1460	ID	CLID	D ORAN	/ D GRN
	CLE	219	1095	IE	CLIE	D ORAN	/ D PINK
	CLT	365	1825	IF	CLIF	M ORAN	/ GREY
	ILT-T	52	-	LI	ILLI	L ORAN	/ L PINK
	ILT-C	52	-	LC	ILLC	L ORAN	/ L BRWN
TOTALS (R)		7988	4380				
SAM II	MATRIX	4	24	DA	MADA	D PURP	/ D PURP
	PROFILE	12	72	DB	PRDB	D PURP	/ D ORAN
	RDAT*	12	72	DC	RDDC	M PURP	/ D GRN
	BANAT*	12	72	DD	BADD	M PURP	/ YELLOW
	NMCT@	52	-	DE	NMDE	D ORAN	EXP LABEL
	ILT@	52	-	LD	ILLD	D ORAN	EXP LABEL
TOTALS		* 24	144				
		@104	-				
	OTHER	16	96				

SENSOR	TAPE ID	ORIG.	COPIES	PDF	DATA TYPE	HORIZ LABEL	/ VERTIC COLORS
LIMS	MATRIX-M	14	28	EA	MAEA	YELLOW	/ BLUE
	MATRIX-C	14	28	EB	MAEB	YELLOW	/ L GREEN
	PROFILE-R	7	14	EC	PREC	YELLOW	/ L PINK
	PROFILE-I	21	42	ED	PRED	YELLOW	/ M TAN
	RAT*	210	945	EE	RAEE	YELLOW	/ D PINK
	IPAT*	105	347	EF	IPEF	YELLOW	/ D ORANGE
	MAT*	70	294	EG	MTEG	YELLOW	/ YELLOW
	CAT*	70	210	EH	CTEH	YELLOW	/ GREY
	SMAT*	7	28	EI	SMEI	YELLOW	/ L BROWN
	SCAT*	7	21	EM	SCEM	YELLOW	/ D GREEN
	NMCT@	52	-	EK	NMEK	YELLOW	EXP LABEL
	UFO@	295	-	UE	UFUE	YELLOW	EXP LABEL
	ILT@	30	-	LE	ILLE	YELLOW	EXP LABEL
TOTALS		*469	1845				
		@377	-				
	OTHER (R)	56	112				
SBUV/ TOMS	MATRIX	24	216	FA	MAFA	D GRN	/ D ORAN
	TABLES	12	-	FB	TAFB	L GRN	/ L PINK
	MONTAGE	52	-	FC	MOFC	D GRN	/ D PINK
	RUT-S*	26	26	FD	SRFD	GREY	/ D GRN
(R)	OZONE-S*	12	100	FE	OSFE	L GRN	/ L BRWN
(R)	OZONE-T*	180	1440	FF	OTFF	D GRN	/ D GRN
	ZMT*	2	16	FH	ZMFH	L GRN	/ L PINK
	RUT-T*	120	120	FJ	TRFJ	D GRN	/ YELLOW
TOTALS (R)		*340	1702				
	OTHER	88	216				
CZCS (R)	CRT360*	100	400	ZI	CRZI	BLUE	/ BLUE
	SOURCE	4500	-	ZA	SOZA	STANDARD STA LABEL	
(R)	CRCST*	250	1000	ZB	CRZB	BLUE	/ D GRN
	CAT	12	96	ZC	CAZC	BLUE	/ D ORAN
	CRT-L	900	1800	ZD	CRZD	BLUE	/ YELLOW
	ILT	52	-	LZ	ILLZ	BLUE	/ M TAN
(R)	CRT	2750	5500	ZE	CRZE	BLUE	/ D GRN
	ILT-L@	52	-	LL	ILLL	BLACK	EXP LABEL
(R)	CCT-F	225	-	ZH	CCZH	BLUE	/ PINK
(R)	LOIT#	250	-	ZF	LOZF	L GRN	/ GREY
(R)	DPIT#	250	-	ZG	DPZG	GRN	/ BLUE
TOTALS (R)		*350	1400				
		@ 52	-				
(R)		#500	-				
(R)		8439	7446				
SAMS	MATRIX	24	24	HA	MAHA	YEL-OR	/ L PINK
	RAT*	180	198	HC	RAHC	YEL-OR	/ YELLOW
	ILT@	183	-	LH	ILLH	GREY	EXP LABEL
	NMCT@	52	-	HD	NMHD	GREY	EXP LABEL
TOTALS		@ 235	-				
		* 180	198				
	OTHER	24	24				

		ORIGINALS	COPIES	PDF
(R)	* TOTALS	2,142	9,911	27
	@ TOTALS	768	-	8
(R)	# TOTALS	500	-	2
(R)	OTHER TOTALS	16,672	12,346	30
(R)	GRAND TOTALS	20,082	22,257	67

* [illegible] AND [illegible]
@ [illegible]
# [illegible]

(R) - SENSORS [illegible] [illegible]

NIMBUS G PROJECT DATA FORMAT CODES (Cont'd.)

SENSOR	TAPE ID	PDFC CODE
LOCATION	ILT/ERB	LA
	ILT/SMMR	LB
	ILT/THIR	LI
	ILT/SAM II	LD
	ILT/LIMS	LE
	ILT/SBUV	LF
	ILT/CZCS	LZ
	ILT/SAMS	LH
USER	UFO/ERB	UA
	UFO/SMMR	UB
	UFO/LIMS	UE
	UFO/SBUV	UF
	UFO/ILT	UL

1st CHARACTER	SOURCE/SENSOR	2nd CHARACTER	USER/SENSOR OR TAPE NUMBER
ERB	A		
SMMR	B		
THIR	I		
SAM II	D		
LIMS	E		
SBUV/TOMS	F		
CZCS	Z		
SAMS	H		
ILT	L		
UFO	U		

The following new standard header specification was added to this document on July 15, 1981.

All of these tape types with a generation date after June 22, 1980 will conform to this standard header.

Tapes processed before this date will conform to the preceeding standard header documentation.

STANDARD HEADER SPECIFICATION AND TAPE DOCUMENTATION

V.1 GENERAL

All computer compatible tapes (CCT's) that are used as interfaces within NOPS require some form of identification. This applies to all CCT's that are currently defined by a NOPS tape specification, and that are also used for distribution or archiving purposes.

In addition to defining a "latest" product, data relating to previous products that went into the making of the "latest" product provides useful information when system problems occur.

The purpose of this revision to existing NOPS tape specifications is to define a scheme that allows the recording of the genealogy of a "latest" product, and in general adheres to existing tape documentation standards.

In brief the system is as follows:

1. A documentation file that consists of a string of physical records follows the data on any tape defined by a current NOPS tape specification. This will be referred to as a Trailing Documentation File (TDF), and be the last file on a tape when it exists.

2. The standard NOPS header file remains as defined, with minor modifications to the standard header record that reflect both the existence of a TDF and adherence to the IPD standard for sequence numbers.

The following sections define the NOPS standard header records and file, and the TDF. Data files as currently defined in NOPS tape specification remain unchanged.

V.2 STANDARD HEADER RECORD (SHR)

The SHR will consist of one physical record that consists of 5 logical records of 126 EBCIDIC characters. The first 126 characters will remain as previously defined with the exception of CHARACTER 1, and those characters that define the sequence number (40-45). CHARACTER 1 will contain an asterisk (*) and serve to notify all systems that a TDF is likely to follow the main data files and that the next logical record contains information relevant to complete identification. As of the implementation date of this specification, all sequence numbers will have the following form that is an IPD standard:[1]

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[1]This does not apply to CZCS Data. For CZCS data, CHARACTERS 40 to 45 represent a 6-digit sequence number.

CHARACTER 40 = The last digit of the year in which the data were acquired.

CHARACTER 41-43 = Julian day of the year in which the data were acquired.

CHARACTER 44 = Sequence number for this particular product (usually a 1) (e.g., CLDT's will have a 1 and 2, as there are 2 products per day).

CHARACTER 45 = The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.

CHARACTER 47 = This will remain as a blank unless it is needed to remove ambiguities in CHARACTER 40. This may occur if data are being acquired on October 24, 1988.

This scheme will uniquely identify any tape when used in conjunction with the tape specification number, the PDFC code, and the subsystem identification.

The second logical record consisting of 126 characters will contain information that is required to complete the history of the product.

CHARACTER 1-12 = Software program name and version number.

CHARACTER 13-18 = Program documentation reference number, if it exists.

CHARACTER 20-126 = User defined comments that may be more relevant to the user than the preceding ones.

The NOPS standard header file will continue to consist of 2 records, the second being a duplicate of the first. Logical records 3 and 4 may be used for anything desired if no remake information is required.[2]

V.3 TRAILING DOCUMENTATION FILE (TDF)

The TDF will consist of all NOPS standard header records (non-duplicated) that relate to products that have gone into the making of the current product. Documentation records will be

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[2] In the case of CZCS these logical records are used to define the genealogy of the image rather than the method of V.3.

sequenced in accordance with their access; that is, first in is the first recorded. Every TDF is 630 bytes in length.

The first record of this file will serve to identify the file as a TDF. This will be accomplished by placing asterisks in CHARACTERS 1 to 10 followed by NOPS TRAILER DOCUMENTATION FILE FOR TAPE PRODUCT T [SPEC NO (6 digits)] GENERATED ON DDD HH MM. The exact spacing of this comment is noncritical as long as it is less than 116 characters. The second physical record will be a repeat of the header file NOPS standard header record for this type with the proviso that data referring to the end-time are correct for the data set. Following physical records will be an accumulation of TDF's of all input tapes. For those products that require more than one tape, the TDF will appear on the last tape only as well as the warning asterisk.

Table V-1

NOPS Specification Numbering Code

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)
6 = 9 Trk 6250 BPI

Tape number in
sequence for subsystem
(code to be derived)

Destination
Facility
1 = NOC (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = LANN

Source Facility
(Same code as
Destination Facility)

1 = ERB
2 = SMMR
3 = THIR
4 = SAM2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

Rev. D adds 6250 bpi tapes as a possible product

Total 24 bit Words	MSB 24 · 22 · 20 · 18 · 16 · 14 · 12 · 10 · 8 · 6 · 4 · 2 · 1 LSB			Total Bits
1–8	* Nimbus – 7$_b$NOPS$_b$SPEC$_b$ NO$_b$T └If TDF exists (24 Characters)			192
9–10	SPEC NO. (6 Digits)			
10–13	$_b$SQ$_b$NO$_b$ (7 Characters)			
13		PDFC CODE (2 Char.)		
14–15	5 Digit Sequence No. (5 Characters) YJJJN *For CZCS these characters (40-45) are a six digit sequence # (includes Redo)		REDO CHARACTER	408
16	1 Char..Tape Copy No	Blank Character		
17	(4 Characters) SUBSYSTEM I.D.			
18	Blank Character	SOURCE FACILITY		
19	(4 Characters)		Blank Character	
20	(T) Character	(Ø) Character	Blank Character	
21	(4 Characters) DESTINATION FACILITY I.D.			
22		(23 Characters)		
22–29	START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$			696
29–36	END DATE AND TIME OF DATA (19 Characters) TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ * Some Facilities may not include end time in header			
36		(20 Characters)		
36–42	DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$			1008
42–84	BLANK (126 Characters) SW Program Name (1-12) Documentation (13-18) Comments (19-126)			2016
84–126	BLANK (126 Characters)			3024
126–168	BLANK (126 Characters)			4032
168–210	BLANK (126 Characters)			5040

EBCDIC TAPE FORMAT

Figure V -1. Standard Header (Physical Record Format) (1 Character = 8 bits)

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

*NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T	(1 - 24 Character Count)
optional	
XXXXXX (96 digit spec number)	(25 - 30 Character Count)
$_b$SQ$_b$NO$_b$	(31 - 37 Character Count)
AA XXXXX (5 digit sequence No.)	(38 - 44 Character Count)

NOTE: If sequence number is zero, tape is not a finished product (i.e., definitive ephemeris not used, artificial VIP data, etc.) *

redo character	
-X (copy number 1 or 2)	(45, 46 Character Count)
$_b$YYYY$_b$ (4 character subsystem ID)	(47 - 52 Character Count)
YYYY (Generation Facility ID)	(53 - 56 Character Count)
$_b$TO$_b$YYYY (4 Char. Des. Fac. ID)	(57 - 64 Character Count)
$_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (Start year, day of year, hours, minutes, seconds)	(65 - 87 Character Count)

*For CZCS, characters 40 to 45 are a 6-digit sequence number.

$_{b}$TO$_{b}$19XX$_{b}$DDD$_{b}$HHMMSS$_{b}$ (88 - 106 Character Count)

(End data and time of data)

GEN$_{b}$19XX$_{b}$DDD$_{b}$HHMMSS$_{b}$ (107 - 126 Character Count)

(Date and time tape was generated)

The second group of 126 characters will contain continuation documentation of the original 126 characters when required.

The third, fourth, and fifth groups of 126 characters each are intended for the use of the subsystem analysts for further identifications of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16 mm microfilm. The NOPS STD HDR file on the tape that IPD receives would contain two of the following records.

*NIMBUS-7NOPS$_{b}$SPEC$_{b}$NO$_{b}$T134031$_{b}$SQ$_{b}$NO$_{b}$

1st day of time period

AA90321-2$_{b}$ERB$_{bb}$SACC$_{b}$TO$_{b}$IPD$_{bb}$START$_{b}$1979$_{b}$

032$_{b}$000432$_{b}$TO$_{b}$1979$_{b}$059$_{b}$235742$_{b}$GEN$_{b}$

1979$_{b}$104$_{b}$094500$_{b}$followed by 504 blanks

First day of time period may not be first data day in the event of multiday-stacked products that are based in an ILT week.

V.4 TAPE DUPLICATION

It has been determined that the duplication of master tapes is neither time nor cost effective, thus the requirement of duplication implied in the preceding specification is rescinded. However, some tapes that require a great deal of effort to produce in terms of manpower and computer time should be duplicated.

If a redo is required due to tape errors or algorithm changes, this will be noted both on the CCT (HEADER C-45) and on the canister.

V.5 SHIPPING LETTERS

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the first 126 (or 138)

characters of the first physical record of SHF. In the event of copies made from CCT's that are not generated in IPD, a new physical record reflecting IPD as the source and the Nimbus experimenter to whom the tape is being sent as the destination, will be added as the second record of the TDF. All existing records in the TDF will be pushed down, but none will be lost. This record should also replace those in the SHF.

VI. PHYSICAL RECORD FORMAT.

For each orbit that the THIR Subsystem is "ON" and the SBUV and/or TOMS Subsystem is "ON" at least one physical record of data is generated. For normal full time (day-time only) operation 51 physical records will be output. These records are based on data orbits and contain only data from a single orbit. Each physical record contains 8 logical records. There are four types of logical records on this tape:

1. SBUV/TOMS HEADER LOGICAL RECORD
2. TOMS DATA LOGICAL RECORD
3. SBUV DATA LOGICAL RECORD
4. SBUV/TOMS DUMMY LOGICAL RECORD

Each is described in the appropriate sections following. The data is output in ascending time order by whole scan lines for TOMS and by IFOV's for SBUV.

The actual histogram ranges for the population counts of the 11 um channel THIR data are determined from the ERB STAGS Tape NOPS Spec. No. T173051.

The values used for bin separation are expressed in radiances. Conversion tables from radiances to Temperature for both channels are available in the THIR/CLDT documentation (T344011).

The first 32 bits of all logical records follow the standard NOPS format for a physical record which is described as follows:

(1a) <u>PHYSICAL RECORD NO.</u> (12 BITS) - This is the number at this physical record within the file. It starts at 1 and increments by 1 throughout the file. All logical records within a physical record repeat the same number.

(1b) <u>SPARE.</u> (4 BITS) - Zeroes for word alignment.

(1c) <u>FILE CONTROL.</u> (2 BITS) - The MSB is set to 1 if this physical record is the last one in the file. The LSB is set to 1 for all records (logical or physical) in the last file on a tape.

(1d) <u>RECORD ID.</u> (6 BITS) - This number identifies the logical record type and is the following:

1) SBUV/TOMS HEADER LOGICAL RECORD ID = 30

2) TOMS DATA (SCAN LINE) LOGICAL RECORD ID = 31

3) SBUV DATA LOGICAL RECORD ID = 32

4) SBUV/TOMS DUMMY LOGICAL RECORD ID = 33

(1e) <u>SPARE.</u> (8 BITS) - Zeroes for word alignment.

VIa. <u>SBUV/TOMS HEADER LOGICAL RECORD</u>.

Figure VI-1 shows the contents of this type of record. A Header Logical record is always placed at the beginning of the first physical record of a data orbit. The first 32-bit word is as described in the previous section. The remaining 251 32-bit words are as follows:

(2a) <u>DATA ORBIT NO</u>. (16 BITS) - The data is output based on a data orbit which starts at a descending node and ends at the following descending node. The orbit number will be the NASA orbit number at the beginning of the data orbit. (NASA orbit is defined as beginning at the ascending node).

(2b) <u>START DAY OF DATA ORBIT</u>. (16 BITS) - The GMT day number at the start of the data orbit (descending node). (0-366).

(3a) <u>YEAR NUMBER</u>. (16 BITS) - The full year number as of the start of data orbit.

(3b) <u>SPARE</u>. (16 BITS) - Zeroes for boundary alignment.

(4) <u>START TIME OF DATA ORBIT</u>. (32 BITS) - The integer seconds of day at the beginning of the data orbit.

(5) <u>END TIME OF DATA ORBIT</u>. (32 BITS) - The Integer seconds of day at the end of the data orbit.

<u>Note</u>: Words 2 thru 9 are taken from the appropriate SBUV/TOMS ILT record.

(6) <u>TIME OF FIRST SBUV DATA</u>. (32 BITS) - The GMT in milliseconds of day at the beginning of the first SBUV IFOV (VIP Major Frame time) in the orbit.

(7) TIME OF LAST SBUV DATA. (32 BITS) - The GMT in milliseconds of day at the beginning of the last SBUV IFOV (VIP Major Frame time) in the orbit as taken from the Clouds-ILT (T324051).

(8) TIME OF FIRST TOMS SCAN. (32 BITS) - The GMT in milliseconds of day at the beginning of the first TOMS SCAN (VIP Major Frame time) in the orbit.

(9) TIME OF LAST TOMS SCAN. (32 BITS) - The GMT in milliseconds of day at the beginning of the last TOMS SCAN (VIP Major Frame time) in the orbit as taken from the Clouds-ILT (T324051).

(10) SPARES. (7,776 BITS) - Zeroes to fill logical record to required length.

FIGURE VI-1

SBUV/TOMS HEADER LOGICAL RECORD (FIRST IN ORBIT)

WORD	32–17		16–1			BITS
1	PHYSICAL RECORD NUMBER (12 BITS)	SPARE (4 BITS)	FILE CONT. 2 BITS	RECORD ID = 30 (6 BITS)	SPARE (8 BITS)	32
2	DATA ORBIT NUMBER (16 BITS)		DAY OF YEAR AT START OF DATA ORBIT (16 BITS)			64
3	YEAR AT START OF DATA ORBIT (16 BITS)		SPARE (ZEROES) (16 BITS)			96
4	GMT (SECONDS OF DAY) AT START OF DATA ORBIT (32 BITS)					128
5	GMT (SECONDS OF DAY) AT END OF DATA ORBIT (32 BITS)					160
6	GMT MILLISECONDS OF FIRST SBUV DATA LOGICAL RECORD IN ORBIT (32 BITS)					192
7	GMT MILLISECONDS OF LAST SBUV DATA LOGICAL RECORD IN ORBIT (32 BITS)					224
8	GMT MILLISECONDS OF FIRST TOMS DATA LOGICAL RECORD (SCAN) IN ORBIT (32 BITS)					256
9	GMT MILLISECONDS OF LAST TOMS DATA LOGICAL RECORD (SCAN) IN ORBIT (32 BITS)					288
10–252	SPARE (ZEROES) 972 BYTES FOR RECORD LENGTH COMPATIBILITY (7,776 BITS)					8,064

224 36 BIT WORDS 252 32 BIT WORDS 336 24 BIT WORDS 1,008 BYTES 8,064 BITS

VIb. TOMS DATA LOGICAL RECORD.

Figure VI-2 shows the contents of this type of record. One of these logical records is generated for each scan line of TOMS data collected as determined from the SBUV/TOMS-ILT. The first 32-Bit word is as described in a previous section. The remaining 251 32-Bit words are as follows:

(2) TIME OF TOMS SCAN. (32 BITS) - The GMT in milliseconds of day of this TOMS Scan line as determined by the VIP Major frame time given on the SBUV/TOMS-ILT.

Words 3 through 9 refers to the first TOMS IFOV of this scan.

(3a) SURFACE CATEGORY CODE. (8 BITS) - This code is taken from the STAGS tape and indicates the type of surface in the ERB-STA in which this IFOV falls. The only valid codes are:

1 = Land 2 = Water 3 = Land and Water 4 = Ice or Snow

5 = Ice and Land 6 = Ice/Snow and Water

7 = Ice, Land, and Water

(3b) POPULATION OF 11.5U SURFACE SAMPLES. (8 BITS) - The number of THIR 11.5 um samples accumulated in the IFOV whose radiances are higher than the SURFACE range described in word (4a).

(3c) MEAN RADIANCE OF SURFACE 11.5 UM. (8 BITS) - The mean of all the 11.5 UM radiances from the samples accumulated in word (3b). The LSB represents 0.125 W/M^2-STER.

(3d) MEAN RADIANCE OF SURFACE 6.7 U. (8 BITS) - The mean of all the 6.7 um radiances for samples colocated with those 11.5 um samples accumulated in word (3b). The LSB represents 0.015625 W/M^2-STER.

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FIGURE VI - 2 TOMS DATA LOGICAL RECORD

WORD	32	24	16	8 1	BITS
1	PHYSICAL RECORD NUMBER (12 BITS)	SPARE (4 BITS)	FILE CONT (2) / RECORD ID=31 (6 BITS)	SPARE (8 BITS)	32
2	GMT MILLISECONDS OF DAY AT START OF TOMS SCAN (32 BITS)				64
3	SURFACE CODE (8 BITS)	POPULATION SURFACE (8 BITS)	MEAN RADIANCE 11.5 SURFACE (8 BITS)	MEAN RADIANCE 6.7 SURFACE (8 BITS)	96
4	SURFACE/LOW CLOUDS RADIANCE (8 BITS)	POPULATION LOW CLOUDS (8 BITS)	MEAN RADIANCE 11.5 LOW CLOUDS (8 BITS)	MEAN RADIANCE 6.7 LOW CLOUDS (8 BITS)	128
5	LOW/MEDIUM CLOUDS RADIANCE (8 BITS)	POPULATION MEDIUM CLOUDS (8 BITS)	MEAN RADIANCE 11.5 MEDIUM CLOUDS (8 BITS)	MEAN RADIANCE 6.7 MEDIUM CLOUDS (8 BITS)	160
6	MEDIUM/HIGH CLOUDS RADIANCE (8 BITS)	POPULATION HIGH CLOUDS (8 BITS)	MEAN RADIANCE 11.5 HIGH CLOUDS (8 BITS)	MEAN RADIANCE 6.7 HIGH CLOUDS (8 BITS)	192
7	SPARE (8 BITS)	CIRRUS LOW/HIGH RADIANCE 6.7 (8 BITS)	TERRAIN HEIGHT (16 BITS)		224
8	RMS DEV 11.5 SURFACE (8 BITS)	RMS DEV 11.5 LOW CLOUDS (8 BITS)	RMS DEV 11.5 MEDIUM CLOUDS (8 BITS)	RMS DEV 11.5 HIGH CLOUDS (8 BITS)	256
9	RMS DEV 6.7 SURFACE (8 BITS)	RMS DEV 6.7 LOW CLOUDS (8 BITS)	RMS DEV 6.7 MEDIUM CLOUDS (8 BITS)	RMS DEV 6.7 HIGH CLOUDS (8 BITS)	288
10 247	REPEAT WORDS 3 THRU 9 34 TIMES FOR A TOTAL OF 35 TOMS IFOVS IN ONE TOMS SCAN 28x34= 952 BYTES (7,616 BITS)				7,904
248	SPARES (ZEROES) 18 BYTES FOR RECORD LENGTH COMPATIBILITY (144 BITS)				
252			LAST RECORD IN ORBIT FLAG (16 BITS)		8,064

224 36 BIT WORDS 252 32 BIT WORDS 336 24 BIT WORDS 1008 BYTES 8,064 BITS

(4a) SURFACE/LOW CLOUD RADIANCE. (8 BITS) - The radiance used to separate the THIR 11.5 UM samples into the lowest histogram level; between Surface and Low Altitude Clouds. The LSB represents 0.125 W/M^2-STER.

(4b) POPULATION OF LOW CLOUD SAMPLES 11.5 UM. (8 BITS) - The number of THIR 11.5 UM samples accumulated in this IFOV whose radiances fall between word (4a) and word (5a).

(4c) MEAN RADIANCE OF LOW CLOUD SAMPLES 11.5 UM. (8 BITS) - Same as word (3c) except for samples accumulated in word (4b).

(4d) MEAN RADIANCE OF.LOW CLOUDS 6.7 UM. (8 BITS) - Same as word (3d) except for samples accumulated in word(4b).

(5a) LOW/MEDIUM CLOUD RADIANCE. (8 BITS) - The radiance used to separate the THIR 11.5 UM samples into the two mid-level histograms; between low and medium altitude clouds. The LSB represents 0.125 W/M^2-STER.

(5b) POPULATION OF MEDIUM CLOUD SAMPLES 11.5 UM. (8 BITS) - The number of THIR 11.5 UM samples accumulated in the IFOV whose radiances fall between words (5a) and (6a).

(5c) MEAN RADIANCE OF MEDIUM CLOUS SAMPLES 11.5 UM. (8 BITS) - Same as word (3c) except for samples accumulated in word (5b).

(5d) MEAN RADIANCE OF MEDIUM CLOUD SAMPLES 6.7 UM. (8 BITS) - Same as word (3d) except for samples accumulated in word (5b).

(6a) MEDIUM/HIGH CLOUD RADIANCE 11.5 UM. (8 BITS) - The radiance used to separate the THIR 11.5 UM samples into the highest histogram level; between high and medium altitude clouds. The LSB represents 0.125 W/M^2-STER.

(6b) POPULATION OF HIGH CLOUD SAMPLES 11.5 UM. (8 BITS)
The number of THIR 11.5 UM samples accumulated in this IFOV whose radiances fall below word (6a).

(6c) MEAN RADIANCES OF HIGH CLOUD SAMPLES 11.5 UM (8 BITS) - Same as word (3c) except for samples accumulated in word (6b).

(6d) MEAN RADIANCE OF HIGH CLOUD SAMPLES 6.7 UM (8 BITS) - Same as word (3d) except for samples accumulated in word (6b).

(7a) SPARE. (8 BITS) - Zeroes for word alignment.

(7b) CIRRUS HIGH/LOW RADIANCE 6.7 UM. (8 BITS) - The 6.7 UM radiance used in SACC(SBUV/TOMS) processing to determine the presence of cirrus clouds in the TOMS IFOV. The LSB represents 0.015625 W/M^2- STER. This word is passed from the ERB/STAGS Tape

(7c) TERRAIN HEIGHT (16 BITS) - The average terrain height equivalent for this IFOV expressed in meters from mean sea level. This word is passed from the ERB/STAGS tape.

(8a) RMS DEVIATION SURFACE 11.5 UM. (8 BITS) - The RMS deviation of the 11.5 UM samples averaged in word (3c). The LSB represents 0.015625 W/M^2-STER.

(8b) RMS DEVIATION LOW CLOUDS 11.5 UM. (8 BITS) - The RMS deviation for word (4c). Scaled the same as word (8a).

(8c) RMS DEVIATION MEDIUM CLOUDS 11.5 UM. (8 BITS) - The RMS deviation for word (5c). Scaled the same as word (8a).

(8d) RMS DEVIATION HIGH CLOUDS 11.5 UM. (8 BITS) - The RMS deviation for word (6c) of item (20). Scaled the same as word (8a).

(9a) RMS DEVIATION SURFAC E 6.7 UM. (8 BITS) - The RMS deviation of the 6.7 U samples averaged in word (3d). The LSB represents 0.00392 W/M^2-STER

(9b) RMS DEVIATION LOW CLOUDS 6.7 UM. (8 BITS) - The RMS deviation for word (4d). Scaled the same as word (9a).

(9c) RMS DEVIATION MEDIUM CLOUDS 6.7 UM. (8 BITS) - The RMS deviation for (5d). Scaled the same as word (9a).

(9d) RMS DEVIATION HIGH CLOUDS 6.7 UM. (8 BITS) - The RMS deviation for word (6d). Scaled the same as word (9a).

(10) IFOVS 2 thru 35 (7,616 BITS) - Repeat words 3 thru 9 34 additional times for a total of 35 IFOVs in this TOMS scan line.

(248) SPARES (144 BITS) Zeroes for word alignment.

(252d) LAST RECORD IN ORBIT FLAG. (16 BITS) - Normally zero these 16 bits are set to all ones (-1) in the last logical record of data in this orbit and all remaining logical records needed to fill out the last physical record.

VIc SBUV DATA LOGICAL RECORD

Figure VI-3 shows the contents of this type of record. One of these logical records contains up to 25 SBUV IFOVs of data collected as determined from the SBUV/TOMS-ILT. The first 32-Bit word is as described in a previous section. The remaining 251 32-Bit words are as follows:

(2) TIME OF SBUV SCAN. (32 BITS) - The GMT in milliseconds of day at the start of this SBUV IFOV as determined by the VIP Major frame time given on the SBUV/TOMS-ILT.

Words 2 thru 11 refer to the first SBUV IFOV of this logical record.

(3a) POPULATION OF 11.5U SURFACE SAMPLES. (16 BITS) - The number of THIR 11.5 um samples accumulated in the IFOV whose radiances are higher than the SURFACE range described in work (10b).

(3b) MEAN RADIANCE OF SURFACE 11.5 UM. (8 BITS) - The mean of all the 11.5 UM radiances from the samples accumulated in word (3a). The LSB represents 0.125 W/M^2-STER.

(3c) MEAN RADIANCE OF SURFACE 6.7 UM (8 BITS) - The mean of all the 6.7 um radiances for samples colocated with those 11.5 um samples accumulated in word (3a). The LSB represents 0.015625 W/M^2-STER.

(4a) POPULATION OF LOW CLOUD SAMPLES 11.5 UM. (16 BITS) - The number of THIR 11.5 UM samples accumulated in this IFOV whose radiances fall between word (10b) and word (10c).

(4b) MEAN RADIANCE OF LOW CLOUD SAMPLES 11.5 UM. (8 BITS) - Same as word (3b) except for samples accumulated in word (4a).

(4c) MEAN RADIANCE OF LOW CLOUDS 6.7 UM. (8 BITS) - Same as word (3c) except for samples accumulated in word (4a).

(5a) POPULATION OF MEDIUM CLOUD SAMPLES 11.5 UM. (16 BITS) - The number of THIR 11.5 UM samples accumulated in the IFOV whose radiances fall between words (10c) and (10d).

(5b) MEAN RADIANCE OF MEDIUM CLOUD SAMPLES 11.5 UM. (8 BITS) - Same as word (3b) except for samples accumulated in word (5a).

(5c) MEAN RADIANCE OF MEDIUM CLOUD SAMPLES 6.7 UM. (8 BITS) - Same as word (3c) except for samples accumulated in word (5a).

FIGURE VI-3 SBUV DATA LOGICAL RECORD

WORD	32	24	16		8	1 BITS
1	PHYSICAL RECORD NUMBER (12 BITS)	SPARE (4 BITS)	FILE CONT (2)	RECORD ID=32 (6 BITS)	SPARE (8 BITS)	32
2	GMT MILLISECONDS OF DAY AT START OF SBUV MAJOR FRAME ZERO (32 BITS)					64
3	POPULATION SURFACE (16 BITS)		MEAN RADIANCE 11.5 SURFACE (8 BITS)		MEAN RADIANCE 6.7 SURFACE (8 BITS)	96
4	POPULATION LOW CLOUDS (16 BITS)		MEAN RADIANCE 11.5 LOW CLOUDS (8 BITS)		MEAN RADIANCE 6.7 LOW CLOUDS (8 BITS)	128
5	POPULATION MEDIUM CLOUDS (16 BITS)		MEAN RADIANCE 11.5 MEDIUM CLOUDS (8 BITS)		MEAN RADIANCE 6.7 MEDIUM CLOUDS (8 BITS)	160
6	POPULATION HIGH CLOUDS (16 BITS)		MEAN RADIANCE 11.5 HIGH CLOUDS (8 BITS)		MEAN RADIANCE 6.7 HIGH CLOUDS (8 BITS)	192
7	SPARE (8 BITS)	CIRRUS LOW/HIGH RADIANCE 6.7 (8 BITS)	TERRAIN HEIGHT (16 BITS)			224
8	RMS DEV 11.5 SURFACE (8 BITS)	RMS DEV 11.5 LOW CLOUDS (8 BITS)	RMS DEV 11.5 MEDIUM CLOUDS (8 BITS)		RMS DEV 11.5 HIGH CLOUDS (8 BITS)	256
9	RMS DEV 6.7 SURFACE (8 BITS)	RMS DEV 6.7 LOW CLOUDS (8 BITS)	RMS DEV 6.7 MEDIUM CLOUDS (8 BITS)		RMS DEV 6.7 HIGH CLOUDS (8 BITS)	288
10	SURFACE CODE (8 BITS)	SURFACE/LOW CLOUD RADIANCE (8 BITS)	LOW/MEDIUM CLOUD RADIANCE (8 BITS)		MEDIUM/HIGH CLOUD RADIANCE (8 BITS)	320
11	GMT MILLISECONDS OF DAY AT 1st THIR SAMPLE IN SBUV IFOV. (32 BITS)					352
12	REPEAT WORDS 2 THRU 11--24 TIMES FOR A TOTAL OF (UP TO) 25 SBUV IFOVs. LOGICAL RECORD WILL BE FILLED OUT WITH ZEROES AT END OF ORBIT (7,680 BITS)					8,032
252	SPARE (ZEROES) 2 BYTES FOR RECORD LENGTH		LAST RECORD IN ORBIT FLAG (16 BITS)			8,064

224 36 BIT WORDS 252 32 BIT WORDS 336 24 BIT WORDS 1008 BYTES 8,064 BITS

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(6a) POPULATION OF HIGH CLOUD SAMPLES 11.5 UM. (16 BITS) - The number of THIR 11.5 UM samples accumulated in this IFOV whose radiances fall below word (10c).

(6b) MEAN RADIANCES OF HIGH CLOUD SAMPLES 11.5 UM. (8 BITS) - Same as word (3b) except for samples accumulated in word (6a).

(6c) MEAN RADIANCE OF HIGH CLOUD SAMPLES 6.7 UM. (8 BITS) - Same as word (3c) except for samples accumulated in word (6a).

(7a) SPARE. (8 BITS) - Zeroes for word alignment.

(7b) CIRRUS HIGH/LOW RADIANCE 6.7 UM. (8 BITS) - The 6.7 UM radiance used in SACC (SBUV/TOMS) processing to determine the presence of cirrus clouds in the SBUV IFOV. The LSB represents 0.015625 W/M^2-STER. This word is passed from the ERB/STAGS Tape.

(7c) TERRAIN HEIGHT. (16 BITS) - The average terrain height equivalent for this IFOV expressed in meters from mean sea level. This word is passed from the ERB/STAGS tape.

(8a) RMS DEVIATION SURFACE 11.5 UM. (8 BITS) - The RMS deviation of the 11.5 UM samples averaged in word (3b). The LSB represents 0.015625 W/M^2-STER.

(8b) RMS DEVIATION LOW CLOUDS 11.5 UM. (8 BITS) - The RMS deviation for word (4b). Scaled the same as word (8a).

(8c) RMS DEVIATION MEDIUM CLOUDS 11.5 UM. (8 BITS) - The RMS deviation for word (5b). Scaled the same as word (8a).

(8d) RMS DEVIATION HIGH CLOUDS 11.5 UM. (8 BITS) - The RMS deviation for word (6b). Scaled the same as word (8a).

(9a) RMS DEVIATION SURFACE 6.7 UM. (8 BITS) - The RMS deviation of the 6.7 U samples averaged in word (3c). The LSB represents 0.00392 W/M^2-STER.

(9b) RMS DEVIATION LOW CLOUDS 6.7 UM. (8 BITS) - The RMS deviation for word (4c). Scaled the same as word (9a).

(9c) RMS DEVIATION MEDIUM CLOUDS 6.7 UM. (8 BITS) - The RMS deviation for (5c). Scaled the same as word (9a).

(9d) RMS DEVIATION HIGH CLOUDS 6.7 UM. (8 BITS) - The RMS deviation for word (6c). Scaled the same as word (9a).

(10a) SURFACE CATEGORY CODE. (8 BITS) - This code is taken from the STAGS tape and indicates the type of surface in the ERB-STA in which this IFOV falls. The only valid codes are

1 = LAND	4 = ICE OR SNOW
2 = WATER	5 = ICE AND LAND
3 = LAND AND WATER	6 = ICE/SNOW AND WATER
	7 = ICE/SNOW, LAND AND WATER

(10b) SURFACE/LOW CLOUD RADIANCE. (8 BITS) - The radiance used to separate the THIR 11.5 UM samples into the lowest histogram level; between Surface and Low Altitude Clouds. The LSB represents 0.125 W/M^2-STER.

(10c) LOW/MEDIUM CLOUD RADIANCE. (8 BITS) - The radiance used to separate the THIR 11.5 UM samples into the two mid-level histograms; between low and medium altitude clouds. The LSB represents 0.225 W/M^2-STER.

(10d) MEDIUM/HIGH CLOUD RADIANCE 11.5 UM. (8 BITS) - The radiance used to separate the THIR 11.5 UM samples into the highest histogram level; between high and medium altitude clouds. The LSB represents 0.125 W/M^2-STER.

(11) FIRST THIR SAMPLE TIME. (32 BITS) - The GMT in milliseconds of day (given in Header Record) for the first THIR 11.5 UM sample entering this SBUV IFOV.

(12) REPEAT words 2 thru 11 up to 24 additional times for a total of (up to) 25 SBUV IFOVs in this logical record.

(252a) SPARES. (16 BITS) - Zeroes for word alignment.

(252b) LAST RECORD IN ORBIT FLAG. (16 BITS) - Normally zero these 16 bits are set to all ones (-1 in 2's complement) in the last logical record of data in this orbit and in all remaining logical records needed to fill out the last physical record.

VId SBUV/TOMS DUMMY LOGICAL RECORD

Figure VI-4 shows the contents of this type of record. One or more of these logical records will be written to fill out any physical record as required. These may also be used to generate the last fill on the tape. The first 32-bit word is as described in a previous section. The remaining 251 32-bit words are as follows:

(2) SPARES. (8,024 BITS) - 1,002 bytes of zeroes used to fill out the record.

(3) LAST RECORD IN ORBIT FLAG. (16 BITS) - Normally zero, these 16-bits are set to all ones (-1 in 2's complement) in the last logical record of data in this orbit and in all remaining logical records needed to fill out the last physical record.

FIGURE VI-4 SBUV/TOMS DUMMY LOGICAL RECORD

WORD	32 24		16		8	1 BITS	
1	PHYSICAL RECORD NUMBER (12 BITS)	SPARE (4 BITS)	FILE CONT. (2)	RECORD ID = 33 (6 BITS)	SPARE (8 BITS)		32
2	SPARE (ZEROES) 1,002 BYTES TO FILLOUT RECORD LENGTH (8,016 BITS)						
252			LAST RECORD IN ORBIT FLAG (16 BITS)				8,064

224 36 BIT WORDS 252 32 BIT WORDS 336 24 BIT WORDS 1,008 BYTES 8,064 BITS

EFFECTIVE DATE: ________

APPENDIX A

STANDARD HEADER SPECIFICATION AND TAPE DOCUMENTATION

Mike Foreman
NASA/GSFC

V.1 GENERAL

All computer compatible tapes (CCT's) that are used as interfaces within NOPS require some form of identification. This applies to all CCT's that are currently defined by a NOPS tape specification, and that are also used for distribution or archiving purposes.

In addition to defining a "latest" product, data relating to previous products that went into the making of the "latest" product provides useful information when system problems occur.

The purpose of this revision to existing NOPS tape specifications is to define a scheme that allows the recording of the genealogy of a "latest" product, and in general adheres to existing tape documentation standards.

In brief the system is as follows:

1. A documentation file that consists of a string of physical records <u>follows</u> the data on any tape defined by a current NOPS tape specification. This will be referred to as a Trailing Documentation File (TDF), and be the last file on a tape when it exists.

2. The standard NOPS header file remains as defined, with minor modifications to the standard header record that reflect both the existence of a TDF and adherence to the IPD standard for sequence numbers.

The following sections define the NOPS standard header records and file, and the TDF. Data files as currently defined in NOPS tape specification remain unchanged.

V.2 STANDARD HEADER RECORD (SHR)

The SHR will consist of one physical record that consists of 5 logical records of 126 EBCIDIC characters. The first 126 characters will remain as previously defined with the exception of CHARACTER 1, and those characters that define the sequence number (40-45). CHARACTER 1 will contain an asterisk (*) and serve to notify all systems that a TDF is likely to follow the main data files and that the next logical record contains information relevant to complete identification. As of the implementation date of this specification, all sequence numbers will have the following form that is an IPD standard:[1]

---

[1]This does not apply to CZCS Data. For CZCS data, CHARACTERS 40 to 45 represent a 6-digit sequence number.

CHARACTER 40 = The last digit of the year in which the data were acquired.

CHARACTER 41-43 = Julian day of the year in which the data were acquired.

CHARACTER 44 = Sequence number for this particular product (usually a 1) (e.g., CLDT's will have a 1 and 2, as there are 2 products per day).

CHARACTER 45 = The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.

CHARACTER 47 = This will remain as a blank unless it is needed to remove ambiguities in CHARACTER 40. This may occur if data are being acquired on October 24, 1988.

This scheme will uniquely identify any tape when used in conjunction with the tape specification number, the PDFC code, and the subsystem identification.

The second logical record consisting of 126 characters will contain information that is required to complete the history of the product.

CHARACTER 1-12 = Software program name and version number.

CHARACTER 13-18 = Program documentation reference number, if it exists.

CHARACTER 20-126 = User defined comments that may be more relevant to the user than the preceding ones.

The NOPS standard header file will continue to consist of 2 records, the second being a duplicate of the first. Logical records 3 and 4 may be used for anything desired if no remake information is required.[2]

V.3 TRAILING DOCUMENTATION FILE (TDF)

The TDF will consist of all NOPS standard header records (non-duplicated) that relate to products that have gone into the making of the current product. Documentation records will be

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[2]In the case of CZCS these logical records are used to define the genealogy of the image rather than the method of V.3.

sequenced in accordance with their access; that is, first in is the first recorded. Every TDF is 630 bytes in length.

The first record of this file will serve to identify the file as a TDF. This will be accomplished by placing asterisks in CHARACTERS 1 to 10 followed by NOPS TRAILER DOCUMENTATION FILE FOR TAPE PRODUCT T [SPEC NO (6 digits)] GENERATED ON DDD HH MM. The exact spacing of this comment is noncritical as long as it is less than 116 characters. The second physical record will be a repeat of the header file NOPS standard header record for this type with the provison that data referring to the end-time are correct for the data set. Following physical records will be an accumulation of TDF's of all input tapes. For those products that require more than one tape, the TDF will appear on the last tape only as well as the warning asterisk.

Table V-1

NOPS Specification Numbering Code

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)
6 = 9 Trk 6250 BPI

Tape number in
sequence for subsystem
(code to be derived)

Destination
Facility
1 = NOC (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = LANN

Source Facility
(Same code as
Destination Facility)

1 = ERB
2 = SMMR
3 = THIR
4 = SAM2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

Rev. D adds 6250 bpi tapes as a possible product

Total 24 bit Words	MSB 24 … LSB 1 (bit positions 24, 22, 20, 18, 16, 14, 12, 10, 8, 6, 4, 2, 1)	Total Bits
1–8	• Nimbus - 7$_b$NOPS$_b$SPEC$_b$ NO$_b$T →If TDF exists (24 Characters)	192
9–10	SPEC NO. (6 Digits)	
	$_b$SQ$_b$NO$_b$ (7 Characters)	
13	PDFC CODE (2 Char.)	
14–15	5 Digit Sequence No. (5 Characters) YJJJN *For CZCS these characters (40-45) are a six digit sequence #(includes Redo) | REDO CHARACTER	408
16	1 Char..Tape Copy No | Blank Character	
17	(4 Characters) SUBSYSTEM I.D.	
18	Blank Character | SOURCE FACILITY	
19	(4 Characters) | Blank Character	
20	(T) Character | (Ø) Character | Blank Character	
21	(4 Characters). DESTINATION FACILITY I.D.	
22	(23 Characters)	
29	START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$	696
36	END DATE AND TIME OF DATA (19 Characters) TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ * Some Facilities may not include end time in header	
42	(20 Characters) DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$	1008
84	BLANK (126 Characters) SW Program Name (1-12) Documentation (13-18) Comments (19-126)	2016
126	BLANK (126 Characters)	3024
168	BLANK (126 Characters)	4032
210	BLANK (126 Characters)	5040

EBCDIC TAPE FORMAT

Figure V -1. Standard Header (Physical Record Format)
(1 Character = 8 bits)

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

*NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T (1 - 24 Character Count)

optional

XXXXXX (96 digit spec number) (25 - 30 Character Count)

$_b$SQ$_b$NO$_b$ (31 - 37 Character Count)

AA XXXXX (5 digit sequence No.) (38 - 44 Character Count)

NOTE: If sequence number is zero, tape is not a finished product (i.e., definitive ephemeris not used, artificial VIP data, etc.) *

redo character

-X (copy number 1 or 2) (45, 46 Character Count)

$_b$YYYY$_b$ (4 character subsystem ID) (47 - 52 Character Count)

YYYY (Generation Facility ID) (53 - 56 Character Count)

$_b$TO$_b$YYYY (4 Char. Des. Fac. ID) (57 - 64 Character Count)

$_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (65 - 87 Character Count)

(Start year, day of year, hours, minutes, seconds)

---

*For CZCS, characters 40 to 45 are a 6-digit sequence number.

$_{b}\mathrm{TO}_{b}\mathrm{19XX}_{b}\mathrm{DDD}_{b}\mathrm{HHMMSS}_{b}$ (88 - 106 Character Count)

(End data and time of data)

$\mathrm{GEN}_{b}\mathrm{19XX}_{b}\mathrm{DDD}_{b}\mathrm{HHMMSS}_{b}$ (107 - 126 Character Count)

(Date and time tape was generated)

The second group of 126 characters will contain continuation documentation of the original 126 characters when required.

The third, fourth, and fifth groups of 126 characters each are intended for the use of the subsystem analysts for further identifications of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16-mm microfilm. The NOPS STD HDR file on the tape that IPD receives would contain two of the following records.

$\mathrm{*NIMBUS\text{-}7NOPS}_{b}\mathrm{SPEC}_{b}\mathrm{NO}_{b}\mathrm{T134031}_{b}\mathrm{SQ}_{b}\mathrm{NO}_{b}$

1st day of time period

AA90321-2$_{b}$ERB$_{bb}$SACC$_{b}$TO$_{b}$IPD$_{bb}$START$_{b}$1979$_{b}$

032$_{b}$000432$_{b}$TO$_{b}$1979$_{b}$059$_{b}$235742$_{b}$GEN$_{b}$

1979$_{b}$104$_{b}$094500$_{b}$followed by 504 blanks

First day of time period may not be first data day in the event of multiday-stacked products that are based in an ILT week.

V.4 TAPE DUPLICATION

It has been determined that the duplication of master tapes is neither time nor cost effective, thus the requirement of duplication implied in the preceding specification is rescinded. However, some tapes that require a great deal of effort to produce in terms of manpower and computer time should be duplicated.

If a redo is required due to tape errors or algorithm changes, this will be noted both on the CCT (HEADER C-45) and on the canister.

V.5 SHIPPING LETTERS

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the first 126 (or 138)

characters of the first physical record of SHF. In the event of copies made from CCT's that are not generated in IPD, a new physical record reflecting IPD as the source and the Nimbus experimenter to whom the tape is being sent as the destination, will be added as the second record of the TDF. All existing records in the TDF will be pushed down, but none will be lost. This record should also replace those in the SHF.

APPENDIX G

TAPE SPECIFICATION FOR THE CLOUDS-ERB TAPE

(CLE, T343031)

SENSOR/INSTRUMENT: THIR

TAPE SPEC. NO. T343031, REVISION B DATED 7/20/81

SPEC. TITLE CLOUD--ERB TAPE (CLE)

REVIEWED BY: Joseph Akley DATE 6/ 9/1980

APPROVED BY: DATE
Gary Wolford
NOPS Manager

REV. A- 6/9/80
REV. B 7/20/81

NIMBUS G

NIMBUS OBSERVATION PROCESSING SYSTEM (NOPS)

REQUIREMENTS DOCUMENT NG #7

TAPE SPECIFICATION NO. T343031

THIR CLOUDS-ERB TAPE (CLE)

PREPARED BY: G. T. Cherrix DATE: 6/1/78

G. T. Cherrix

REV. A- Minor corrections on pp. 1.2.3,11,12,13,16

REV. B- Minor changes on pp.1 and 2, addendum to Section V (Standard Header)

Rev. 7-20-81

ABSTRACT

The THIR CLOUDS-ERB Tape will be a 9-track, 1600 BPI tape generated by a MODCOMP IV or UNIVAC 1180 or 1108 computer. The first file will contain a NOPS STANDARD HEADER written twice. Each subsequent file will contain one day of data. Nominally, there will be a daily data file on the tape, terminated by a double end of file. Clouds-ERB tapes will be generated whenever the THIR sensor is on.

Within a daily file, there may be as many as 14 orbits of data. Each orbit of THIR data will be processed such that the THIR samples will be placed into ERB SUB-TARGET AREA bins by location. After accumulating all possible THIR samples for the orbit, the sub-target area bins will be written to the tape in ascending sequence by time of the initial THIR sample placed into the bin. As many as thirty-two physical records may be written for each data orbit.

A Dummy Data Record, consisting of all ones except for the first 32 bits, may be used as the last record in a file, or as the only record(s) in the last file.

I. REQUIREMENT IDENTIFICATION

THIR CLOUDS "E" (ERB) Tape Specification No. T343031.

II. INPUT DATA SOURCE

1. THIR Calibrated located data tape (CLDT) Specification No. T344011, and

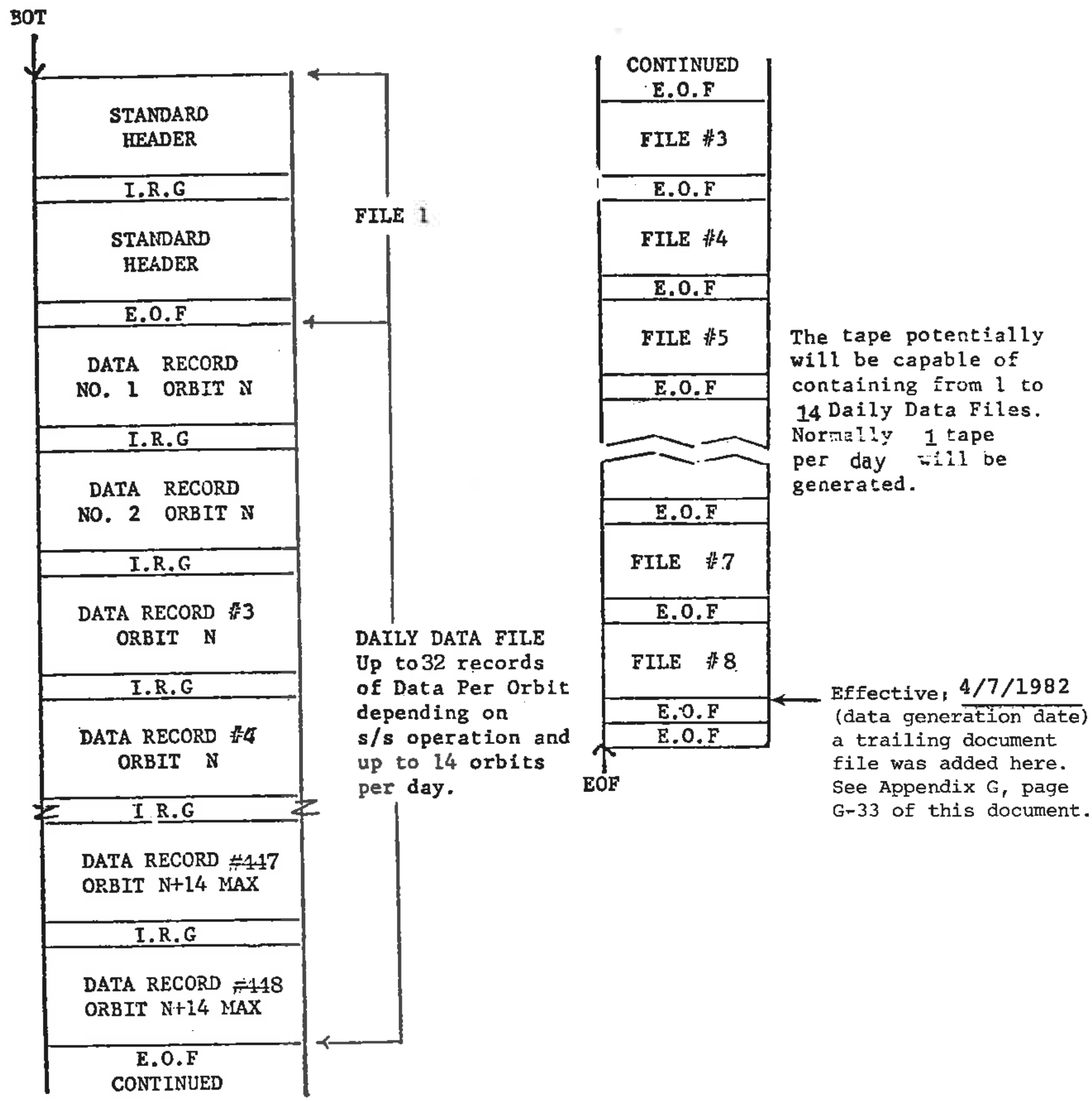
2. ERB Sub-Target Area Geographical Season Tape (STAGS) Tape Specification No. T173051.

III. OPERATING MODE

Data will be available based on the THIR system being ON. No record will contain data from 2 data orbits, and an orbit of data may require up to a maximum of 32 records. A tape could be written containing up to 10 calendar days of data. One Day Periods will be nominal.

Data acquired for dates after 21 June 1980 shall be stacked on an ILT weekly basis. Thus these data tapes shall have 7 files rather than one file on all tapes before June 21, 1980. The PDF code for the stacked tapes remains the same.

IV. GROSS OUTPUT FORMAT



V. STANDARD HEADER

All magnetic tapes used as interfaces within NOPS will require some form of identification. A standardized series of records in the initial file on each tape will be used and will be called a NOPS "Standard Header File." Some tapes used within a NOPS facility which do not pass an interface will be exempt from this requirement - although it is a recommended procedure.

The STD HRD will contain the spec number of the tape generated. The interface spec numbering system is shown in Table V-1.

Each STD HDR will be written in EBCDIC so that it can be easily printed for quick identification of the tape. Figure V-1 shows the standard header format using 24 bit words.

Because of the real possibility of an original tape being damaged in handling (resulting in the loss of many computations), each processing facility within NOPS will generate duplicate copies of master tapes. These duplicates will be delivered to IPD for data product generation or user copy generation and will be indicated by the characters "-2" added to the sequence number in the STD HDR. The original will be indicated by the characters "-1" and will be retained in a secure environment at the originating facility. When IPD returns copy no. 2 due to tape errors, a new copy will be sent to IPD with the same copy number, but identified on the tape canister as "-2A", then "-2B" for a subsequent redo, etc.

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the STD HDR on the tape. In the case of copies made from tapes not generated in IPD, a new set of 126 characters reflecting IPD as the source, and the Nimbus experimenter to whom the tape is being sent, as the destination, is produced. This new 126 character set is put at the start of the header and the second through fifth blocks of 126 characters are the first through fourth blocks from the original copy 2 tape (the first block of the copy 2 will be 1).

TABLE V -1

NOPS SPECIFICATION NUMBERING CODE

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)

Tape number in sequence for subsystem (code to be derived)

Destination Facility:
1 = NOC$_b$ (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD$_b$
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = USER

Source Facility (Same code as Destination Facility)

Subsystem
1 = ERB$_b$
2 = SMMR
3 = THIR
4 = SAM 2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT$_b$

Word	MSB 24 22 20 18 16 14 12 10 8 6 4 2 1 LSB	
1	${}_b$Nimbus - 7${}_b$NOPS${}_b$SPEC${}_b$ NO${}_b$T (24 Characters)	
8		192
9	SPEC NO. (6 Digits)	
10		
	${}_b$SQ${}_b$NO${}_b$ (7 Characters)	
13	PDFC CODE (2 Char.)	
14	5 Digit Sequence No. (5 Characters	
15	Hyphen (1 Char.)	408
16	1 Char. Tape Copy No · Blank Character	
17	(4 Characters) SUBSYSTEM I.D.	
18	Blank Character · SOURCE FACILITY	
19	(4 Characters) · Blank Character	
20	(T) Character · (Ø) Character · Blank Character	
21	(4 Characters) DESTINATION FACILITY I.D.	
22	(23 Characters)	
	START YEAR, DAY, HOURS, MINUTES, SECONDS ${}_b$START${}_b$19XX${}_b$DDD${}_b$HHMMSS${}_b$	
29		696
	END DATE AND TIME OF DATA (19 Characters) TO${}_b$19XX${}_b$DDD${}_b$HHMMSS${}_b$ * Some Facilities may not include end time in header	
36	(20 Characters)	
	DATE AND TIME TAPE WAS GENERATED	
42	GEN${}_b$19XX${}_b$DDD${}_b$HHMMSS${}_b$	1008
	BLANK (126 Characters	
84		2016
	BLANK (126 Characters)	
126		3024
	BLANK (126 Characters)	
168		4032
	BLANK (126 Characters)	
210		5040

EBCDIC TAPE FORMAT
FIGURE V -1

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

$_b$NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T	(24 char.)	
XXXXXX (6 digit spec number)	(6 char.)	
$_b$SQ$_b$NO$_b$	(7 char.)	PDFC Designator and 5 digit sequence No.
AAXXXXX (5 digit sequence No.)	(7 char.)	

NOTE: If sequence number is zero, tape is not a finished product (i.e. definitive ephemeris not used, artificial VIP data, etc.)

-X (copy number 1 or 2)	(2 char.)
$_b$YYYY$_b$ (4 char. subsystem ID)	(6 char.)
YYYY (Generation Facility ID)	(4 char.)
$_b$TO$_b$YYYY (4 char. Des. Fac. ID)	(8 char.)
$_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (Start year, day of year, hours, minutes, seconds)	(23 char.)
TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (end data and time of data)	(19 char.)
GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (date and time tape was generated)	(20 char.)
	(126 char.)

The second group of 126 characters will contain blanks (to allow for the original 126 characters when IPD duplicates tape for distribution).

The third, fourth, and fifth groups of 126 characters each are intended for the use of the Subsystem Analysts for further identification of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16 mm microfilm. The NOPS STD HDR File on the tape which IPD receives would contain two of the following records.

${}_b$NIMBUS-7${}_b$NOPS${}_b$SPEC${}_b$NO${}_b$T134031${}_b$SQ${}_b$NO${}_b$

AA00027-2${}_b$ERB${}_{bb}$SACC${}_b$TO${}_b$IPD${}_{bb}$START${}_b$1979${}_b$

032${}_b$000432${}_b$TO${}_b$1979${}_b$059${}_b$235742${}_b$GEN${}_b$

1979${}_b$104${}_b$094500${}_b$followed by 504 blanks

NIMBUS-G PROJECT DATA FORMAT CODES (MAY 5, 1980) REV. FROM MARCH 3, 1980

SENSOR	TAPE ID	ORIG.	COPIES	PDF	DATA TYPE	HORIZ LABEL / VERTIC COLORS
ERB	MATRIX	12	72	AA	MAAA	D RED / L RED
	TABLES	12	-	AB	TAAB	D RED / D PINK
	MAT*	365	2555	AC	MTAC	D RED / D RED
	SEFOT*	12	84	AD	SEAD	D RED / YELLOW
	ZMT*	2	14	AE	ZMAE	L RED / L PINK
	STAGS	1	-	AG	STAG	D RED / D ORANGE
TOTALS		*379	2653			
	OTHER	25	72			
SMMR	MATRIX-30	12	-	BA	MABA	L TAN / YELLOW
	MATRIX-LO	12	-	BB	LOBB	L BRWN / L GRN
	MATRIX-SS	12	-	BC	SSBC	L BRWN / L ORAN
	MAP-30*	12	60	BD	MPBD	L BRWN / L PINK
	MAP-LO*	12	60	BE	LOBE	L BRWN / BLUE
	MAP-SS*	12	60	BF	SSBF	M TAN / M TAN
	PARM-30*	60	360	BG	PABG	M TAN / YELLOW
	PARM-LO*	30	150	BH	LOBH	M BRWN / YELLOW
	PARM-SS*	30	120	BI	SSBI	M BRWN / M BRWN
	TAT*	183	732	BJ	TABJ	D BRWN / YELLOW
	CELL-ALL*	61	427	BK	DEBK	D BRWN / L GRN
TOTALS		*400	1969			
	OTHER	36	-			
THIR	SOURCE	5110	-	IA	SOIA	D ORAN / D ORAN
	STT	1095	-	IB	STIB	D ORAN / YELLOW
	BSHT	365	-	IC	BSIC	D RED EXP LABEL
	CLDT	730	1460	ID	CLID	D ORAN / D GRN
	CLE	219	1095	IE	CLIE	D ORAN / D PINK
	CLT	365	1825	IF	CLIF	M ORAN / GREY
	ILT-T	52	-	LI	ILLI	L ORAN / L PINK
	ILT-C	52	-	LC	ILLC	L ORAN / L BRWN
TOTALS (R)		7988	4380			
SAM II	MATRIX	4	24	DA	MADA	D PURP / D PURP
	PROFILE	12	72	DB	PROB	D PURP / D ORAN
	RDAT*	12	72	DC	RDDC	M PURP / D GRN
	BANAT*	12	72	DD	BADD	M PURP / YELLOW
	NMCT@	52	-	DE	NMDE	D ORAN EXP LABEL
	ILT@	52	-	LD	ILLD	D ORAN EXP LABEL
TOTALS		* 24	144			
		@104	-			
	OTHER	16	96			

SENSOR	TAPE ID	ORIG.	COPIES	PDF	DATA TYPE	HORIZ LABEL / VERTIC COLORS
LIMS	MATRIX-M	14	28	EA	MAEA	YELLOW / BLUE
	MATRIX-C	14	28	EB	MAEB	YELLOW / L GREEN
	PROFILE-R	7	14	EC	PREC	YELLOW / L PINK
	PROFILE-I	21	42	ED	PRED	YELLOW / M TAN
	RAT*	210	945	EE	RAEE	YELLOW / D PINK
	IPAT*	105	347	EF	IPEF	YELLOW / D ORANGE
	MAT*	70	294	EG	MTEG	YELLOW / YELLOW
	CAT*	70	210	EH	CTEH	YELLOW / GREY
	SMAT*	7	28	EI	SMEI	YELLOW / L BROWN
	SCAT*	7	21	EM	SCEM	YELLOW / D GREEN
	NMCT@	52	-	EK	NMEK	YELLOW EXP LABEL
	UFO@	295	-	UE	UFUE	YELLOW EXP LABEL
	ILT@	30	-	LE	ILLE	YELLOW EXP LABEL
TOTALS		*469	1845			
		@377	-			
	OTHER (R)	56	112			
SBUV/ TOMS	MATRIX	24	216	FA	MAFA	D GRN / D ORAN
	TABLES	12	-	FB	TAFB	L GRN / L PINK
	MONTAGE	52	-	FC	MOFC	D GRN / D PINK
	RUT-S*	26	26	FD	SRFD	GREY / D GRN
(R)	OZONE-S*	12	100	FE	OSFE	L GRN / L BRWN
(R)	OZONE-T*	180	1440	FF	OTFF	D GRN / D GRN
	ZMT*	2	16	FH	ZMFH	L GRN / L PINK
	RUT-T*	120	120	FJ	TRFJ	D GRN / YELLOW
TOTALS (R)		*340	1702			
	OTHER	88	216			
CZCS (R)	CRT360*	100	400	ZI	CRZI	BLUE / BLUE
	SOURCE	4500	-	ZA	SOZA	STANDARD STA LABEL
(R)	CRCST*	250	1000	ZB	CRZB	BLUE / D GRN
	CAT	12	96	ZC	CAZC	BLUE / D ORAN
	CRT-L	900	1800	ZD	CRZD	BLUE / YELLOW
	ILT	52	-	LZ	ILLZ	BLUE / M TAN
(R)	CRT	2750	5500	ZE	CRZE	BLUE / D GRN
	ILT-L@	52	-	LL	ILLL	BLACK EXP LABEL
(R)	CCT-F	225	-	ZH	CCZH	BLUE / PINK
(R)	LOIT#	250	-	ZF	LOZF	L GRN / GREY
(R)	DPIT#	250	-	ZG	DPZG	GRN / BLUE
TOTALS (R)		*350	1400			
		@ 52	-			
(R)		#500	-			
(R)		8439	7446			
SAMS	MATRIX	24	24	HA	MAHA	YEL-OR / L PINK
	RAT*	180	198	HC	RAHC	YEL-OR / YELLOW
	ILT@	183	-	LH	ILLH	GREY EXP LABEL
	NMCT@	52	-	HD	NMHD	GREY EXP LABEL
TOTALS		@ 235	-			
		* 180	198			
	OTHER	24	24			

		ORIGINALS	COPIES	PDF
(R)	* TOTALS	2,142	9,911	27
	@ TOTALS	768	-	8
(R)	# TOTALS	500	-	2
(R)	OTHER TOTALS	16,672	12,346	30
(R)	GRAND TOTALS	20,092	22,257	67

* P[illegible] MEDIUM AND COPIES [illegible]
@ [illegible]
\# [illegible]

(R) - SENSORS WHERE [illegible]
CHANGES TO [illegible]
ON AVAILABILITY [illegible]

NIMBUS G PROJECT DATA FORMAT CODES (Cont'd.)

SENSOR	TAPE ID	PDFC CODE
LOCATION	ILT/ERB	LA
	ILT/SMMR	LB
	ILT/THIR	LI
	ILT/SAM II	LD
	ILT/LIMS	LE
	ILT/SBUV	LF
	ILT/CZCS	LZ
	ILT/SAMS	LH
USER	UFO/ERB	UA
	UFO/SMMR	UB
	UFO/LIMS	UE
	UFO/SBUV	UF
	UFO/ILT	UL

1st CHARACTER	SOURCE/SENSOR	2nd CHARACTER	USER/SENSOR OR TAPE NUMBER
ERB	A		
SMMR	B		
THIR	I		
SAM II	D		
LIMS	E		
SBUV/TOMS	F		
CZCS	Z		
SAMS	H		
ILT	L		
UFO	U		

The following new standard header specification was added to this document on July 15, 1981.

All of these tape types with a generation date after June 22, 1980 will conform to this standard header.

Tapes processed before this date will conform to the preceeding standard header documentation.

EFFECTIVE DATE:__________

STANDARD HEADER SPECIFICATION AND TAPE DOCUMENTATION

V.1 GENERAL

All computer compatible tapes (CCT's) that are used as interfaces within NOPS require some form of identification. This applies to all CCT's that are currently defined by a NOPS tape specification, and that are also used for distribution or archiving purposes.

In addition to defining a "latest" product, data relating to previous products that went into the making of the "latest" product provides useful information when system problems occur.

The purpose of this revision to existing NOPS tape specifications is to define a scheme that allows the recording of the genealogy of a "latest" product, and in general adheres to existing tape documentation standards.

In brief the system is as follows:

1. A documentation file that consists of a string of physical records follows the data on any tape defined by a current NOPS tape specification. This will be referred to as a Trailing Documentation File (TDF), and be the last file on a tape when it exists.

2. The standard NOPS header file remains as defined, with minor modifications to the standard header record that reflect both the existence of a TDF and adherence to the IPD standard for sequence numbers.

The following sections define the NOPS standard header records and file, and the TDF. Data files as currently defined in NOPS tape specification remain unchanged.

V.2 STANDARD HEADER RECORD (SHR)

The SHR will consist of one physical record that consists of 5 logical records of 126 EBCIDIC characters. The first 126 characters will remain as previously defined with the exception of CHARACTER 1, and those characters that define the sequence number (40-45). CHARACTER 1 will contain an asterisk (*) and serve to notify all systems that a TDF is likely to follow the main data files and that the next logical record contains information relevant to complete identification. As of the implementation date of this specification, all sequence numbers will have the following form that is an IPD standard:[1]

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[1] This does not apply to CZCS Data. For CZCS data, CHARACTERS 40 to 45 represent a 6-digit sequence number.

CHARACTER 40 = The last digit of the year in which the data were acquired.

CHARACTER 41-43 = Julian day of the year in which the data were acquired.

CHARACTER 44 = Sequence number for this particular product (usually a 1) (e.g., CLDT's will have a 1 and 2, as there are 2 products per day).

CHARACTER 45 = The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.

CHARACTER 47 = This will remain as a blank unless it is needed to remove ambiguities in CHARACTER 40. This may occur if data are being acquired on October 24, 1988.

This scheme will uniquely identify any tape when used in conjunction with the tape specification number, the PDFC code, and the subsystem identification.

The second logical record consisting of 126 characters will contain information that is required to complete the history of the product.

CHARACTER 1-12 = Software program name and version number.

CHARACTER 13-18 = Program documentation reference number, if it exists.

CHARACTER 20-126 = User defined comments that may be more relevant to the user than the preceding ones.

The NOPS standard header file will continue to consist of 2 records, the second being a duplicate of the first. Logical records 3 and 4 may be used for anything desired if no remake information is required.[2]

V.3 TRAILING DOCUMENTATION FILE (TDF)

The TDF will consist of all NOPS standard header records (non-duplicated) that relate to products that have gone into the making of the current product. Documentation records will be

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[2] In the case of CZCS these logical records are used to define the genealogy of the image rather than the method of V.3.

sequenced in accordance with their access; that is, first in is the first recorded. Every TDF is 630 bytes in length.

The first record of this file will serve to identify the file as a TDF. This will be accomplished by placing asterisks in CHARACTERS 1 to 10 followed by NOPS TRAILER DOCUMENTATION FILE FOR TAPE PRODUCT T [SPEC NO (6 digits)] GENERATED ON DDD HH MM. The exact spacing of this comment is noncritical as long as it is less than 116 characters. The second physical record will be a repeat of the header file NOPS standard header record for this type with the proviso that data referring to the end-time are correct for the data set. Following physical records will be an accumulation of TDF's of all input tapes. For those products that require more than one tape, the TDF will appear on the last tape only as well as the warning asterisk.

Table V-1

NOPS Specification Numbering Code

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)
6 = 9 Trk 6250 BPI

Tape number in sequence for subsystem (code to be derived)

Destination Facility
1 = NOC (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = LANN

Source Facility (Same code as Destination Facility)

1 = ERB
2 = SMMR
3 = THIR
4 = SAM2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

Rev. D adds 6250 bpi tapes as a possible product

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

*NIMBUS-7 $_b$ NOPS $_b$ SPEC $_b$ NO $_b$ T	(1 - 24 Character Count)
optional	
XXXXXX (96 digit spec number)	(25 - 30 Character Count)
$_b$ SQ $_b$ NO $_b$	(31 - 37 Character Count)
AA XXXXX (5 digit sequence No.)	(38 - 44 Character Count)

NOTE: If sequence number is zero, tape is not a finished product (i.e., definitive ephemeris not used, artificial VIP data, etc.) *

redo character	
-X (copy number 1 or 2)	(45, 46 Character Count)
$_b$ YYYY $_b$ (4 character subsystem ID)	(47 - 52 Character Count)
YYYY (Generation Facility ID)	(53 - 56 Character Count)
$_b$ TO $_b$ YYYY (4 Char. Des. Fac. ID)	(57 - 64 Character Count)
$_b$ START $_b$ 19XX $_b$ DDD $_b$ HHMMSS $_b$ (Start year, day of year, hours, minutes, seconds)	(65 - 87 Character Count)

*For CZCS, characters 40 to 45 are a 6-digit sequence number.

Total 24 bit Words	MSB 24 · 22 · 20 · 18 · 16 · 14 · 12 · 10 · 8 · 6 · 4 · 2 · LSB 1	Total Bits
1–8	• Nimbus - 7$_b$NOPS$_b$SPEC$_b$ NO$_b$T └If TDF exists (24 Characters)	192
9–10	SPEC NO. (6 Digits)	
10–13	$_b$SQ$_b$NO$_b$ (7 Characters)	
13	PDFC CODE (2 Char.)	
14–15	5 Digit Sequence No. (5 Characters) YJJJN *For CZCS these characters (40-45) are a six digit sequence #(includes Redo)	
15	REDO CHARACTER	408
16	1 Char. Tape Copy No · Blank Character	
17	(4 Characters) SUBSYSTEM I.D.	
18	Blank Character · SOURCE FACILITY	
19	(4 Characters) · Blank Character	
20	(T) Character · (Ø) Character · Blank Character	
21	(4 Characters) DESTINATION FACILITY I.D.	
22	(23 Characters)	
22–29	START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$	696
29–36	END DATE AND TIME OF DATA (19 Characters) TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ * Some Facilities may not include end time in header	
36	(20 Characters)	
36–42	DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$	1008
42–84	BLANK (126 Characters) SW Program Name (1-12) Documentation (13-18) Comments (19-126)	2016
84–126	BLANK (126 Characters)	3024
126–168	BLANK (126 Characters)	4032
168–210	BLANK (126 Characters)	5040

EBCDIC TAPE FORMAT

Figure V -1. Standard Header (Physical Record Format)
(1 Character = 8 bits)

$_{b}\text{TO}_{b}\text{19XX}_{b}\text{DDD}_{b}\text{HHMMSS}_{b}$ (88 - 106 Character Count)

(End data and time of data)

$\text{GEN}_{b}\text{19XX}_{b}\text{DDD}_{b}\text{HHMMSS}_{b}$ (107 - 126 Character Count)

(Date and time tape was generated)

The second group of 126 characters will contain continuation documentation of the original 126 characters when required.

The third, fourth, and fifth groups of 126 characters each are intended for the use of the subsystem analysts for further identifications of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16 mm microfilm. The NOPS STD HDR file on the tape that IPD receives would contain two of the following records.

$\text{*NIMBUS-7NOPS}_{b}\text{SPEC}_{b}\text{NO}_{b}\text{T134031}_{b}\text{SQ}_{b}\text{NO}_{b}$

1st day of time period

AA90321-2$_b$ERB$_{bb}$SACC$_b$TO$_b$IPD$_{bb}$START$_b$1979$_b$

032$_b$000432$_b$TO$_b$1979$_b$059$_b$235742$_b$GEN$_b$

1979$_b$104$_b$094500$_b$followed by 504 blanks

First day of time period may not be first data day in the event of multiday-stacked products that are based in an ILT week.

V.4 TAPE DUPLICATION

It has been determined that the duplication of master tapes is neither time nor cost effective, thus the requirement of duplication implied in the preceding specification is rescinded. However, some tapes that require a great deal of effort to produce in terms of manpower and computer time should be duplicated.

If a redo is required due to tape errors or algorithm changes, this will be noted both on the CCT (HEADER C-45) and on the canister.

V.5 SHIPPING LETTERS

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the first 126 (or 138)

characters of the first physical record of SHF. In the event of copies made from CCT's that are not generated in IPD, a new physical record reflecting IPD as the source and the Nimbus experimenter to whom the tape is being sent as the destination, will be added as the second record of the TDF. All existing records in the TDF will be pushed down, but none will be lost. This record should also replace those in the SHF.

VI. DATA RECORD FORMAT

For each data orbit that the THIR Subsystem is powered (ON) at least one data record will be output and under normal full time operation 32 records will be output. The record(s) are based on data orbits and will never contain data for more than 1 data orbit. Where there are insufficient sub-target area sets of data to completely fill a physical record, the target area number and sub-target area numbers will be set to a full scale value as a flag. That is, the Target Area Number and the Sub-Target Area Number will be set to the full scale value on the first data set after all the valid sub-target area data sets have been output to that data record. The remaining bytes in the Data record will be ones filled.

The data will be output by ascending time order of the time of the first sample put into a sub target area. The program will allow a sufficient amount of elapsed time for all possible samples to be accumulated on each sub target area. The actual histogram ranges for the population counts of the 11u channel data will be determined from the ERB/STAGS Tape, NOPS Specification No. T173051.

The values used for bin separation are expressed in Radiances since the THIR calibration is linear in radiance and not in temperature. Conversion tables from radiances to Temperature for both channels are available in the THIR/CLDT documentation (T344011).

Figure VI-1 shows the format of the data record and the descriptions are as follows:

(1) PHYSICAL RECORD NO. (12 BITS) - This is the number of this record within a file. Increment by 1 throughout a file and starts at 1.

(2) RECORD I.D. (8 BITS) - Identifies record type and the last record written in a file and records in the last file on the tape. The MSB will be set to "1" if that record is the last one written in the file. The second most MSB will be set on all records in the last file on the tape. Record identification number will be 21. Dummy Record I.D. is 25.

FIGURE VI - 1. THIR CLOUD-E (ERB) DATA RECORD FORMAT

WORD	MSB 32	24	16	8 … LSB 1	BITS
1	PHYSICAL RECORD NUMBER (12 BITS)	SPARE(4 BITS)	FILE CONT. / RECORD ID(6 BITS)	SPARE (8 BITS)	32
2	DATA ORBIT NUMBER (16 BITS)		DAY OF YEAR AT START OF DATA ORBIT (16 BITS)		64
3	YEAR AT START OF DATA ORBIT (16 BITS)		SPARE (ZEROES) (16 BITS)		96
4	START TIME OF DATA ORBIT IN SECONDS OF DAY (32 BITS)				128
5	END TIME OF DATA ORBIT IN SECONDS OF DAY (32 BITS)				160
6	ERB TARGET AREA NUMBER (16 BITS)		ERB SUB-TARGET AREA NUMBER (16 BITS)		192
7	POPULATION SURFACE (16 BITS)		MEAN RADIANCE 11.5 μ SURFACE (8 BITS)	MEAN RADIANCE 6.7 μ SURFACE (8 BITS)	224
8	POPULATION LOW CLOUDS (16 BITS)		MEAN RADIANCE 11.5 μ LOW CLOUDS (8 BITS)	MEAN RADIANCE 6.7 μ LOW CLOUDS (8 BITS)	256
9	POPULATION MEDIUM CLOUDS (16 BITS)		MEAN RADIANCE 11.5 μ MEDIUM CLOUDS (8 BITS)	MEAN RADIANCE 6.7 μ MEDIUM CLOUDS (8 BITS)	288
10	POPULATION HIGH CLOUDS (16 BITS)		MEAN RADIANCE 11.5 μ HIGH CLOUDS (8 BITS)	MEAN RADIANCE 6.7 μ HIGH CLOUDS (8 BITS)	320
11	S/C Zenith Angle (8 BITS)	CIRRUS HIGH/LOW RADIANCE 6.7 μ(8 BITS)	TIME OF FIRST THIR SAMPLE (16 BITS)		352
12	RMS DEV 11.5 μ SURFACE (8 BITS)	RMS DEV 11.5 μ LOW CLOUDS (8 BITS)	RMS DEV 11.5μ MEDIUM CLOUDS (8 BITS)	RMS DEV 11 5 μ HIGH CLOUDS (8 BITS)	384
13	RMS DEV 6.7 μ SURFACE (8 BITS)	RMS DEV 6.7 μ LOW CLOUDS (8 BITS)	RMS DEV 6.7 μ MEDIUM CLOUDS (8 BITS)	RMS DEV 6.7 μ HIGH CLOUDS (8 BITS)	416
14	SURFACE/LAND FRACTION (8 BITS)	SURFACE/LOW CLOUD RADIANCE (8 BITS)	LOW/MEDIUM CLOUD RADIANCE (8 BITS)	MEDIUM/HIGH CLOUD RADIANCE (8 BITS)	448
15-1994	REPEAT WORDS 6 THRU 14 (36 BYTES) 220 TIMES FOR A TOTAL OF 221 SETS (63,360 BITS)				63,808
1995	SPARES (ZEROES) (96 BITS)				63,904
1998	SPARES (ZEROES) (16 BITS)		LAST RECORD IN THIS ORBIT FLAG (16 BITS)		63,936

1,776 36 BIT WORDS 1,998 32 BIT WORDS 2,664 24 BIT WORDS 7,992 BYTES 63,936 BITS

(3) DATA ORBIT NO. (16 BITS) - The data is output based on a data orbit which starts at a descending node and ends at the following descending node. The orbit number will be the NASA orbit number at the beginning of the data orbit. (NASA orbit is defined as beginning at the ascending node).

(4) START DAY OF DATA ORBIT. (16 BITS) - The GMT day number for the start of the data orbit (descending node).

(5) YEAR NUMBER. (16 BITS) - The full year number as of the start of data orbit. Followed by 16 spare bits (zeroes).

(6) START TIME OF DATA ORBIT. (32 BITS) - The integer milliseconds of day at the beginning of the data orbit.

(7) END TIME OF DATA ORBIT. (32 BITS) - Time at end of data orbit in integer milliseconds from start day (item 4).

(8) ERB TARGET AREA NO. (TA) (16 BITS) - Each Target Area is defined in Table VI-1. This number will range from 1 to 2070 inclusive. The number 32767 will be used as a flag to indicate no more target area data sets. The target area number will be in the order they are first encountered by time.

(9) ERB SUB-TARGET ARE NO. (STA) (16 BITS) - This number will range from 1 to 9 for legitimate target areas and will be set to 32767 in the first data set after the last valid data set. See Table VI-1 for target area definition. The sub-target area will be ordered by the ascending time that a sample was initially counted in it.

It has been roughly estimated that 1 full data orbit will cross 6912 sub-target areas, or 37% of the world (18630 sub-target areas). The assumptions were that the THIR Scan was ± 58 degrees Nadir which provided a ground swath of 38° of great circle arc and the Altitude was 955 KM.

TABLE VI-1

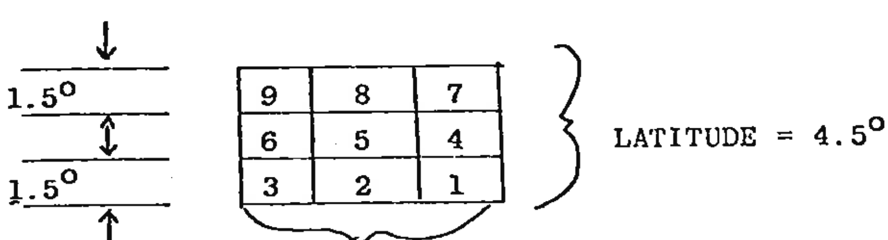
ERB SCANNING CHANNEL TARGET AREAS

TARGET NO. SOUTH HEM.	TARGET NO. NORTH HEM.	LATITUDE LIMITS Lower Limit	LATITUDE LIMITS Upper Limit	LONGITUDE INTERVAL	TARGET SIZES LAT.	SUBDIV DE LON
956-1035	1036-1115	EQ. 0.0	4.5	4.5	1.5°	1.5
876-955	1116-1195	4.5	9.0	4.5		
796-875	1196-1275	9.0	13.5	4.5		
716-795	1276-1355	13.5	18.0	4.5		
644-715	1356-1427	18.0	22.5	5.0		1.6
572-643	1428-1499	22.5	27.0	5.0		
500-571	1500-1571	27.0	31.5	5.0		
428-499	1572-1643	31.5	36.0	5.0		
368-427	1644-1703	36.0	40.5	6.0		2.0
308-367	1704-1763	40.5	45.0	6.0		
248-307	1764-1823	45.0	49.5	6.0		
200-247	1824-1871	49.5	54.0	7.5		2.5
155-199	1872-1916	54.0	58.5	8.0		2.66
115-154	1917-1956	58.5	63.0	9.0		3.0
79-114	1957-1992	63.0	67.5	10.0		3.33
49-78	1993-2022	67.5	72.0	12.0		4.0°
29-48	2023-2042	72.0	76.5	18.0		6.0°
13-28	2043-2058	76.5	81.0	22.5		7.5°
4-12	2059-2067	81.0	85.5	40.0		13.33
1-3	2068-2070	85.5	Pole	120.0		40.0

* For each latitude band the longitude intervals start at the 0 degree meridian and progress West by the increments listed.

The sequential numbering system assigns a number, between 1 and 2070, to each target area starting from the South Pole. Within each latitude belt the numbers increase westward from the 0° meridian and continue to increase within the adjacent latitude belt to the North.

In each hemisphere there will be 1035 target areas and each of those areas is further subdivided into 9 subdivisions as shown below.



LONGITUDE ° = AS IN TABLE ABOVE.

SUBDIVISION LONGITUDE ° = LONGITUDE INTERVAL FOR TARGET AREA ÷ 3.

(10) POPULATION OF 11.5μ SURFACE SAMPLES (16BITS) - The number of THIR 11.5μ samples accumulated in the STA whose radiances are higher than the SURFACE range described in item (34).

(11) MEAN RADIANCE OF SURFACE 11.5μ (8 BITS) - The mean of all the 11.5μ radiances from the samples accumulated in item (10). LSB represents 0.125 W/M^2-STER.

(12) MEAN RADIANCE OF SURFACE 6.7μ (8 BITS) - The mean of all the 6.7μ radiances from the samples colocated with those samples accumulated in item (10). LSB represents 0.015625 W/M^2-STER.

(13) POPULATION OF LOW CLOUD SAMPLES 11.5μ (16 BITS) - The number of THIR 11.5μ samples accumulated in the STA whose radiances fall between items (34) and (35).

(14) MEAN RADIANCE OF LOW CLOUD SAMPLES 11.5μ (8 BITS) - Same as item (11) except for samples accumulated in item (13).

(15) MEAN RADIANCE OF LOW CLOUDS 6.7μ (8 BITS) - Same as item (12) except for samples accumulated in item (13).

(16) POPULATION OF MEDIUM CLOUD SAMPLES 11.5μ (16 BITS) - The number of THIR 11.5μ samples accumulated in the STA whose radiances fall between items (35) and (36).

(17) MEAN RADIANCE OF MEDIUM CLOUD SAMPLES 11.5μ (8 BITS) - Same as item (11) except for samples accumulated in item (16).

(18) MEAN RADIANCE OF MEDIUM CLOUD SAMPLES 6.7μ (8 BITS) - Same as item (12) except for samples accumulated in item (16).

(19) POPULATION OF HIGH CLOUD SAMPLES 11.5μ (16 BITS) - The number of THIR 11.5μ samples accumulated in the STA whose radiances fall below item (36).

(20) MEAN RADIANCE OF HIGH CLOUD SAMPLES 11.5μ (8 BITS) - Same as item (11) except for samples accumulated in item (19).

(21) MEAN RADIANCE OF HIGH CLOUD SAMPLES 6.7μ (8 BITS) - Same as item (12) except for samples accumulated in item (19).

(22) S/C ZENITH ANGLE (8 BITS) - The zenith angle as measured from the THIR FOV to the S/C, given in thirds of a degree.

(23) CIRRUS HIGH/LOW RADIANCE 6.7 μ (8 BITS) - The 6.7 μ radiance used in SACC/ERB processing to determine the presence of cirrus clouds in the ERB-STA. LSB represents 0.015625 W/M^2-STER. This word is passed from the ERB/STAGS Tape (T173051).

(24) TIME OF FIRST THIR SAMPLE - The time in integer seconds from the start of the Data Orbit, item (4), of the THIR Scan Line containing the earliest sample colocated with this ERB-STA.

(25) RMS DEVIATION SURFACE 11.5 μ (8 BITS) - The RMS deviation of the 11.5 μ samples averaged in item (11). LSB represents 0.015625 W/M^2-STER.

(26) RMS DEVIATION LOW CLOUDS 11.5 μ (8 BITS) - The RMS deviation of item (14). Scaled the same as item (25).

(27) RMS DEVIATION MEDIUM CLOUDS 11.5 μ (8 BITS) - The RMS deviation of item (17). Scaled the same as item (25).

(28) RMS DEVIATION HIGH CLOUDS 11.5 μ (8 BITS) - The RMS deviation of item (20). Scaled the same as item (25).

(29) RMS DEVIATION SURFACE 6.7 μ (8 BITS) - The RMS deviation of the 6.7 μ samples averaged in item (12). LSB represents 0.00392 W/M^2-STER.

(30) RMS DEVIATION LOW CLOUDS 6.7 μ (8 BITS) - The RMS deviation of item (15). Scaled the same as item (29).

(31) RMS DEVIATION MEDIUM CLOUDS 6.7 μ (8 BITS) - The RMS deviation of item (18). Scaled the same as item (29).

(32) RMS DEVIATION HIGH CLOUDS 6.7 μ (8 BITS) - The RMS deviation of item (21). Scaled the same as item (29).

(33) SURFACE LAND/WATER FRACTION (8 BITS) - The percent Land in the STA. This information is passed from the ERB-STAGS Tape (Spec. No. T 173051). LSB represents one percent Land (or 99 percent water).

(34) SURFACE/LOW CLOUD RADIANCE (8 BITS) - The radiance used to separate the THIR 11.5μ samples into the lowest histogram level; between Surface and Low Altitude Clouds. LSB represents 0.125 W/M^2-STER.

(35) LOW/MEDIUM CLOUD RADIANCE (8 BITS) - The radiance used to separate the THIR 11.5μ samples into the two mid-level histograms; between low and medium altitude clouds. LSB represents 0.125 W/M^2-STER.

(36) MEDIUM/HIGH CLOUD RADIANCE 11.5μ (8 BITS) - The radiance used to separate the THIR 11.5μ samples into the highest histogram level; between high and medium altitude clouds. LSB represents 0.125 W/M^2-STER.

(37) Repeat items (8) thru (36) inclusive (bytes 31 thru 56) 221 times for a total of 222 STAs. Estimates indicate that less than 7000 STAs will be crossed in any one orbit, resulting in 28 Physical records per orbit maximum.

(38) SPARES (96 BITS) - Zeroes for record length control.

(39) SPARES (16 BITS) - Zero fill for record lenght control.

(40) LAST RECORD IN THIS ORBIT FLAG (16 BITS) - In all records except the last physical record of each data orbit, this word will be zero. For the last record, the lower 8 bits will be ones (255).

APPENDIX A

TAPE LENGTH CALCULATIONS

(1) HEADER FILE = 12"

(2) (32) RECORDS/ORBIT = 5.645" (including IRG) x 32 = 181"

(3) 14 ORBITS/DAY = 181" x 14 = 2534"

(4) 7 DAYS/TAPE = 2534" x 7 = 17,738"

17,738" =	1,479	Feet for Data
	1	Foot for Header
	1,480	Feet, Total Tape Length Used

EFFECTIVE DATE: ________

APPENDIX B

STANDARD HEADER SPECIFICATION AND TAPE DOCUMENTATION

Mike Foreman
NASA/GSFC

V.1 GENERAL

All computer compatible tapes (CCT's) that are used as interfaces within NOPS require some form of identification. This applies to all CCT's that are currently defined by a NOPS tape specification, and that are also used for distribution or archiving purposes.

In addition to defining a "latest" product, data relating to previous products that went into the making of the "latest" product provides useful information when system problems occur.

The purpose of this revision to existing NOPS tape specifications is to define a scheme that allows the recording of the genealogy of a "latest" product, and in general adheres to existing tape documentation standards.

In brief the system is as follows:

1. A documentation file that consists of a string of physical records follows the data on any tape defined by a current NOPS tape specification. This will be referred to as a Trailing Documentation File (TDF), and be the last file on a tape when it exists.

2. The standard NOPS header file remains as defined, with minor modifications to the standard header record that reflect both the existence of a TDF and adherence to the IPD standard for sequence numbers.

The following sections define the NOPS standard header records and file, and the TDF. Data files as currently defined in NOPS tape specification remain unchanged.

V.2 STANDARD HEADER RECORD (SHR)

The SHR will consist of one physical record that consists of 5 logical records of 126 EBCIDIC characters. The first 126 characters will remain as previously defined with the exception of CHARACTER 1, and those characters that define the sequence number (40-45). CHARACTER 1 will contain an asterisk (*) and serve to notify all systems that a TDF is likely to follow the main data files and that the next logical record contains information relevant to complete identification. As of the implementation date of this specification, all sequence numbers will have the following form that is an IPD standard:[1]

---

[1]This does not apply to CZCS Data. For CZCS data, CHARACTERS 40 to 45 represent a 6-digit sequence number.

CHARACTER 40 = The last digit of the year in which the data were acquired.

CHARACTER 41-43 = Julian day of the year in which the data were acquired.

CHARACTER 44 = Sequence number for this particular product (usually a 1) (e.g., CLDT's will have a 1 and 2, as there are 2 products per day).

CHARACTER 45 = The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.

CHARACTER 47 = This will remain as a blank unless it is needed to remove ambiguities in CHARACTER 40. This may occur if data are being acquired on October 24, 1988.

This scheme will uniquely identify any tape when used in conjunction with the tape specification number, the PDFC code, and the subsystem identification.

The second logical record consisting of 126 characters will contain information that is required to complete the history of the product.

CHARACTER 1-12 = Software program name and version number.

CHARACTER 13-18 = Program documentation reference number, if it exists.

CHARACTER 20-126 = User defined comments that may be more relevant to the user than the preceding ones.

The NOPS standard header file will continue to consist of 2 records, the second being a duplicate of the first. Logical records 3 and 4 may be used for anything desired if no remake information is required.[2]

V.3 TRAILING DOCUMENTATION FILE (TDF)

The TDF will consist of all NOPS standard header records (non-duplicated) that relate to products that have gone into the making of the current product. Documentation records will be

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[2]In the case of CZCS these logical records are used to define the genealogy of the image rather than the method of V.3.

sequenced in accordance with their access; that is, first in is the first recorded. Every TDF is 630 bytes in length.

The first record of this file will serve to identify the file as a TDF. This will be accomplished by placing asterisks in CHARACTERS 1 to 10 followed by NOPS TRAILER DOCUMENTATION FILE FOR TAPE PRODUCT T [SPEC NO (6 digits)] GENERATED ON DDD HH MM. The exact spacing of this comment is noncritical as long as it is less than 116 characters. The second physical record will be a repeat of the header file NOPS standard header record for this type with the proviso that data referring to the end-time are correct for the data set. Following physical records will be an accumulation of TDF's of all input tapes. For those products that require more than one tape, the TDF will appear on the last tape only as well as the warning asterisk.

Table V-1

NOPS Specification Numbering Code

T X X X X X X

Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)
6 = 9 Trk 6250 BPI

Tape number in
sequence for subsystem
(code to be derived)

Destination
Facility
1 = NOC (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD
5 = LaRC
6 = NCAR
7 = NOAA
8 = OXFD
9 = LANN

Source Facility
(Same code as
Destination Facility)

1 = ERB
2 = SMMR
3 = THIR
4 = SAM2
5 = LIMS
6 = SBUV
7 = CZCS
8 = SAMS
9 = ILT

TAPES: A six digit number prefixed with a T to denote TAPE will be used.

Rev. D adds 6250 bpi tapes as a possible product

Total 24 bit Words	MSB 24 22 20 18 16 14 12 10 8 6 4 2 LSB 1	Total Bits
1	* Nimbus - 7$_b$NOPS$_b$SPEC$_b$ NO$_b$T └If TDF exists (24 Characters)	
8		192
9	SPEC NO. (6 Digits)	
10		
	$_b$SQ$_b$NO$_b$ (7 Characters)	
13	PDFC CODE (2 Char.)	
14	5 Digit Sequence No. (5 Characters) YJJJN *For CZCS these characters (40-45) are a six digit sequence # (includes Redo)	
15	REDO CHARACTER	408
16	1 Char..Tape Copy No | Blank Character	
17	(4 Characters) SUBSYSTEM I.D.	
18	Blank Character | SOURCE FACILITY	
19	(4 Characters) | Blank Character	
20	(T) Character | (Ø) Character | Blank Character	
21	(4 Characters). DESTINATION FACILITY I.D.	
22	(23 Characters)	
	START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$	
29		696
	END DATE AND TIME OF DATA (19 Characters) TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ * Some Facilities may not include end time in header	
36	(20 Characters)	
	DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$	
42		1008
84	BLANK (126 Characters) SW Program Name (1-12) Documentation (13-18) Comments (19-126)	2016
126	BLANK (126 Characters)	3024
168	BLANK (126 Characters)	4032
210	BLANK (126 Characters)	5040

EBCDIC TAPE FORMAT

Figure V -1. Standard Header (Physical Record Format)
(1 Character = 8 bits)

The STD HDR will contain the following:

Two identical records (physical) of 630 characters (eight bits each) followed by an end-of-file.

The first 126 characters of the first record will consist of:

*NIMBUS-7$_b$NOPS$_b$SPEC$_b$NO$_b$T	(1 - 24 Character Count)
optional	
XXXXXX (96 digit spec number)	(25 - 30 Character Count)
$_b$SQ$_b$NO$_b$	(31 - 37 Character Count)
AA XXXXX (5 digit sequence No.)	(38 - 44 Character Count)

NOTE: If sequence number is zero, tape is not a finished product (i.e., definitive ephemeris not used, artificial VIP data, etc.) *

redo character	
-X (copy number 1 or 2)	(45, 46 Character Count)
$_b$YYYY$_b$ (4 character subsystem ID)	(47 - 52 Character Count)
YYYY (Generation Facility ID)	(53 - 56 Character Count)
$_b$TO$_b$YYYY (4 Char. Des. Fac. ID)	(57 - 64 Character Count)
$_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (Start year, day of year, hours, minutes, seconds)	(65 - 87 Character Count)

*For CZCS, characters 40 to 45 are a 6-digit sequence number.

$_b$TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (88 - 106 Character Count)

(End data and time of data)

GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$ (107 - 126 Character Count)

(Date and time tape was generated)

The second group of 126 characters will contain continuation documentation of the original 126 characters when required.

The third, fourth, and fifth groups of 126 characters each are intended for the use of the subsystem analysts for further identifications of their data. They may contain blanks, EBCDIC, BDC, or binary characters or zeros.

The second record in the file is a duplicate of the first record for redundancy.

The PDFC codes are as defined in Table V-2.

EXAMPLE: An ERB matrix tape covering the month of February 1979 is generated by SACC and sent to IPD for production of contour maps on 16-mm microfilm. The NOPS STD HDR file on the tape that IPD receives would contain two of the following records.

*NIMBUS-7NOPS$_b$SPEC$_b$NO$_b$T134031$_b$SQ$_b$NO$_b$

1st day of time period

AA90321-2$_b$ERB$_{bb}$SACC$_b$TO$_b$IPD$_{bb}$START$_b$1979$_b$

032$_b$000432$_b$TO$_b$1979$_b$059$_b$235742$_b$GEN$_b$

1979$_b$104$_b$094500$_b$followed by 504 blanks

First day of time period may not be first data day in the event of multiday-stacked products that are based in an ILT week.

V.4 TAPE DUPLICATION

It has been determined that the duplication of master tapes is neither time nor cost effective, thus the requirement of duplication implied in the preceding specification is rescinded. However, some tapes that require a great deal of effort to produce in terms of manpower and computer time should be duplicated.

If a redo is required due to tape errors or algorithm changes, this will be noted both on the CCT (HEADER C-45) and on the canister.

V.5 SHIPPING LETTERS

IPD will include a shipping letter with every tape distributed. The shipping letter will be printed directly from the first 126 (or 138)

characters of the first physical record of SHF. In the event of copies made from CCT's that are not generated in IPD, a new physical record reflecting IPD as the source and the Nimbus experimenter to whom the tape is being sent as the destination, will be added as the second record of the TDF. All existing records in the TDF will be pushed down, but none will be lost. This record should also replace those in the SHF.

APPENDIX H

EARTH LOCATION PROBLEM IN THE THIR CLOUDS PROGRAM
(for CLE and the CLT)

APPENDIX H

EARTH LOCATION PROBLEM IN THE THIR CLOUDS PROGRAM (for CLE and the CLT)

H.1 GREENWICH MERIDIAN PROBLEMS

While the THIR clouds program was being converted to ASCII Fortran the longitude interpolation increment in the subroutine 'GETHIR' was incorrectly computed. This error resulted in a small longitude anomaly on each orbit. As the spacecraft crossed the Greenwich meridian the interpolated longitude points backed up. In addition, this error caused 7 (nadir views) to 30 percent (horizon views) of the samples in the 240 subtarget areas, adjacent to the Greenwich meridian, to be mislocated, but it was considered too insignificant to warrant reprocessing of the data tapes. Subsequently, this subroutine was modified and the problem resolved for any data generated after September 29, 1980.

APPENDIX I

NIMBUS 7 THIR MONTAGE SCAN LOCATION ERRORS AROUND THE POLAR AREA

APPENDIX I

NIMBUS 7 THIR MONTAGE SCAN LOCATION ERRORS AROUND THE POLAR AREA

I.1 ERROR ANALYSIS

The worst-case error analysis is based on the following assumptions:

- The Earth is a sphere with a radius of 6367 kilometers
- The track of the subsatellite point is a great circle inclined at 80° 45' to the Equator
- The altitude of the spacecraft is 984 kilometers
- The THIR scans are great-circular arcs perpendicular to the track of the subsatellite point

The second and third assumptions are based on information from a few ILT-T tapes. The assumed altitude is greater than the nominal value of 955 kilometers, because the Earth's flattening results in a greater altitude near the poles, where interpolation errors are significant.

The criterion for exact locations of a scan chosen for THIR montage was that one of the anchor points should lie above 80 degrees latitude (north or south). The anchor points are chosen so that the nadir angle, the angle between the direction the sensor is looking and the nadir of the scan, is no more than 57° 8' 21". From these assumptions, it may be shown that the displacement on the Earth's surface of the corresponding FOV from the nadir is at most 18° 44' 46". Based on this, the anchor point of a scan will be above the 80th parallel if the subsatellite point is above 80° 12' 34". This should occur for approximately 3.6 percent of the scans in an orbit.

When interpolation of latitude and longitude is done to locate most of the points of a scan, the points nearest the limbs are located exactly. Interpolation begins when the direction of the instrument's line of sight is about 53 degrees away from the nadir direction. In the last scan before exact location of all points takes over from interpolation, we expect the two points nearest the limb between which interpolation is done to be separated by 3° 15', and the mean of their latitudes should be 85 degrees. To measure interpolation error, the deflection angle between the interpolated point and the great circle is used, because it is reasonably straightforward to compute with and it is a true measure of the scan's distortion. The maximum value this angle can have at the central interpolated point between two points is 17' 41". This is a noticeable error, but much less than most of the interpolation errors shown on the attached plot of actual scans from CLDT tape, which range to almost 1 degree.

The previously mentioned error is truly worst case for several reasons. First, the point in the orbit at which scan-anchor points go above 80 degrees latitude is quite sensitive to perturbations, and the assumptions usually perturb in the direction of pessimism. The most important source of error is that latitude is not on a sphere but on an ellipsoid. Geodetic latitude, is the criterion for exact location of a scan, because it is the larger of the two most common measures of latitude on an ellipsoid. A geodetic latitude of 80 degrees corresponds to a geocentric latitude of 79° 50' 2". As a result, more scans than predicted are located exactly--about twice as many in the examples we have looked at. Consequently, the highest latitude at which interpolation takes place seems to be somewhat less than the 85 degrees predicted by the simplified model. Second, only a few points per orbit will be mislocated by an amount anywhere near the maximum error, because the distance between exactly located points decreases very rapidly away from the limbs of a scan, being less than 1 degree near the nadir. Table I-1 shows the impact of latitude and distance between points on distortion of scans. Note that interpolation errors are significant only at high latitudes.

Table I-1
Table of Interpolation Errors

L \ D*	1°	2°	3°
75°	32"	2'8"	4'48"
80°	49"	3'14"	7'19"
83°	1'10"	4'40"	10'34"
85°	1'38"	6'35"	15'0"
87°	2'44"	11'12"	26'14"
88°	4'9"	17'29"	44'7"
88°30'	5'36"	24'55"	1°30'0"

*L = The means of the latitudes of the two points between which we interpolate
D = The great-circle distance between the two points

I.2 THEORETICAL BACKGROUND AND MODIFICATION IN THE PROGRAM

Upon close inspection of formatted record dumps from THIR CLDTs, scans were found to be severely distorted near the poles. Examination of the THIR montage code showed that a portion of this distortion was caused by incorrect interpolation of longitude. This interpolation was reversed only when the difference between two longitude values was 300 degrees or more, a circumstance that arose when the points between which interpolation was to be done straddled the Greenwich meridian. The correct interpolation algorithm is that of shortest path (i.e., to reverse the interpolation when the difference between successive longitude values is 180 degrees or more). See Figure I-1 for the result of this correction. Distortion is ameliorated but not eliminated because a certain amount of distortion is inherent in linear interpolation of latitude and longitude. In particular, subtarget area 3 is missed entirely. The montage scan-location algorithm and its important properties will be analyzed to put the changes made in their proper perspective.

The following is the standard THIR Montage procedure for locating a scan. First, based on the position and attitude of the Nimbus 7 spacecraft, two "anchor points" are located as near as possible to the limbs of the scan.

Second, assume that a planar scan is between the anchor points and locate 35 of the 92 points whose latitudes and longitudes are defined by the intersections between the optical axis of instrument and the reference ellipsoid which identifies with the Earth's surface. These 35 points include the 8 points nearest one limb, the 9 points nearest the other limb, and 18 points spaced four apart in between.

Third, to compute the latitudes and longitudes of the 35 points fill in the gaps by linearly interpolating the latitude and longitude. This results in a significant CPU time savings as compared to locating all 92 points exactly, and it is quite satisfactory for most scans. Figures I-1 and I-2 show that this interpolation is unsatisfactory for 5 percent of the scans that pass near the poles.

Summarizing the theoretical background of the changes made in the THIR montage program it can be supposed that the Earth is a sphere, that the scans are great-circular arcs, and that the deviations from this model are very slight. When linearly interpolating latitude and longitude, the interpolated points usually do not lie on the great circle. In the first approximation, the deflection angle between the interpolated point and the great circle is proportional to the difference between the longitudes of the known points. Since the great-circle distance is never more than 3 degrees (and much less near the nadir of a scan), the difference of the longitudes is similarly small, with the crucial exception of the polar regions, where the lines of longitude converge. When the difference in

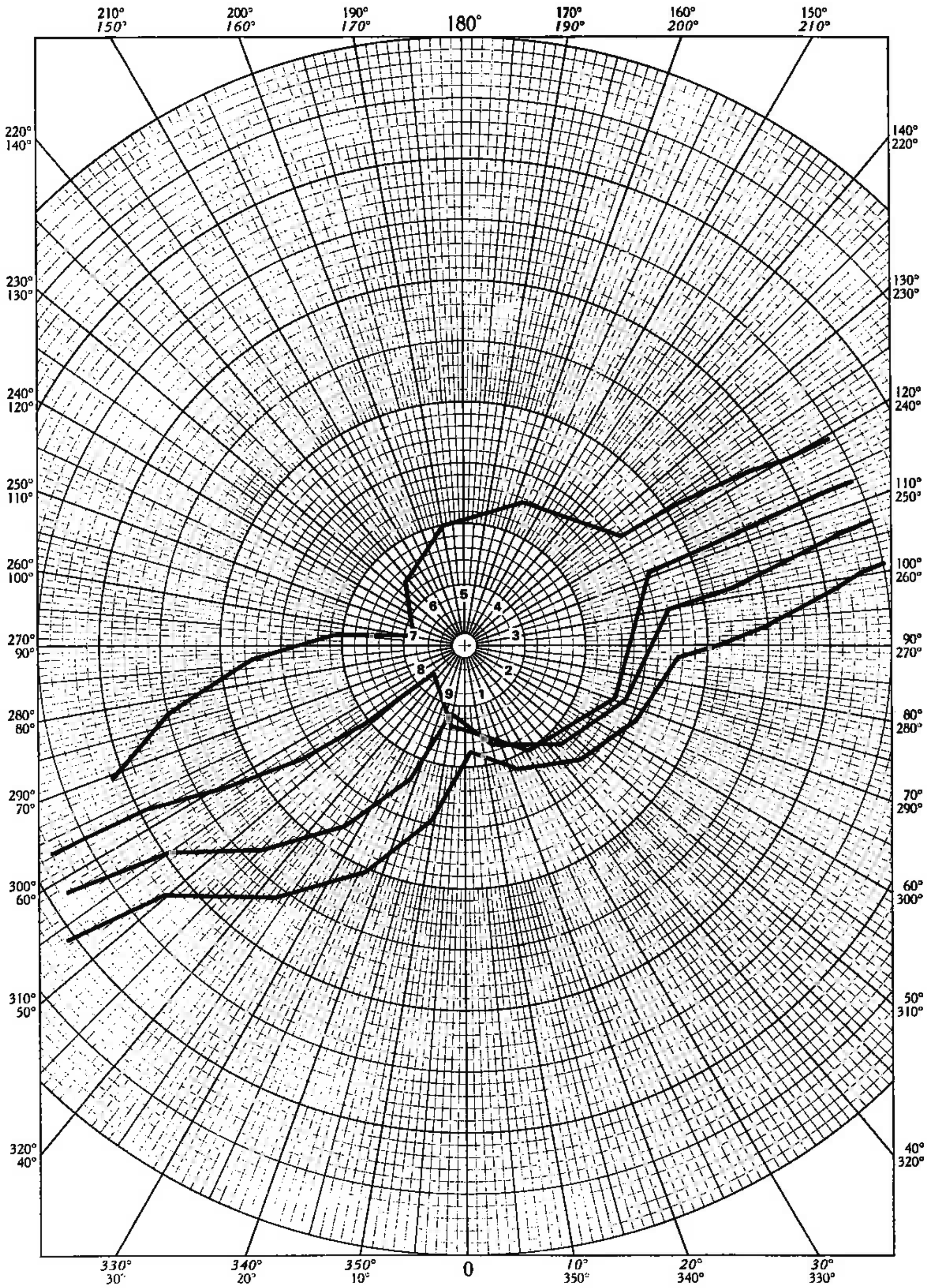

Figure I-1. Scans Near South Pole After Correction of Interpolation

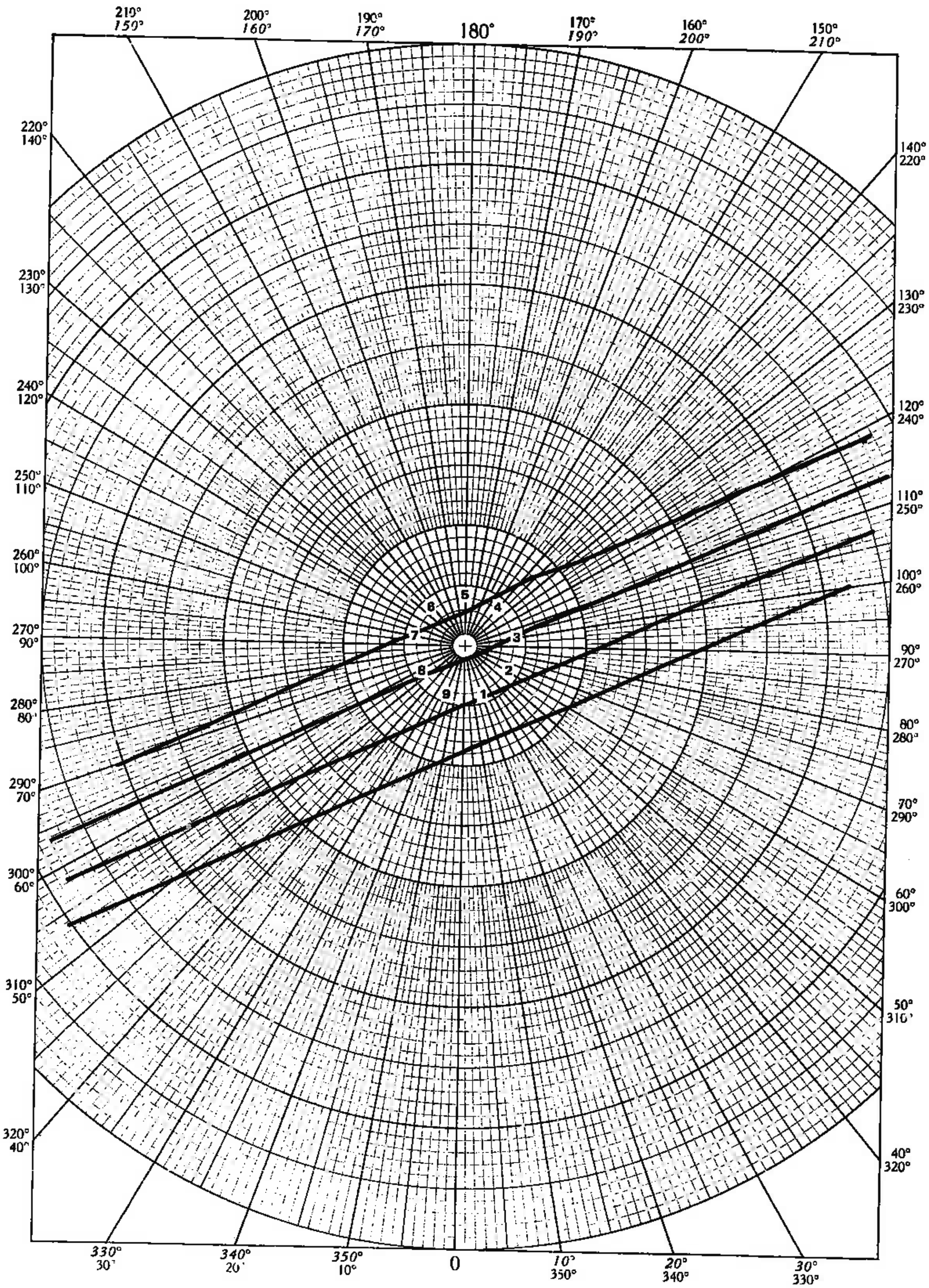

Figure I-2. Scans Near South Pole After Elimination of Interpolation longitudes is less than 5 degrees, the deflection of the interpolated points from the great circle becomes as great as 1 minute of arc only in the worst case (near the limbs of a scan). Even at 20 degrees, the deflection can only reach a noticeable but not worrisome 5 minutes. At 160 degrees, however, it becomes approximately half a degree, and in still more extreme cases exceeds 1 degree.

The obvious solution is to eschew interpolation when a scan is near either of the poles and to exactly locate all 92 points of the scan. It was found that if a scan lies between the two 80th parallels, the difference between the longitudes of two points located exactly, according to the algorithm described earlier, is never more than 20 degrees, and usually much less. Since the anchor points are the first points of a scan to be located, it was decided that if either of these points lay above the 80th parallel (north or south), all points of the scan would be located exactly and no interpolation would be done. (The initial attempt to implement this solution led to the discovery of the overflow problem in the anchor-point location routine.) Approximately 7 percent of the scans in an orbit satisfy this criterion, including all the scans which pass as close to the poles as those shown in the graphs. See Figure I-2. Since there is no interpolation, there is also no distortion. This is accomplished at the cost of less than a minute of extra CPU time, which should not have any noticeable impact on montage production.

Discussion of the polar problem is now complete; however, the Clouds program still has a problem, namely, that of multiple reports on the same subtarget area within the same orbit. By looking at Figures I-1, I-2, and I-3, which are divided into three polar target areas and their subtarget areas, the reason for this problem may be found. The outermost subtarget areas of the polar target areas are the largest on Earth, and they fully span 3 degrees of arc along their greatest dimension. Because there are 5000 scans per orbit, over 40 scans can be required--close to a minute of real time--to cover one of these subtarget areas.

The Clouds program stores information needed for subtarget area report as nodes of a queue. According to the original design, once the time of the scan currently being processed was more than 35 seconds beyond that of a scan represented in a given queue node, the corresponding subtarget area was assumed to be fully scanned and the report written to the CLE tape. Presumably, this was devised to keep the current size of the queue (i.e., a maximum value of 180 allowed) no greater than absolutely necessary. This was significant because each time a new scan point was associated with a subtarget area, the queue was searched sequentially to determine whether there was a corresponding node. CSTA implemented a much faster hash search which made the size of the queue irrelevant. Consequently, it was possible to permit the queue size to grow to 180 and to remain there with no impact on CPU time. This final change in the Clouds program eliminated and resolved the polar problem of location

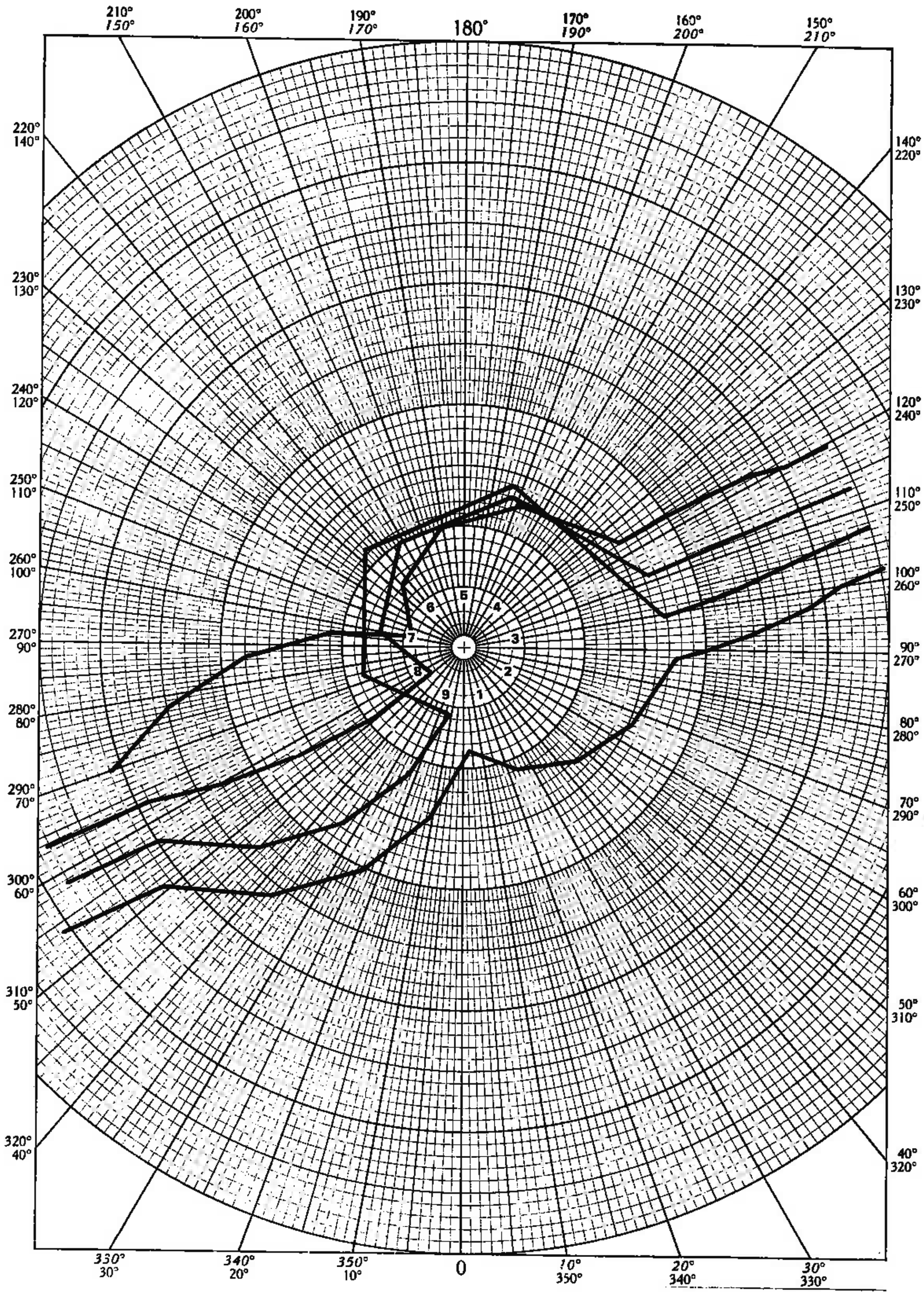

Figure I-3. Scans Near South Pole Before Correction of Interpolation and multiple subtarget area reports by May 1981. The cloud algorithm is least sensitive to the presence of clouds in polar regions because the lapse rate is nearly isothermal. Therefore, these polar-location errors were considered not significant enough to warrant reprocessing of data types generated before May 6, 1981.

APPENDIX J

THIR DATA PROCESSING SOFTWARE DOCUMENTS

APPENDIX J

THIR DATA PROCESSING SOFTWARE DOCUMENTS

The following documents are available to the user upon request from the NEAT Office, Code 910.2, NASA/GSFC:

1. Shaffer, E. S., "Nimbus Observations Processing System THIR Subsystem Software Design Review," Systems and Applied Sciences Corporation Report R-SAG-9177-20, September 1977.

2. McConaughy, G., "Nimbus-7 THIR Montage Generation System Documentation Version TMG S/UV," Systems and Applied Sciences Corporation, Contract NAS5-25346, March 1981.

3. McConaughy, G., et al., "Nimbus-7 THIR CLDT-To-Image Program Documentation," Systems and Applied Sciences Corporation, Contract NAS5-25346, April 1981.

4. Ikley, J., "Nimbus-7 THIR Clouds Generation System Documentation," Version TCGS/UV01, Systems and Applied Sciences Corporation, Contract NAS5-253766, February 1980.

5. Milasuk, N., et al., "Nimbus-7 Temperature/Humidity Infrared Radiometer (THIR) Processing System User's Guide," Computer Sciences--Technicolor Associates, CSTA/SD-81/0005, July 1981.

APPENDIX K

THIR TAPE SPECIFICATIONS

APPENDIX K

THIR TAPE SPECIFICATIONS

The following documents are available to the user upon request from the NEAT Office, Code 910.2, NASA/GSFC:

1. "Stripped THIR Tape (STT)," Tape Spec. T344081, Revision A, July 15, 1981.
2. "Image Location Tape (ILT-THIR)," Tape Spec. T34021, Revision D, July 15, 1981.
3. "Calibrated-Located Data Tape (CLDT-THIR)," Tape Spec. T344011, Revision E, July 15, 1981.
4. "Cloud Image Location Tape (ILT-C)," Tape Spec. T324051, Revision E, July 15, 1981.
5. "Clouds-SBUV/TOMS Tape (CLT-THIR)," Tape Spec. T343041, Revision D, July 20, 1981.
6. "Subtarget Area Geographical-Season (STAGS) Tape," Tape Spec. T173051, Revision B, July 15, 1981.
7. "Cloud-ERB Tape (CLE)," Tape Spec. T3433031, Revision B, July 20, 1981.