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NASA Technical Memorandum 106760

GSOSTATS Database—USAF Synchronous Satellite Catalog Data Conversion Software
User's Guide and Software Maintenance Manual, Version 2.1

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October 1994
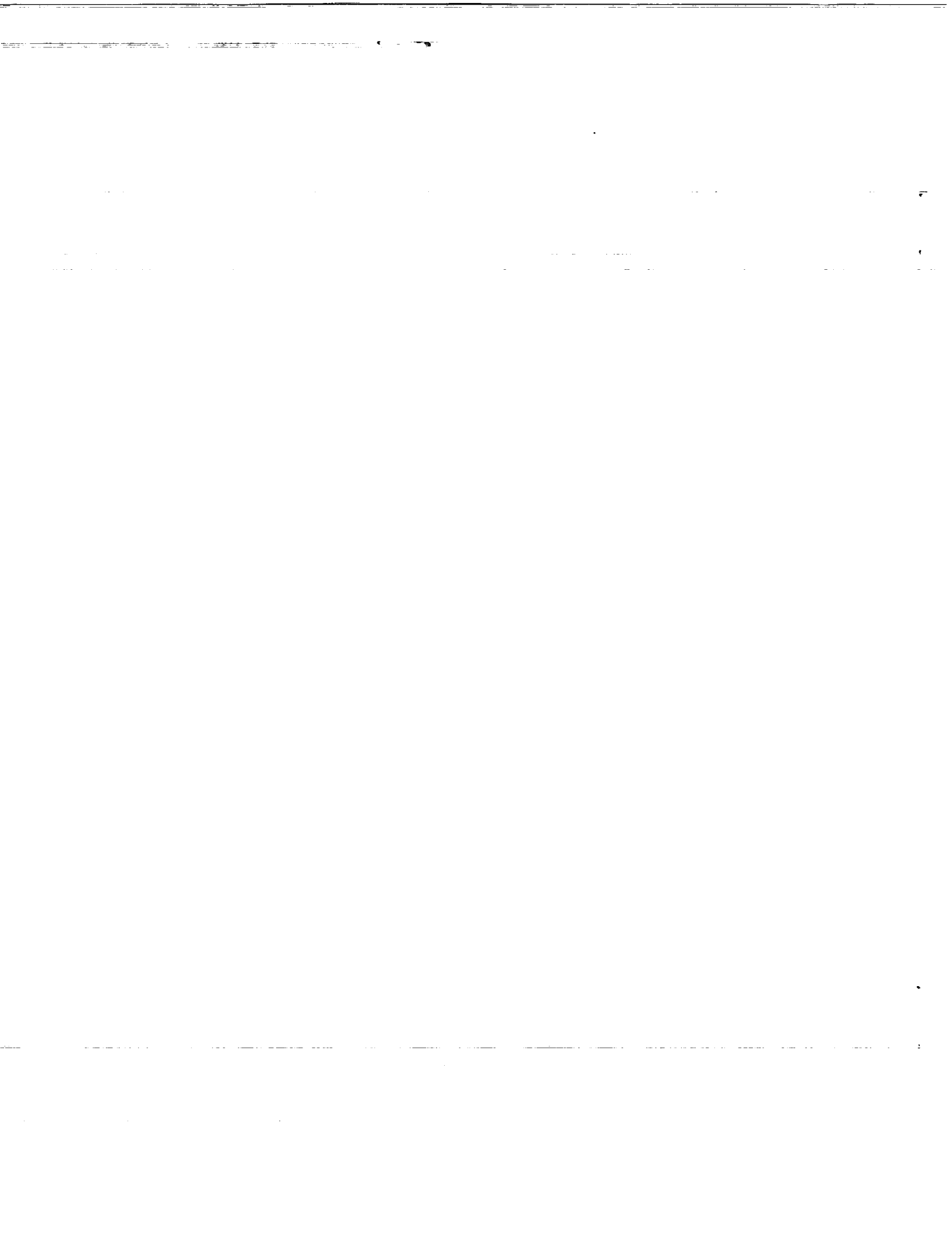
National Aeronautics and
Space Administration

GSOSTATS Database

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PREFACE

This volume contains the complete software system documentation for the United States Air Force (USAF) Synchronous Satellite Catalog Data Conversion Software (FIX-USAF). This software facilitates the formatting and conversion of USAF Synchronous Satellite Catalog data before loading it into the NASA Geosynchronous Satellite Orbital Statistics Database System (GSOSTATS). The information that USAF supplies NASA is in a report form that requires conversion into a structure readable by the database management software used in the GSOSTATS database application.

This document contains both the User's Guide and Software Maintenance Manual.

The NASA Software Management and Assurance Program (SMAP) life cycle and documentation standards were used in the development of this document. Accordingly, these standards were used in the review.

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* Federal Junior Fellowship Program

GSOSTATS Database

USAF Synchronous Satellite Catalog Data Conversion Software

User's Guide and Software Maintenance Manual

Version 2.1, August 1994

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USAF Synchronous Satellite Catalog Data Conversion Software

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Version 2.1, June 1994

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ABSTRACT

The United States Air Force (USAF) provides NASA Lewis Research Center with monthly reports containing the Synchronous Satellite Catalog and the associated Two Line Mean Element Sets. The USAF Synchronous Satellite Catalog supplies satellite orbital parameters collected by an automated monitoring system and provided to Lewis Research Center as text files on magnetic tape. Software was developed to facilitate automated formatting, data normalization, cross-referencing, and error correction of Synchronous Satellite Catalog files before loading into the NASA Geosynchronous Satellite Orbital Statistics Database System (GSOSTATS). This document contains the User's Guide and Software Maintenance Manual with information necessary for installation, initialization, start-up, operation, error recovery, and termination of the software application. It also contains implementation details, modification aids, and software source code adaptations for use in future revisions.

1.0 INTRODUCTION

1.1 Identification of Document

This is the User's Guide and Software Maintenance Manual for the NASA Geosynchronous Satellite Orbital Statistics Database System (GSOSTATS) -- United States Air Force (USAF) Synchronous Satellite Catalog Data Conversion Software (FIX-USAF). It is only one component of the complete GSOSTATS database system document set.

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1.2 Scope of Document

This User's Guide and Software Maintenance Manual contain all the information necessary for installation, initialization, start-up, operation, error recovery, and termination of the FIX-USAF software system. It also contains the implementation details, modification aids, and source code adaptations of the software.

This document adheres to the NASA Software Management and Assurance Program (SMAP) documentation standards (Release 4.3) for a User's Guide and Software Maintenance Manual and is only applicable to the FIX-USAF application. Only minimal information is provided on the actual GSOSTATS database application. A working knowledge of the basic features of the Unix operating system is assumed, and specific knowledge of the C language is necessary if the user wishes to modify the FIX-USAF source code.

1.3 Purpose and Objectives of Document

The purpose of the document is to provide a well organized, easily used guide for the user of the FIX-USAF software system. It is intended to guide the user through the steps necessary for installation, start-up, initialization, operation, and termination of the FIX-USAF program. Modifications to the main satellite data file and recovery from satellite catalog data errors are discussed. This document also presents the role that the FIX-USAF program performs in the overall GSOSTATS application. As a software maintenance manual, this document intends to guide the developer through the details of the implementation and modification or code adaptation of the software source code.

1.4 Volume Status and Schedule

Release 2.1 is the third release for the USAF Synchronous Satellite Catalog Data Conversion Software. Modifications to Release 2.0 were implemented to include additional error-correction, data cross-referencing, and code optimization. Release 2.0 replaced 1.0 as a complete source code rewrite to reflect the current satellite data format and content received from USAF. The FIX-USAF software supports GSOSTATS, so this document, along with the software, is a small and separate subset of the overall GSOSTATS application. Collecting all pertinent FIX-USAF software system documentation into one volume allows for easy reference.

No further updates are planned, but should the USAF again alter the format or content of the USAF Synchronous Satellite Catalog data received by the NASA Lewis Research Center (LeRC), modifications to the FIX-USAF program may have to be made.

1.5 Volume Organization and Roll-Out

This document is organized into 12 sections (including appendices). A short description of each of the sections follows:

Section 1	Identifies the document and states its purpose and status.
Section 2	Identifies related documents.
Section 3	Provides an overview of the purpose and functions of the FIX-USAF software files.
Section 4	Documents the installation procedures and initialization process of the software system for the new user.
Section 5	Presents the software startup and termination procedures.
Section 6	Describes each function with its corresponding operation.
Section 7	Identifies possible error messages and warning messages that may occur.
Section 8	Contains possible recovery steps the user may employ should an error occur.
Section 9	Contains a list of abbreviations and acronyms used in this guide.
Section 10	Provides a glossary of terms used in this guide.
Section 11	Information on how to contact the manager of the application and notes for first time users of the software.
Section 12	Contains appendices, including:

	Appendix A:	Representative sample of the USAF Synchronous Satellite Catalog and associated Two Line Mean Element Sets.
	Appendix B:	Master FIX-USAF output files.
	Appendix C:	Samples of secondary files generated by the software.
	Appendix D:	The master satellite data file.
	Appendix E:	XREF-UPDATE software.
	Appendix F:	A software change request form.
	Appendix G:	A data change request form.
	Appendix H:	An errors encountered report form.

2.0 RELATED DOCUMENTS

2.1 Parent Documents

The following documents are the parent from which this document's scope and content are derived:

1.   *User's Manual for the NASA GSOSTATS USAF Data Conversion Program*, Western Michigan University Software Systems Development Team D, March 1993.

2.   *Maintenance Manual for the NASA GSOSTATS USAF Data Conversion Program*, Western Michigan University Software Systems Development Team D, March 1993.

2.2 Applicable Documents

The following documents are directly applicable to the content of this volume:

1.   *NASA GSOSTATS Maintenance Manual* (Release 3.0), Western Michigan University Department of Computer Science, January 1992.

2.   *GO_UPD Maintenance Manual* (Release 2.0a), Western Michigan University Department of Computer Science, September 1992.

3.   *User's Guide for Database Maintenance and Update* (Release 2.0), Western Michigan University Department of Computer Science, September 1992.

2.3 Information Documents

The following document, although not directly applicable, amplifies or clarifies the information presented in this volume, and is not binding:

1.   *TRW Space Log — Volume 25, The Fast Track on Orbital Traffic*, TRW Space and Technology Group, 1990.

3.0 OVERVIEW OF PURPOSE AND FUNCTIONS

3.1 GSOSTATS Database Overview

GSOSTATS is a computer-based information management system that collects, maintains and allows easy access to information pertaining to various characteristics of in-orbit and planned non-classified geosynchronous communications satellites. GSOSTATS development utilized the INGRES Database Management System (DBMS) maintained on the NASA Headquarters VAX-Cluster. GSOSTATS is designed to serve a wide range of requirements while addressing the fundamental problem of accommodating several comprehensive and authoritative data sources that are sometimes in conflict.

NASA is involved in virtually every phase of satellite communications forecasting, research, planning, and operations. As such, NASA recognized a need to automate the data collecting efforts relating to satellite communications. By automating and selecting reliable sources of data, the research burden (finding sources and verifying the validity of the data) has been significantly reduced, allowing better analysis of data.

The GSOSTATS concept has been formulated with flexibility and survivability as the central theme. The system is highly responsive to a diverse set of user requirements and is meant to complement existing sources of communications satellite information. Currently, the GSOSTATS database consists of the following four (4) sections:

1. Federal Communications Commission (FCC) Section containing quarterly automated transponder occupancy report information on US domestic satellites. Various statistical reports can be produced and usage trends plotted on up to six past quarters of transponder loading data.

2. Westsat Communications Satellite Channel Section reporting bimonthly on all video and analog/digital subcarrier audio programming services on North American C and Ku-band satellites. Transponder service details may be cross-referenced with the FCC section for actual usage information.

3. International Telecommunications Union/International Frequency Registration Board (ITU/IFRB) Section records annual updates of world data on satellite filings. Extensive earth station information that relates to satellite networks is also included.

4. United States Air Force (USAF) Section collects precise orbital parameters of all unclassified synchronous satellites currently in orbit. This section is updated monthly with data from the Space Surveillance Center (NORAD) after manipulation by the software described in this document.

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3.2 FIX-USAF Software Overview

3.2.1 FIX-USAF Software Functions

Data for the GSOSTATS database is gathered from other established systems designed to collect and archive satellite information. GSOSTATS data updates are performed by a series of magnetic tape and floppy diskette file transfers from these other systems. USAF is just one organization that NASA receives data from on a regular basis.

Every month, USAF provides NASA with a Synchronous Satellite Catalog and associated Two Line Element Sets. This report provides information defining a synchronous satellite's orbit, showing where it was at a given time and allowing for predictions of where it will be in the future. Refer to *Information Documents (Section 2.3)* for a more complete discussion of the tracking method.

The main function of the FIX-USAF software system is to organize the USAF's data in such a way so as to allow the GSOSTATS data tables to be loaded with this new information. Satellite orbital data provided by USAF is in report form contained on magnetic tape. This report must be reorganized (or normalized) in such a way as to facilitate data table loading and retrieval within the GSOSTATS Database. Once a new set of normalized data files has been produced, they can be transferred to the NASA Headquarters VAX-Cluster in a variety of ways, including electronic file transfer. This new data file can then be loaded into the appropriate database tables. Please refer to the *User's Guide for Database Maintenance and Update* for additional information on loading the database tables.

During the conversion process, the program will generate a number of ASCII text files indicating errors and certain other anomalies that may have occurred. These files are created in the same directory as the conversion program and may be printed for later reference. Refer to *Appendix C* for a sample of these report files. Refer to *Section 7.0* of this document for a complete guide to the error and warning messages.

3.2.2 FIX-USAF Software Options

FIX-USAF is primarily a data conversion utility with no substantial options. However, the user is able to physically modify the master satellite data file used by the FIX-USAF software. This ASCII data file contains a list of valid satellite names, numbers, administrations, international designators, and other pertinent information. It is used by the software to verify and cross-reference the USAF data during conversion. The user may modify the data file to reflect additional satellites being tracked by the USAF or other items important to the operation of the FIX-USAF software. Refer to *Section 4.3* of this document for a description of how to modify the master satellite data file.

3.2.3 FIX-USAF Software Restrictions and Limitations

The FIX-USAF software system must read and format an ASCII text file so it relies on the present structure and content of the USAF Synchronous Satellite Catalog data received on magnetic tape. The conversion software is flexible enough to accommodate minor changes USAF may introduce into their satellite catalog file. However, some variations may not behave as expected during the conversion process, so the software itself may also have to be modified to reflect those irregularities. Please refer to *Appendix A* for a description of the catalog file format.

While a variety of anomalies occurring in the original USAF data have been taken into consideration by the developers, it is still possible to encounter an abnormality that has not been considered. The FIX-USAF software is able to correct several types of errors during the conversion process, but should an unexpected error occur, the user should send the original USAF data file, the unfinished files containing the converted data, copies of all informational files, and a completed *Abnormal Errors Encountered Report Form* to the GSOSTATS database manager. Refer to *Appendix H* for instructions and a copy of the *Abnormal Errors Encountered Report Form*.

3.2.3.1 Non-Standard Satellite Names and Numbers (Cross Reference Compatibilities)

The conversion program uses the SATNAMES.DAT cross reference file to extract the common name, satellite number, object type, and administration. The satellite names and numbers, as they appear in the original USAF catalog file, can vary widely. It is up to the user of FIX-USAF when modifying or adding satellites to the cross reference file to establish a satellite naming convention or standard.

> **Note:** The satellite names that finally appear in the GSOSTATS data tables are taken directly from the cross reference file, so it is essential that the user maintain consistency when modifying the cross reference file.

3.3 Implementation Details

3.3.1 Specific Data Representations

There are several specific data representations that must be adhered to during any modification to the FIX-USAF software system. Refer to *Appendices A and D* for additional information on each of the data representations required for a working software system.

3.3.2 Operating System Interfaces and Dependencies

The FIX-USAF software system operates and was developed on a Unix platform running SunOS version 4.1.3. The source code was written in Unix C. The source code may be obtained and compiled on another system, however, the user must make sure to adhere to the function prototyping and function placement rules of their C compiler. Otherwise, no guarantees can be made on the operability of the software if it is compiled under a different system with a varying C compiler. Refer to *Section 4.4* to obtain a copy of the source code.

3.3.3 Support Software and Libraries

The FIX-USAF software system requires only the **SATNAMES.DAT** Master Satellite Data File for system execution. This ASCII text file contains valid satellite names, numbers, and other pertinent information to the successful conversion of the USAF data. Refer to *Appendix D* for more information on this data file.

> **Note:** The **SATNAMES.DAT** file **must** be present in the same directory as the **FIX-USAF** executable file in order for the program to function properly.

No other software is required for maintenance of the FIX-USAF system. The SATNAMES.DAT cross-reference file may be edited with an ASCII text editor such as vi. However, the user is advised to make use of the XREF-UPDATE software provided with FIX-USAF to update the cross reference file. The XREF-UPDATE provides a more controlled environment for editing the SATNAMES.DAT file than can be found in a standard text editor. It can greatly reduce the probability of errors and the time it takes to edit the SATNAMES.DAT file, specifically when the SATNAMES.DAT requires a large modification. Refer to *Appendix E* for details on the XREF-UPDATE software.

3.3.4 Hardware Dependencies

The FIX-USAF software system operates and was developed on a Sun Sparcstation 2. However, due to the hardware independent source code, the software may be compiled on a different machine as long as the guidelines stated in *Section 3.3.2 Operating System Interfaces and Dependencies* are followed. Due to the frequent amount of disk access conducted by the FIX-USAF software, the developers of FIX-USAF recommend that the software be implemented in a multi-tasking environment with fast disk access.

An optional printer may be attached to the system in order to print the output files generated by the software.

> **Note:** This manual does not cover the printing process. The user must manually issue a print command specific to his system in order to print the output files. The user

should refer to his system's operating guidelines or consult the system administrator for details on how to print from the local system.

3.3.5 Other Interfaces

None.

4.0 INSTALLATION AND INITIALIZATION

4.1 Equipment Requirements and Set-up

The FIX-USAF software system operates and was developed on a Unix platform running SunOS version 4.1.3. The source code was written in Unix C. The source code may be obtained and compiled on another system, but no guarantees can be made on the operability of the program if it is ported.

The software and related data files are distributed on tape or disk.

An optional printer may be attached to the system in order to print the output files generated by the software.

> **Note:** This manual does not cover the printing process. The user must manually issue a print command specific to his system in order to print the output files. The user should refer to his system's operating guidelines or consult the system administrator for details on how to print from the local system.

4.2 Bootstrap and Loading of Software Files

The FIX-USAF software system consists of two separate, but related files; **FIX-USAF** and **SATNAMES.DAT**. **FIX-USAF** is the actual executable software while **SATNAMES.DAT** is an ASCII text file containing valid satellite family names, numbers, and other pertinent information.

> **Note:** The following installation procedure should only be conducted by the Unix System Administrator so that he/she may choose an appropriate directory and set access levels.

1. Choose an appropriate location for the FIX-USAF software on your file system.

2. Move to the directory location using the cd command, and create a new directory named FIX-USAF. For example, if you select the location /usr/local, use the commands (user-entered commands in bold):

```
$ cd /usr/local
/usr/local> mkdir GSOSTATS
/usr/local> cd GSOSTATS
```

3. Insert the tape into the tape drive.

4. To install the software to the current directory issue the command:

```
/usr/local/GSOSTATS> tar -xvf /dev/rst0
```

5. This command will install the software files into the FIX-USAF sub-directory within the GSOSTATS directory.

If any error messages are encountered during the installation procedure, check the command for spelling and/or syntax errors, then retype the command that failed. If the files cannot be successfully transferred, please complete and return the *Abnormal Errors Encountered Report Form* contained in *Appendix F* of this document.

4.3 Modifying the SATNAMES.DAT Satellite Data File

The FIX-USAF software system accesses an ASCII data file named **SATNAMES.DAT** during the conversion process. This user accessible text file contains the valid satellite names, satellite numbers, satellite types, and administrations.

> **Note:** Should the USAF discontinue tracking one or more of the satellites or if additional satellites begin to be tracked by the USAF, the **SATNAMES.DAT** file **must** be modified to reflect these changes. Other changes in the original USAF Synchronous Satellite Catalog Data may or may not require a modification of this data file.

Any standard text editor or word processor with the ability to read and write ASCII text files may be used to alter this data file. The user must, however, follow the current file format as outlined in *Appendix D* or software errors and erroneous results could result. *The developers of FIX-USAF recommend that the user make use of the XREF-UPDATE software provided with FIX-USAF to update the cross reference file. Refer to Appendix E for details on the XREF-UPDATE software.*

> **Note:** The **SATNAMES.DAT** file **must** be present on the same disk drive and in the same directory as the **FIX-USAF** file in order for the software to function properly.

The user may easily modify the **SATNAMES.DAT** data file as many times as necessary. Possible USAF Satellite Catalog data modifications include, but are not limited to the following:

1. An existing satellite or satellites are no longer being tracked by the USAF.

2. The USAF begins tracking one or more new satellites.

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3. The common name, satellite number, or administration has changed.

Users must exercise caution when adding or modifying the records in the **SATNAMES.DAT** data file as software errors and erroneous results could result from improperly placed record items. Also note that the **SATNAMES.DAT** data file must be in ASCII format in order for the file to be read and utilized by the FIX-USAF software. Please refer to *Appendix E* for information on the correct record entry and position for each item listed in the data file.

4.4 Obtaining a Copy of the Software

The original and backup copies of the FIX-USAF software system reside at LeRC and are controlled by the GSOSTATS database manager. Additional copies of the FIX-USAF source code, **SATNAMES.DAT** data file, and related documentation may be obtained by contacting:

James E. Hollansworth
Mail Stop 54-2
NASA Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135-3191
Telephone: (216) 433-3458
FAX: (216) 433-8705

5.0 STARTUP AND TERMINATION

5.1 Startup Procedures

To start the FIX-USAF software system, perform the following steps from within Unix (user entered commands are in bold):

1.   Change to the directory where the data file **FIX-USAF** is located.

/usr/local/GSOSTATS> **cd FIX-USAF**

2.   Enter the name of the executable software file followed by the name of the Air Force catalog. The USAF Satellite Catalog file must be located in the same directory as the FIX-USAF software or a valid pathname must be specified.

/usr/local/GSOSTATS/FIX-USAF> **FIX-USAF SatCat.07_94**

You cannot start the FIX-USAF software from a directory other than where **FIX-USAF** is located because the data file **SATNAMES.DAT** must be accessed from the same location.

The FIX-USAF software system immediately accesses the **SATNAMES.DAT** satellite data file and begins processing the given catalog file.

5.2 Normal Termination Procedures

Besides the initial command line parameters, the USAF conversion program is a non-interactive process. The program continues until it is finished processing the catalog file or has been terminated abnormally (refer to Abnormal Termination Procedures).

5.3 Abnormal Termination Procedures

To exit the FIX-USAF software system during the data conversion processing or after the occurrence of some unknown software error, hold down the **Control** key and press the C key (**Ctrl-C**). This sequence of keystrokes will abort the current process regardless of what it is doing and return the Unix command prompt.

> **Note:** This method of aborting the software will **not** change the original satellite data input file being converted, but the newly converted (and possibly incomplete) data output file will be unusable in the GSOSTATS database.

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Aborting the software with **Ctrl-C** in no way harms the original satellite data file or the **SATNAMES.DAT** data file. However, since all of the output files are closed for output during the end of the execution process, they may be corrupted depending on whether or not the file stream was flushed. The user should restart the execution process (refer to *Section 5.4 Abnormal Restart Procedures*) to ensure valid output files.

5.4 Abnormal Restart Procedures

If a user aborts the conversion of satellite data or encounters some unknown software error that halts the program, the FIX-USAF software may be restarted by retyping the required commands found in *Section 5.1 Startup Procedures* of this document.

If the software cannot be successfully restarted, please complete and return the *Abnormal Errors Encountered Report Form* contained in *Appendix H* of this document.

5.5 Loading the Data Into the GSOSTATS Database

Once the USAF Satellite Catalog has been successfully converted and the new data files have been produced, the normalized data can be transferred to the NASA Headquarters VAX-Cluster. This transfer can be accomplished in a variety of ways, but is not described in this document. The user may employ whatever method best satisfies his needs.

Refer to the *User's Guide for Database Maintenance and Update* for more information on loading the normalized USAF Satellite Catalog Data into GSOSTATS.

6.0 FUNCTIONS AND THEIR OPERATION

6.1 Input File Name Function

6.1.1 Input File Name Function Purpose

The purpose of the *Input File Name* function is to allow the user to name the USAF Synchronous Satellite Catalog Data file to be converted. The original input file is completely separate from the output file and is left unchanged for archive purposes. File conversion cannot begin without first naming a valid input data file.

6.1.2 Input File Name Function Execution and Results

The FIX-USAF software takes an input file name as a command line parameter. The input file is the name of the USAF Satellite catalog. After the command line is entered and the **Enter Key**
is pressed, FIX-USAF begins processing the input file without further intervention from the user.

6.2 Output File Names

6.2.1 Output File Name Descriptions

The output data files are created automatically through the processing of the input file. Four error files are named: BADAF1.DAT, BADAF2.DAT, INAF1.DAT, INAF2.DAT. There also are two temporary files named TEMPAF1.DAT and TEMPAF2.DAT. Two main output files to be exported to GSOSTATS database are labeled AF1.DAT and AF2.DAT. The following list briefly describes these data files. Refer to *Appendices B and C* for details on these files.

> **Note:** The original input file is completely separate from the output file and is left unchanged for archive purposes.

BADAF1.DAT: This file contains the bad records extracted from the two line element sets of the USAF data.

BADAF2.DAT: This file contains the bad records extracted from the first portion of the USAF data.

INAF1.DAT : This file contains those records located in TEMPAF1.DAT but not in TEMPAF2.DAT. Records may not be present or may extract as errors during the processing of the first portion of the USAF file.

INAF2.DAT : This file contains those records located in TEMPAF2.DAT but not in TEMPAF1.DAT. Records may not be present or may extract as errors during the processing of the two line mean element sets.

TEMPAF1.DAT : This file contains immediate data extracted from the two line element sets of the USAF data minus those records that were marked as bad.

TEMPAF2.DAT : This file contains immediate data extracted from data in the first portion of the USAF file minus those records that were marked as bad.

AF1.DAT : Final data to be imported into GSOSTATS Database. This contains data located in TEMPAF1.DAT minus those records located in INAF1.DAT.

AF2.DAT : Final data to be imported into GSOSTATS Database. This contains data located in TEMPAF2.DAT minus those records located in INAF2.DAT.

6.3 Conversion Process

Refer to *Section 7.0* of this document for a description of the error and warning messages possible during software execution and file conversion.

6.3.1 Conversion Process Execution and Results

Conversion is the main process of the FIX-USAF software. It is this process that takes the input file specified by the user (refer to *Section 6.1*) and creates the final output files.

During the conversion process, satellite data found in the input file will be checked for invalid satellite names, numbers, and other abnormalities that may have resulted in the creation of the data file. Any discrepancies found by the software during the conversion process will be reported to the user via output error files. Please refer to *Appendix A* for a description of the required input file format, *Appendix B* for an outline of the master output file formats, and *Appendix C* for an example of the secondary reports generated during the conversion process.

Verification of satellite data is important in maintaining the integrity of the GSOSTATS database and alerting the user to possible errors in USAF reports.

Following the startup of the FIX-USAF process, the user will see five different messages indicating the processing progress of the USAF file. Please refer to *Figure 6-1* for an example of these messages. The progress indicators are as follows:

Processing USAF file: *nnnnn*

> Indicates the current record that FIX-USAF is processing. The final number represented by *nnnnn* should correspond to twice the number of total objects within the USAF Satellite Catalog. Processing begins with the first portion of orbital data and continues sequentially through the two line element sets. Upon processing of the records, error files BADAF1.DAT and BADAF2.DAT and temporary files TEMPAF1.DAT and TEMPAF2.DAT will have been written. The two temporary files will contain partially processed error checked records.

Processing INAF file: *nnnnn*

> This message occurs twice during processing of a USAF Satellite Catalog. The first message indicates processing of INAF1.DAT, while the second message indicates processing of INAF2.DAT. The final numbers represented by *nnnnn* correspond to the number of records located within the INAF files. If the number for the two messages is equal, no records were written to error files. The INAF files themselves indicate what records were located in one of the temporary files but not the other (i.e., INAF1.DAT indicates those records located within TEMPAF1.DAT but not TEMPAF2.DAT).

Processing AF file: *nnnnn*

> This message occurs twice during processing of a USAF Satellite Catalog file. The first message indicates processing of AF1.DAT, while the second message indicates processing of AF2.DAT. The final numbers *nnnnn* should correspond to the numbers listed after the INAF prompts. This final portion of processing is simply a comparison of the INAF files (i.e., The final AF1.DAT file will contain those records contained with TEMPAF1.DAT minus those flagged in INAF1.DAT).

Figure 6-1 Representative Sample of FIX-USAF Screen Output

The following output represents the processing of 505 total objects within the satellite catalog file.

```
/usr/local/GSOSTATS/FIX-USAF> FIX-USAF SatCat.07_94

                  Processing USAF file:  1010
                  Processing INAF file:  505*
                  Processing INAF file:  505
                  Processing AF file:  505
                  Processing AF file:  505
```

---

* This equal number indicates that no records were removed as errors.

7.0 ERROR AND WARNING MESSAGES

7.1 Error Messages

Aside from entering the file name parameter, FIX-USAF software is a wholly non-interactive process. Therefore, the majority of errors that occur arise from abnormalities within the input file itself. Errors can be divided into four major areas: user input errors, field errors, cross-reference file errors, and unmatched object errors. These four areas are discussed in the following sections.

7.1.1 User Input Errors

User input errors can only occur at the command line. Users must enter the name of the FIX-USAF executable followed by a valid USAF Satellite Catalog input file. If the user fails to enter an input file or the input file is invalid, FIX-USAF will issue a usage error indicating the proper usage of the FIX-USAF command. At this point, the user should re-enter the correct command line to begin processing of the USAF input file.

7.1.2 Field Errors

Errors in Orbital Data: All numeric fields are checked for valid numeric characters. Fields that are cross-referenced with the SATNAMES.DAT file are not error checked since the data is assumed to be valid within the cross-reference file. Errors occuring within any other fields are flagged and written to the BADAF2.DAT file. After processing the USAF Satellite Catalog is complete, the user can go back and correct these errors within the original Satellite Catalog file with any ASCII text editor. After correcting these errors, users should re-execute FIX-USAF to process the Satellite Catalog with the revised fields.

Errors in Two Line Mean Element Sets: All fields processed within this section are checked for valid numeric characters. Errors are flagged and written to the BADAF1.DAT file. After processing the USAF Satellite Catalog is complete, the user can go back and correct these errors within the original Satellite Catalog file with any standard ASCII text editor. After correcting these errors, users should re-execute FIX-USAF to process the Satellite Catalog with the corrected fields.

7.1.3 Cross-Reference File Errors

Only one type of cross-reference file error may occur. As part of the execution process, FIX-USAF cross-references the SATNAMES.DAT data file in order to retrieve the corresponding

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common name and number for a given object number. At times, however, FIX-USAF cannot find a cross-listed object number. This event is flagged as an error within the BADAF2.DAT error file. The user may proceed to update GSOSTATS data tables, but the tables will be partially incomplete due to the inability of FIX-USAF to cross-reference a given object. The user should edit the SATNAMES.DAT file to include the missing satellite and then re-execute the FIX-USAF program. The user may use any standard ASCII text editor to modify the SATNAMES.DAT file. *The developer's of FIX-USAF recommend that the user make use of the XREF-UPDATE software made available with FIX-USAF in order to update the SATNAMES.DAT data file.* While modifying the cross-reference file, the user should keep in mind that any modifications or additions made to the cross-reference file may eventually appear in the GSOSTATS data tables. Therefore, it is imperative that the user maintain consistency in naming and modifying the SATNAMES.DAT file.

7.1.4 Unmatched Object Number Error

This type of error deals directly with the INAF1.DAT and INAF2.DAT files that are produced by the conversion process. There must be a one-to-one correspondence between the objects located in the orbital parameters' data and the two line mean element sets. If there is not a correspondence, the given records are flagged within their respective output files (i.e., records located within TEMPAF1.DAT but not TEMPAF2.DAT are flagged in the INAF1.DAT file). This error occurs for one of two reasons; either the USAF was in error in creating the catalog and omitted one of the object numbers, or one of the fields in one section was marked as bad and omitted in the TEMPAF file. Therefore, when the comparisons are being matched, there is an unmatched set. Most probably, the latter case will be the norm.

8.0 RECOVERY STEPS

Recovery from almost any of the corrections, warnings, or errors listed in *Section 7.0* is possible using the following methods:

1. **Error:** Field Error

    Action: Review the original USAF Synchronous Satellite Catalog data file and correct the erroneous field in question if possible. This method is possible only in cases where the user is confident that the new data is correct.

2. **Error:** Cross-Reference File Error

    Action: Compare the original USAF Synchronous Satellite Catalog data file and the contents of the **SATNAMES.DAT** file with the known satellite catalog specifications and modify the **SATNAMES.DAT** data file as necessary.

Users should seek an independent source to verify the satellite's physical characteristics any time a change is made.

Should the preceding methods fail, or if the user is unable to correct the original USAF catalog loading data file correctly, the user's only recourse is to notify the USAF of the problem with the original data file and request a corrected data file.

9.0 ABBREVIATIONS AND ACRONYMS

All abbreviations are defined when they first appear in the text. An alphabetized list of the definitions for abbreviations and acronyms used in this document is defined here.

ASCII	American Standard Code for Information Interchange
DBMS	Database Management System
FCC	Federal Communications Commission
FIX-USAF	USAF Synchronous Satellite Catalog Data Conversion Software
GSOSTATS	Geosynchronous Satellite Orbital Statistics Database System
IFRB	International Frequency Registration Board
ITU	International Telecommunications Union
LeRC	Lewis Research Center
NASA	National Aeronautics and Space Administration
SMAP	Software Management and Assurance Program
USAF	United States Air Force

10.0 GLOSSARY

Acceleration of Mean Motion - The rate of change in mean motion of a satellite. If the value is negative, the satellite is decelerating.

Administration - The country or group that currently administers a given satellite. Administration may change from time to time.

Apogee - The orbit location farthest from the object being orbited.

Class ID - A classification identification code used internally by the United States Air Force.

Data Base Management System - A set of procedures and data structures that isolates the applications from the details of the creation, retrieval, storage, modification, security, and physical storage structure of a computerized data base. It presents an application with a view, as required by its processing needs, without consideration for the physical storage or access of the data. The INGRES database management system from Relational Technology Inc. was used to develop GSOSTATS.

Days from Epoch - The number of days referenced from the current catalog date for which the orbital data is valid.

Drift - A gradual deviation from a set adjustment. In satellite terms, drift is caused by the pressure of solar radiation and by minor gravitational perturbations of the orbit due to the sun, the moon, and the oblateness of Earth.

Eccentricity - The distance of the geometric center of a revolving body from the axis of rotation. It ranges from 0 to 1 and is the measure of the ovalness of a satellite's orbit (i.e., when the eccentricity is 0, the orbit is a circle; when the eccentricity is 0.9, the orbit is a long, thin, ellipse).

Epoch - A particular instant for which certain data are valid.

Geosynchronous Satellite - An artificial satellite, placed in a circular orbit at a distance of 22,300 miles above the earth with a period of precisely one day. Launched toward the East (in the direction of the earth's rotation) the satellite will hover over one point on the earth.

Hardware - Physical equipment used in data processing, as opposed to computer programs, procedures, rules, and associated documentation.

Inclination - Angle between orbital plane of satellite and equatorial plane of Earth. A negative number indicates a position south of the equator while a positive position indicates a position north of the equator.

Latitude - The North/South position in degrees from zero to ninety above or below the equator.

Longitude - The East/West position in degrees from 0 to 180 along the equator East or West of the prime meridian. The USAF Synchronous Satellite Catalog lists satellites in degrees continually East.

Mean Motion - The speed which a planet or its satellite would have if it were moving in a circular orbit with radius equal to its distance from the sun or a central planet with a period equal to the actual period.

Normalization - A step-by-step reversible process of replacing a given collection of relations by successive collections in which the relations have a progressively simpler and more regular structure. The simplifying process is based on non-statistical criteria. The reversibility guarantees that the original collection of relations can be recovered and therefore no information has been lost.

Perigee - The orbit location closest to the body being orbited.

Software - Programs, procedures, rules, and any associated documentation and data pertaining to the operation of a computer system, including programs and data contained in firmware.

Testing - The process of exercising or evaluating software by manual or automated means to demonstrate that it satisfies specified requirements or to identify differences between expected and actual results.

11.0 NOTES

The USAF Synchronous Satellite Catalog is produced by the USAF for use within that organization and is provided to NASA as a free service. NASA receives a copy of the report on tape in a format that is basically a duplicate of hard copy or paper output. The USAF must prepare the report specifically for NASA every month.

Through the compilation of the report, various errors may be introduced into the data received by NASA. The user will find that it is sometimes necessary to physically edit the report before the FIX-USAF software is able to successfully convert the data without errors. Any standard text editor or word processor with the ability to read and write ASCII text files may be used to correct this report file. The user must remember to follow the current file format (including the width of the current data file) as outlined in *Appendix A* or software errors and erroneous results could result.

Possible items a user may have to edit in the USAF Synchronous Satellite Catalog data file include, but are not limited to the following:

1. A satellite common name or number has been entered incorrectly by the USAF and must be corrected before the FIX-USAF software can be executed. (The correct satellite information for the sample in question should be confirmed by the user.)

2. A satellite sample is not completely listed in the data file. (The sample may be missing one or more of the elements necessary for the FIX-USAF software to convert the sampling data.)

There may be occasions where a sample is so badly corrupted that the user needs to contact the USAF and request that a new report be produced. This method is often better than trying to correct a badly contaminated USAF Satellite Catalog data file.

12.0 APPENDICES

Appendix A

USAF Synchronous Satellite Catalog Input Sample

Explanatory Note

The purpose of the USAF Synchronous Satellite Catalog Input Sample is to document the format of the report received by LeRC on tape. The catalog is an ASCII text file organized in a specific way. The FIX-USAF software system relies on the present format and structure of the sample presented here. Any changes in the format of the USAF Satellite Catalog file report **may require** a modification of the FIX-USAF software.

The following sections outline the data fields and the order in which they should occur in the input file. These fields and their relative positions in the text are candidates for possible modification should the USAF modify the structure of the Synchronous Satellite Catalog.

The USAF Synchronous Satellite Catalog data file is divided into three sections. The first section is the header containing the title and catalog information. The second section contains administration and orbital positioning data. The third section contains classical two line element sets containing movement information such as drift, eccentricity, and mean motion.

12.1 USAF Synchronous Satellite Catalog

12.1.1 Description of Header

The header of the Satellite Catalog file is composed of a number of elements. The first line consists of the title followed by the date. The date is assumed to be of the form DAY_MONTH_YEAR, where the underscore character indicates a space. The following line consists of the description on how the catalog is sorted. USAF sorts this file in ascending order according to longitude continuously East. The third line contains the number of satellites contained within the satellite file. The next two lines consist of the column headings. Refer to *Figure 12-1* for a representative example of the header.

> **Note:** This header, with the exception of the catalog date, is ignored. The catalog date itself is extracted and converted into the format DAY-MON-YEAR. This converted date is later used in the first output file AF1.DAT.

Figure A-1 Header Portion of USAF Satellite Catalog File

```
                    SYNCHRONOUS SATELLITE CATALOG FOR 1 JUL 1994
                           ASCENDING SORT ON LONGITUDE
                            NUMBER OF SATELLITES: 505


OBJ.NO   INT-DES   COMMON NAME   USER    EPOCH .... PERIGEE   INCL.  DRIFT    CLASS
NO.                              CODE                                (DEG/DAY) ID
```

12.1.2 Description of Satellite Catalog (orbital data)

Column:

> **Note:** The field parsing function is not dependent on the spaces between the columns.
> There may be any number of white space characters separating the columns. Refer to
> *Figure 12-2* for a representative sample.

1. *OBJECT NUMBER>* The first five digits of the Satellite Catalog designate USAF
   object number. If the value of the number is less than 10000, the number is assumed
   to be filled with leading zeros.

2. *INTERNATIONAL DESIGNATOR>* The column consists of an eight character
   international designator field. The first four characters are digits that designate the
   launch date of the object. The next character is a hyphen followed by four characters
   that can be any alphanumeric characters. The final character is normally alphabetic
   and indicates some detail about the object. For instance, coding usually begins with an
   'a' for satellite and continues through with 'b', 'c', etc. to indicate varying types of
   objects including rocket bodies and debris.

3. *COMMON NAME>* This column consists of a twelve character field comprised of the
   satelltie name, number, and possibly satellite type. It is different from the other
   columns in that it may contain spaces within itself or that a portion of the field may be
   truncated. The FIX-USAF software is versatile enough to accommodate such
   anomalies. The software extracts the common name, number, and type from within
   the cross-reference file that corresponds to the object number contained within the
   satellite catalog.

4. *USER/ADMINISTRATION>* This column consists of two to four character codes that
   indicates the administrating country or group of the satellite. This field is also
   extracted from the satellite cross-reference file.

5. *EPOCH>* This column consists of an eight character field. The first two digits of the
   field are the year in which the object's epoch is to occur. The next five characters

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consist of a three digit ordinate and a two digit mantissa. This number indicates the numbered day of the year in which the epoch will occur.

6. *DAYS FROM EPOCH>* This column consists of a six character field indicating how many days the satellite is from its epoch.

7. *LATITUDE>* This column consists of an eight character numeric field. The number contained within the field may be either positive or negative. A negative number indicates that the latitude is south of the equator. A positive number indicates that the latitude is north of the equator.

8. *LONGITUDE>* This column consists of an eight character number field. The number contained within the field indicates the longitude of the satellite measured East from the Prime Meridian. Note that the FIX-USAF software converts this value into a measurement West of the Prime Meridian if the longitude is greater than 180 degrees.

9. *HEIGHT>* This column consists of a five character numeric field. Its value indicates the height, in kilometers, that the satellite is above the Earth's surface.

10. *APOGEE>* This column consists of a five character numeric field. Its value indicates the greatest height, in kilometers, that the satellite obtains above the Earth's mean sea level during orbit.

11. *PERIGEE>* This column consists of a five character numeric field. Its value indicates the lowest height, in kilometers, that the satellite obtains above the Earth's surface during orbit.

12. *INCLINATION>* This column consists of a five character numeric field. Its value indicates the value between the orbital plane of the satellite and the equatorial plane of earth.

13. *DRIFT>* This column consists of a signed six character floating point field designating the drift of the satellite in degrees per day.

14. *CLASS ID>* A single character classification identification code used internally by USAF.

Figure A-2 Orbital Data Representation for USAF Satellite Catalog

```
21140 1991-015B MOP 2        ESA  94179.28  2.7  -0.3111  0.3828  35797.  35797.  35782.  0.32  -0.0469 U
18952 1988-018B TELECOM 1C  FR   94180.62  1.4  -0.0192  3.0191  35803.  35807.  35764.  0.02   0.0057 U
14333 1983-088F RADUGA 13 R/ USSR 94157.35 24.6  -6.3987  4.1143  36499.  36602.  36494.  8.51  -9.5708 U
19919 1989-027A TELE X       SWED 94166.64 15.4  -0.0096  5.2361  35796.  35799.  35773.  0.02   0.0035 U
                                                       •
                                                       •
                                                       •
```

12.1.3 Description of Satellite Catalog (two-line element sets)

Line 1:

Note: The field parsing function is not dependent on the spaces between the columns. There may be any number of white space characters separating the columns. Refer to *Figure 12-3* for a representative sample.

Column	Field Name
1	Line Number Designation
2	Satellite Number
3	International Designator
4	Epoch
5	1st Derivative of Mean Motion
6	2nd Derivative of Mean Motion
7	BSTAR Number
8	ELSET Number

Line 2:

Note: The field parsing function is not dependent on the spaces between the columns. There may be any number of white space characters separating the columns.

Column	Field Name
1	Line Number Designation
2	Satellite Number
3	Inclination
4	Right Ascension of the Ascending Node
5	Eccentricity
6	Argument of Perigee
7	Mean Anomaly
8	Mean Motion (divide by 1440 to find orbital period)
9	Revolution

The USAF is not planning any changes or modifications of the format of the Synchronous Satellite Catalog in the near future. For this reason, the content and format of the report should remain the same, allowing the FIX-USAF software system to successfully convert the data samples.

Figure A-3 Two Line Element Sets

```
1 18877U 88012A   94177.92391671  .00000000  00000-0  10000-3 0   159
2 18877   0.0201  69.2556 0000081 270.3140  39.7810 1.00265616 12991
1 18922U 88014A   94180.70909722  .00000000  00000-0  00000+0 0   935
2 18922   0.9757  75.8723 0002261  45.8695 138.5147 1.00276165 23037
1 18951U 88018A   94179.46720433  .00000000  00000-0  00000+0 0   820
2 18951   0.0059 128.4934 0002742 338.1619 250.8383 1.00270321  8167
1 18952U 88018B   94180.62302083  .00000000  00000-0  00000+0 0  7858
2 18952   0.0215  93.3005 0005044 333.9165  77.5553 1.00275379   958

                                    .
                                    .
                                    .
```

Appendix B

USAF Synchronous Satellite Catalog Output File Sample

Explanatory Note

The purpose of the USAF Synchronous Satellite Catalog Output File Sample is to document the format of the files produced by the FIX-USAF software system. The output files are produced as ASCII text files organized in third normal form. This format allows for easy data validation, transfer, and INGRES database table loading. The main output is organized into two data files AF1.DAT and AF2.DAT.

12.2 USAF Synchronous Satellite Catalog Output File

12.2.1 Description of the AF1.DAT data file

Field:

> **Note:** The data contained within the AF1.DAT file is extracted from the two line element set portion of the USAF Satellite Catalog. The output is divided into five fields delimited by commas.

1. *OBJECT NUMBER>* The USAF designated object number.

2. *ACCELERATION OF MEAN MOTION>* The rate of change in the given satellite's mean motion. Negative values indicate deceleration.

3. *ECCENTRICITY>* A number between 0 and 1 indicating the ovalness of the given satellite's orbit. A number closer to 0 indicates a more circular orbit while a number closer to 1 indicates an eccentric orbit.

4. *MEAN MOTION>* The speed the given satellite would have if it had a circular orbit with its period equal to the actual period.

5. *CATALOG DATE>* The given date for which the satellite catalog was compiled.

The data in *Figure B-1* lists only a short sample of the AF1.DAT data file output.

Figure B-1 Output File Sample

```
00751,0.0,0.6920505,1.04038311,1-JUL-94
01317,0.0,0.0005687,1.00302880,1-JUL-94
02608,0.0,0.0010345,1.00374663,1-JUL-94
02639,0.0,0.0017764,1.00222485,1-JUL-94
                    •
                    •
                    •
```

Please refer to *User's Guide for Database Maintenance and Update* for more information on loading the converted output file into the GSOSTATS database.

12.2.2 Description of the AF2.DAT Data File:

Field:

> **Note:** The data contained within the AF2.DAT file is extracted from the first portion of the USAF Satellite Catalog data file. The output is divided into eighteen fields delimited by commas.

1.   *OBJECT NUMBER>* The USAF designated object number.

2.   *COMMON NAME>* The base name to which the satellite is referred (i.e., RADUGA, COMSAT, BSB, etc.).

> **Note:** Since it is up to the managing user to edit and maintain the cross-reference file, the names that the user decides upon within the cross-reference file will determine the common names within the final output file, and consequently, the GSOSTATS database tables.

3.   *SATELLITE NUMBER>* The managing administration's designated satellite number.

4.   *ZERO-FILLED SATELLITE NUMBER>* This field is the same as the satellite number except that numbers less than four digits are padded up to four digits with zeros.

> **Note:** This field has no significance within the context of the USAF Satellite Catalog, but is necessary to allow the loading of GSOSTATS database tables.

5.   *OBJECT TYPE>* The object type for a given record. It can be either SAT for satellite, R/B for rocket body, or DEB for debris.

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6. *EPOCH YEAR>* The given year for which the epoch is to occur.

7. *EPOCH DAY>* The given day within the year during which the epoch will occur.

8. *DAYS FROM EPOCH>* The number of days from the epoch referenced to the current USAF satellite catalog date.

9. *INCLINATION>* Angle between the orbital plane of the satellite and the equatorial plane of the earth.

10. *LATITUDE>* The latitude at which the satellite is located. This is an absolute number between 0 and 90.

11. *NORTH/SOUTH OF EQUATOR>* The field resolves the latitude as being either North or South of the equator.

12. *LONGITUDE>* The longitude at which the satellite is located. This is an absolute number between 0 and 180.

13. *EAST/WEST OF PRIME MERIDIAN>* This field resolves whether the longitude is measured East or West of the Prime Meridian.

14. *HEIGHT>* The current height in kilometers at which the satellite is located for the given catalog date.

15. *APOGEE>* The highest point in kilometers that the satellite obtains in its orbit.

16. *PERIGEE>* The lowest point in kilometers that the satellite obtains in its orbit.

17. *DRIFT>* A slight deviation in orbital positioning of the satellite due to solar radiation and gravitational perturbations.

The data in *Figure B-2* lists only a short sample of the AF1.DAT data file output.

Figure B-2 AF2.DAT Output File Sample

```
21140,MOP,2,0002,SAT,ESA,94,179.28,2.7,0.32,0.3111,S,0.3828,E,35797,35797,35782,-0.0469
18952,TELECOM(C),1,0001,SAT,FR,94,180.62,1.4,0.02,0.0192,S,3.0191,E,35803,35807,35764,0.0057
14333,RADUGA,13,0013,R/B,USSR,94,157.35,24.6,8.51,6.3987,S,4.1143,E,36499,36602,36494,-9.5708
19919,TELE_X,0,0000,SAT,SWED,94,166.64,15.4,0.02,0.0096,S,5.2361,E,35796,35799,35773,0.0035
                                         .
                                         .
                                         .
```

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Appendix C

FIX-USAF Software Report Output Sample

Explanatory Note

The purpose of the FIX-USAF Software Report Output Sample is to document the format of the output files that the FIX-USAF software produces during run time. *Figures C-1* through *C-6* represent shorter versions of what the output reports might look like once the FIX-USAF software is finished processing a data file.

12.3 Output Files

12.3.1 Descriptions of Output Files

TEMPAF1.DAT - This file temporarily holds all of the processed records from the two line element set section of the USAF Satellite Catalog. Refer to *Figure C-1* for a sample. Refer to *Section 12.2.1* for a description of the fields.

Figure C-1 Representative FIX-USAF TEMPAF1.DAT File

```
00751,0.0,0.6920505,1.04038311,1-JUL-94
01317,0.0,0.0005687,1.00302880,1-JUL-94
02608,0.0,0.0010345,1.00374663,1-JUL-94
02639,0.0,0.0017764,1.00222485,1-JUL-94
                    .
                    .
                    .
```

TEMPAF2.DAT - This file temporarily holds all of the processed records from the first section of the USAF Satellite Catalog. Refer to *Figure C-2* for a sample. Refer to Section *12.2.2* for a description of the fields.

Figure C-2 Representative FIX-USAF TEMPAF2.DAT File

```
21140,MOP,2,0002,SAT,ESA,94,179.28,2.7,0.32,0.3111,S,0.3828,E,35797,35797,35782,-0.0469
18952,TELECOM(C),1,0001,SAT,FR,94,180.62,1.4,0.02,0.0192,S,3.0191,E,35803,35807,35764,0.0057
14333,RADUGA,13,0013,R/B,USSR,94,157.35,24.6,8.51,6.3987,S,4.1143,E,36499,36602,36494,-9.5708
19919,TELE_X,0,0000,SAT,SWED,94,166.64,15.4,0.02,0.0096,S,5.2361,E,35796,35799,35773,0.0035
                    .
                    .
                    .
```

INAF1.DAT - This file is processed after the temporary files and contains those satellites contained within TEMPAF1.DAT but not TEMPAF2.DAT. This information is important for catalog maintenance since there must be a one to one correspondence between the objects in the first section of the catalog and the objects in the two line element sets. Refer to *Figure C-3* for a sample. Refer to *Section 12.2.1* for field descriptions.

Figure C-3 Representative FIX-USAF INAF1.DAT File

```
06473,0.0,0.0029049,0.97656664,1-APR-94
18747,0.0,0.0024770,1.00271503,1-APR-94
29503,0.0,0.0066796,1.00220992,1-APR-94
11987,0.0,0.0011196,1.00236942,1-APR-94
                  .
                  .
                  .
```

INAF2.DAT - This file is processed after the temporary files and contains those satellites contained within TEMPAF2.DAT but not TEMPAF1.DAT. This information is important for catalog maintenance since there must be a one to one correspondence between the objects in the first section of the catalog and the objects in the two line element sets. Refer to *Figure C-4* for a sample. Refer to *Section 12.2.2* for field descriptions.

Figure C-4 Representative FIX-USAF INAF2.DAT File

```
22044,GORIZONT,26,0026,R/B,USSR,94,086.01,5.0,0.22,0.1916,S,2.6665,E,36576,36596,36373,-8.7892
04881,INTELSAT(4),2,0002,SAT,ITSO,94,086.00,5.0,13.40,5.6134,N,2.6894,E,36157,36236,36150,-5.1654
18952,TELECOM(C),1,0001,SAT,FR,94,091.19,-1.2,0.04,0.0383,S,3.0200,E,35790,35791,35781,0.0005
07547,SKYNET(B),2,0002,SAT,UK,94,089.97,1.0,12.43,4.9739,N,3.0380,E,35806,35814,35770,-0.0809
                  .
                  .
                  .
```

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BADAF1.DAT - This file contains the lines within the two line element sets of the USAF
Satellite Catalog that contain fields with errors. Refer to *Figure C-5* for a sample.

Figure C-5 Representative FIX-USAF BADAF1.DAT File

```
0x428,0.0,0.0082290,1.015,1-APR-94
Error in "object number" field!!!

03443,0.0,0.0080345,1.0444,1-APR-94
Error in "eccentricity" field!!!

04583,0.0,0.0034343,1.44-4,1-APR-94
Error in "mean motion" field!!!
                    •
                    •
                    •
```

BADAF2.DAT - This file contains the lines within the first section of the USAF Satellite
Catalog that contain fields with errors. Refer to *Figure C-6* for a sample.

Figure C-6 Representative FIX-USAF BADAF2.DAT File

OBJ	INT-DES	NAME	ADMIN	EPOCH	DFE	LAT	LONG	HEIGHT	APOGEE	PERIGEE	INCL.	DRIFT	ID
13141	1983-066F	GORIZONT 7	USSR	94085.01	6.0	4.5405	13.9590	36560.	36592.	36503.	8.41	.5630	U
This Satellite was not found in the "Check File"!													
106s8	1988-109	BASTRA 1A	LUXE	94089.98	1.0	0.0048	19.1850	35805.	35806.	35767.	0.02	-0.0037	U
Error in "object number" field!													
14494	1981-027F	RADUGA 8	USSR	940-2.97	8.0	1.0438	35.0773	36540.	36609.	36459.	11.29	-9.3961	U
Error in "epoch" field!													
22427	1992-041A	INSAT-2A	IND	94089.76	1.2	0.0247	74.0x21	35779.	35803.	35770.	0.01	-0.0063	U
Error in "longitude" field!!													
29643	1990-051A	INSAT 1D	IND	94090.80	0.2	0.0208	82.8772	35782.	35815.	35759.	0.02	-0.-2	U
Error in "drift" field!													

Appendix D

Master Satellite Data File SATNAMES.DAT

Explanatory Note

The **SATNAMES.DAT** Master Satellite Data File contains (in ASCII text format) the valid object numbers, international designators, satellite names, satellite numbers, administrations, and satellite types.

> **Note:** The **SATNAMES.DAT** file **must** be present on the same disk and in the same directory as the **FIX-USAF** file in order for the software to function properly.

If a user wishes to modify the **SATNAMES.DAT** data file, the *Data Change Request Form* in *Appendix G* must be completed and returned to the GSOSTATS database manager. This allows the database administrator to track and monitor any and all modifications to the satellite cross-reference data.

The user may employ any standard text editor or word processor with the ability to read and write ASCII text files to alter this data file. Users must, however, enter each of the following data items on a single line of text, separated by commas or white space (one line equals the information for one satellite).

The developers of FIX-USAF recommend that the user make use of the XREF-UPDATE software provided with FIX-USAF to update the cross-reference file. Refer to *Appendix E* for details on the XREF-UPDATE software.

1. *OBJECT NUMBER>* This field must be a five digit numeric. Any number less than 10000 must be entered with leading zeros.

2. *INTERNATIONAL DESIGNATOR>* This field must consist of nine characters. The first four characters represent the launch date of the given satellite. The fifth character must be a hyphen and the last four character consist of an alphanumeric sequence.

3. *SATELLITE NAME>* This is the name that the satellite is commonly referred to as (i.e., RADUGA, COMSAT, SBS, etc).

    Note: The conversion program uses the SATNAMES.DAT cross-reference file to extract the common name, satellite number, type, and administration. The names as they appear in the original USAF catalog file can vary widely. It is up to the user of FIX-USAF when modifying or adding satellites to the cross reference file to establish a naming convention or standard. Satellite names that finally appear in the GSOSTATS data tables are taken directly from the cross reference file, so it is essential that the user maintain consistency when modifying the cross-reference file.

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4. *SATELLITE NUMBER>* This is the administration designated satellite number.

5. *ADMINISTRATION>* This is the name or code of the country or group administrating the satellite. It is commonly a two to four character abbreviation.

6. *SATELLITE TYPE>* An object within the cross-reference file can consist of only three types: SAT, R/B, or DEB. These correspond to satellite, rocket body, and debris respectively.

Figure D-1 contains the present contents of the **SATNAMES.DAT** data file for use as a reference.

Figure D-1 Sample of SATNAMES.DAT Data File

```
19239,1993-045B,BSB,1,US,SAT
13434,1990-3443,RADUGA,5,USSR,SAT
20303,1993-0A44,GALAXY,5,US,SAT
10230,1993-00DD,MOLNIYA,10,USSR,R/B
                    •
                    •
                    •
```

Appendix E

XREF-UPDATE SOFTWARE

Purpose

In order to ensure the integrity of the output files from the FIX-USAF program, the cross-reference file must be updated when new satellites are introduced in the USAF Synchronous Satellite Catalog. There may also be need to modify or delete satellites contained within the cross-reference file. Editing the cross-reference file with a text editor leaves a large margin for user error and can be inefficient.

The XREF-UPDATE software cross-reference utility facilitates the addition, modification, or deletion of satellites within the cross-reference file. The user may specify the satellite to act upon directly from the command-line, or specify an input file that contains a list of satellites to be processed. The utility executes the appropriate action depending on the parameters issued. It also applies rudimentary error checking to a satellite that has been added or modified to ensure the integrity of the cross-reference file.

12.4 Execution of XREF-UPDATE Software

The XREF-UPDATE may be executed in one of two ways, The user may specify the satellite to act upon directly from the command-line, or he may specify an input file that contains a list of satellites to be processed. Both methods will be discussed in the following sections.

12.4.1 Execution with Input File

Executing the XREF-UPDATE with an input file is more efficient when there are a large number of satellites to be acted upon. There are three options with the UPDATE software; add satellites to the existing SATNAMES.DAT list, modify existing satellites within the cross-reference file, or delete satellites.

The format of the input file is the same for insertion and modification but may vary with the deletion function.

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12.4.1.1 Addition and Modification

For adding or modifying a given satellite, the user must first create an ASCII text file containing information in the following order:

1. Object Number
2. International Designator
3. Satellite Name
4. Satellite Number
5. Object Type
6. Administration

Data for a given satellite is entered one satellite per line within the text file. Fields must be separated by commas or white space, and there cannot be any commas or white space characters within any of the fields themselves. Text may be in mixed case as the program will automatically convert all text to uppercase during its processing. *Figure E-1* is a sample representation of the input file the user must provide.

Figure E-1 Sample Input Text File

```
13222,1994-23AB,RADUGA,5,SAT,USSR
13423,1993-334A,COMSAT,6,SAT,US
20343,1994-77BB,MOLNIYA,12,R/B,USSR
21099,1994-848F,ANIK,2,DEB,CAN
                    .
                    .
                    .
```

After the text file has been created, the user may issue the addition, modification, or deletion commands at the command line. The following example would add a set of satellites contained within the INFILE file to the **SATNAMES.DAT** file:

```
../FIX-USAF> XREF-UPDATE -a INFILE
```

When using XREF-UPDATE with the '-m' switch, those satellites contained within INFILE are located and subsequently modified with the **SATNAMES.DAT** file as illustrated below:

```
../FIX-USAF> XREF-UPDATE -m INFILE
```

12.4.1.2 Deletion

To delete satellites within the cross-reference file, the input file may take one of two formats; the file may contain valid satellite fields represented in *Figure E-1*, or it may contain a list of object numbers, one object per line. To delete those satellites contained within INFILE from **SATNAMES.DAT**, the user would type:

```
../FIX-USAF> XREF-UPDATE -d INFILE
```

> **Note:** Only one of the previous options may be used at the command line. The user may either add, modify, or delete satellites with a given input file.

12.4.2 Execution with Command Line Parameters

Execution with command-line parameters is much the same as with the input file. The user may either add, modify, or delete satellites. The arguments are the same as above, except that instead of specifying an input file, the user enters the satellite information directly on the command line. The only difference is that commas are not acceptable on the command-line and fields must be delimited by white space. In cases of deletion only the object number need be specified on the command-line. *Figure E-2* contains samples of command-line executions.

Figure E-2 Sample Command-Line Usage

```
../FIX-USAF> XREF-UPDATE -a 13222 1994-23AB RADUGA 5 SAT USSR (add satellite)
../FIX-USAF> XREF-UPDATE -m 13423 1993-334A COMSAT 6 SAT US (modify satellite)
../FIX-USAF> XREF-UPDATE -d 20343                            (delete satellite)
```

12.4.3 Possible Errors

12.4.3.1 Physical Errors

Physical errors refer to user input errors. These can consist of a number of errors including:

1.   Incorrect number of fields entered for a given satellite.
2.   Invalid data entered within a given field.

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12.4.3.2 Logic Errors

Logical errors refer to errors of inconsistency. These include:

1. The user attempts to insert a satellite in the list that is already there.
2. The user attempts to modify a satellite that is non-existent.
3. The user attempts to delete a satellite that is non-existent.

12.4.3.3 Recovery Steps

If any of the above errors occur for a given object number, that object will be unaffected within the SATNAMES.DAT file. The user must correct the errors that occurred for each object number that contained errors within its fields and rerun XREF-UPDATE.

Appendix F

Software Change Request Form

Explanatory Note

A Software Change Request Form has been provided in the event that a user wishes to modify the operation or output of the FIX-USAF software system. Once software has been completed and placed under configuration control, it is important to thoroughly document each modification to the system. Each change has the potential of introducing new errors, and requires repeating the entire review, test, acceptance, and configuration control procedure. Software changes represent a major contribution to the software maintenance cost due to the large number of man-hours required to complete the process. It is therefore most important that software changes be well thought out and firmly established before coding begins.

Software changes may be required for a number of reasons. These may include changes in the requirements, input or output formats, as well as errors in the software that were missed in the acceptance testing, and improvements for reliability and quality. Modifications made for any reason must be traceable from proposal, through all reviews and tests, to the final acceptance and placement under configuration control.

All software changes must be requested in writing using a copy of the *Software Change Request Form* in *Figure F-1*. This form should then be submitted to the GSOSTATS database manager, who will be responsible for reviewing and possibly initiating the proposed change.

Figure F-1 Software Change Request Form

FIX-USAF Software System Change Request

Requested By: _____   Date: _____

Address: _____   Telephone: _____

_____

_____

_____

Problem:

_____

_____

_____

_____

_____

Description of Change:

_____

_____

_____

_____

_____

Reason for Change:
       ___ Modified Requirement   ___ New Software
       ___ Programming Error   ___ Obtain Data
       ___ Reliability   ___ Flexibility
       ___ Other:_____

Change is: ___ Mandatory   ___ Improvement

Other Systems Affected:_____

Return the completed form and any addition sheets to:

    James E. Hollansworth
    Mail Stop 54-2
    NASA/Lewis Research Center
    21000 Brookpark Rd.
    Cleveland, Ohio 44135
    FAX: (216) 433-8705

Appendix G

Data Change Request Form

Explanatory Note

A Data Change Request Form has been provided in the event that a user wishes to modify the **SATNAMES.DAT** data file of the FIX-USAF software system. Once software has been completed and placed under configuration control, it is important to thoroughly document each modification to the system. Each change has the potential of introducing new errors, and requires repeating the entire review, test, acceptance, and configuration control procedure. Software and data changes represent a major contribution to the software maintenance cost due to the large number of man-hours required to complete the process. It is therefore most important that data modifications be well thought out and firmly established before any changes are made.

Changes to the **SATNAMES.DAT** data file may be required for a number of reasons. These may include changes in the actual USAF sampling, as well as errors in the data file that were missed in the acceptance testing, and improvements for reliability and quality. Modifications made for any reason must be traceable from proposal, through all reviews and tests, to the final acceptance and placement under configuration control.

All changes to the **SATNAMES.DAT** file must be requested in writing using a copy of the *Data Change Request Form* in *Figure G-1*. This form should then be submitted to the GSOSTATS database manager who will be responsible for reviewing and possibly initiating the proposed change.

Please refer to *Appendix E* for information on the correct record entry and position for each item listed in the **SATNAMES.DAT** data file.

Figure G-1 Data Change Request Form

FIX-USAF Software System Data Change Request

Requested By: _____ Date: _____

Address: _____ Telephone: _____

_____

_____

_____

Problem:

_____

_____

_____

_____

_____

_____

Description of Change:

_____

_____

_____

_____

_____

_____

Reason for Change:
    ___ Modified Sampling   ___ New Satellite Sampling
    ___ Satellite Removed
    ___ Other: _____

Change is: ___ Mandatory   ___ Improvement

Return the completed form and any addition sheets to:

    James E. Hollansworth
    Mail Stop 54-2
    NASA/Lewis Research Center
    21000 Brookpark Rd.
    Cleveland, Ohio 44135
    FAX: (216) 433-8705

Appendix H

Abnormal Errors Encountered Report Form

Explanatory Note

An Abnormal Errors Encountered Report Form has been provided in the event that a user encounters an undocumented error or problem during the operation of either FIX-USAF or XREF-UPDATE software systems.

While a variety of errors occurring in the original USAF data have been taken into consideration by the developers, it is still possible to encounter an error that has not been considered. The FIX-USAF software is able to correct several types of errors during the conversion process. Should an unexpected error occur, the user should send the original USAF data file, unfinished files containing the converted data, and a completed *Abnormal Errors Encountered Report Form* to the GSOSTATS database manager.

Documenting all software errors will allow the developers of the FIX-USAF software to correct problems and make the necessary modifications to the software code in a timely and useful manner. Refer to *Figure H-1* for a copy of the report form.

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Figure H-1 Abnormal Errors Encountered Report Form

Abnormal Errors Encountered Report Form

Discovered By: _____ Date: _____

Address: _____ Telephone: _____

_____

_____

_____

Problem:

_____

_____

_____

_____

_____

_____

Description of Error Messages (If Any):

_____

_____

_____

_____

_____

Type of workstation Used to Run the Software:

_____

Version of UNIX Being Used:

_____

Memory Available:

_____

Other Information:

_____

_____

Return the completed form and any addition sheets to:.

    James E. Hollansworth
    Mail Stop 54-2
    NASA/Lewis Research Center
    21000 Brookpark Rd.
    Cleveland, Ohio 44135
    FAX: (216) 433-8705

REPORT DOCUMENTATION PAGE

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 1994	Technical Memorandum

4. TITLE AND SUBTITLE

GSOSTATS Database—USAF Synchronous Satellite Catalog Data Conversion Software

User's Guide and Software Maintenance Manual, Version 2.1

5. FUNDING NUMBERS

WU–235–01–02

6. AUTHOR(S)

Paul G. Mallasch and Slavoljub Babic

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135–3191

8. PERFORMING ORGANIZATION REPORT NUMBER

E–9195

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

National Aeronautics and Space Administration
Washington, D.C. 20546–0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

NASA TM–106760

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Unclassified - Unlimited
Subject Category 61

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The United States Air Force (USAF) provides NASA Lewis Research Center with monthly reports containing the Synchronous Satellite Catalog and the associated Two Line Mean Element Sets. The USAF Synchronous Satellite Catalog supplies satellite orbital parameters collected by an automated monitoring system and provided to Lewis Research Center as text files on magnetic tape. Software was developed to facilitate automated formatting, data normalization, cross-referencing, and error correction of Synchronous Satellite Catalog files before loading into the NASA Geosynchronous Satellite Orbital Statistics Database System (GSOSTATS). This document contains the User's Guide and Software Maintenance Manual with information necessary for installation, initialization, start-up, operation, error recovery, and termination of the software application. It also contains implementation details, modification aids, and software source code adaptations for use in future revisions.

14. SUBJECT TERMS

GSOSTATS database; USAF synchronous satellite catalog; SATCAT

15. NUMBER OF PAGES
54

16. PRICE CODE
A04

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	