U.S. Department of Commerce
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
National Ocean Service

```
MM            MM   TTTTTTTTTTTT   EEEEEEEEEE   NNN      NN
MMM          MMM        TT        EE           NNNN     NN
MMMM        MMMM        TT        EE           NN NN    NN
MM MM      MM MM        TT        EEEEEEE      NN  NN   NN
MM  MM    MM  MM        TT        EE           NN   NN  NN
MM   MM  MM   MM        TT        EE           NN    NN NN
MM    MMMM    MM        TT        EE           NN     NNNN
MM     MM     MM        TT        EEEEEEEEEE   NN      NNN
```

Micro -(Terminal ENtry Command Language)

A System for the Use with

NATIONAL GEODETIC SURVEY DATA BASE
INPUT FORMATS AND SPECIFICATIONS

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PREFACE

The reference manual is a compilation of field methods and computations used by the National Geodetic Survey (NGS). The purpose is to furnish instructions to personnel engaged on field operations in the use of a micro computer system to code, key, and submit field observational data by "National Geodetic Survey Data Base Input Formats and Specifications".

The material in this manual is the product of accumulated experience in the field and office of many members of the National Geodetic Survey. The material in this manual is taken freely from previously published manuals of NGS and the U.S. Coast and Geodetic Survey in particular Special Publication 247.

This manual has been prepared under the direction of Dr. C.R. Schwarz, Chief, Systems Development Branch, whose help and advice are greatly appreciated. Assistance in the preparation of programs within the MTEN system has been given by many members of NGS. In particular, Mr. J.G. Gergen, Chief, Horizontal Network Branch and from the Operations Branch Mr. B.R. Lewis and Mr. E.D. Wegner, all of who reviewed the entire manuscript and contributed suggestions. A special thanks to the North Carolina Geodetic Survey and Mr. J.W. Garner, who first took and used the MTEN Programs to produce "Blue Book" Data Sets in 1983.

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FOREWORD

The microcomputer system MTEN (Micro TENcol) is an extension of the computer system TENCOL (Terminal ENtry COmmand Language) developed by the National Geodetic Survey in 1975 for use by its mobil field parties. Since that time it has become necessary to have all data submitted to NGS to be in formats set forth in "Input Formats and Specifications of the National Geodetic Survey Data Base", Volume I. To this end MTEN was developed to provide, not only NGS Field Parties but outside users as well, an intergrated system to perform the following functions:

(1) Collect and store geodetic data at the survey site,
(2) Then make geodetic computations with the stored data, and
(3) Lastly, submit the geodetic data to NGS in the proper formats set forth in "Input Formats and Specifications".

The microcomputer selected by NGS was the Columbia 1181 with the multi-user operating system MP/M II, a Digital Research acronym for Multi-Programming Monitor Control Program for Microprocessors. The MTEN System configuration as planned by NGS for its field parties would be one hard disk, one or two floppy disks, two consoles and a printer.

The information provided in this reference manual is broken up into six major areas. The first area which includes Sections 1 thru 4 explains the setup or how to initialize new project files, defines how MTEN Commands operate for the user, what files are required by the MTEN system. and how to input given or known initial geodetic data such as station names, positions, and elevations. Sections 5 thru 7 allows the user to enter all informational data observed or generated during the span of the survey. Area three, Sections 8 and 9 preforms all geodetic computations required in the execution of a given project or adjustment. Area four, Sections 10 and 11 describe the listings available from the data files and the final data sets generated at the conclusion of a project, i.e. the Horizontal Observation Data (HZTLOBS) and Horizontal Descriptive Data (HZTLDESC). Section 12, the fifth area, describes the method by which a user may list the MTEN files in case of difficulties. The last area of information provided the user is the Appendix.

Before the programs of this system are used to initialize disk space for a given project, it is recommended that the program BBKDOC.COM be executed by the user to become familiar with the set of MTEN Commands. This can be done by keying the word BBKDOC <cr> after this program has been properly loaded onto the user's computer system.

Introduction to MTEN Command Structure

Each MTEN Command is a complete executable program with a primary filename equal to the MTEN Command name. Thus by just keying the MTEN Command Name the operating system will execute the program. The entire MTEN system supports 45+ executable programs and 61+ subroutines.

MTEN (Columbia) SYSTEM

All programs and subroutines were written in Microsoft FORTRAN-80 with only one exception the subroutine CHGCPM. This subroutine CHGCPM.MAC was written in assembler with the macro facility MACRO-80. Each program was compiled using Microsoft's Fortran-80 (F80) and then combined with Link-80 (L80), linking loader, to create the executable programs. During the L80 step each program was linked with the Fortran library (FORLIB.REL), however this library has been modified at NGS by installing APUFLIB (so all floating point functions would be preformed via the WD9511 high speed math processor).

MTEN (IBM PC) SYSTEM

All programs and subroutines were written in Microsoft FORTRAN (MS-FORTRAN version 3.1) with one exception---subroutine CONIN. This subroutine CONIN.ASM was written in assembler. Each program was compiled using Microsoft's MS-FORTRAN Compiler package and then combined with MS-LINK, the linking loader, to create the executable programs. During the LINK step each program was linked with the Fortran library (FORTRAN.OBJ). This library was modified by NGS so that at runtime, the actual library for use is the 8087 coprocessor.

Each program was designed to operate on a console with a screen field size of 24 rows by 80 columns. The actual interface to-and-from the screen is accomplished by the subroutine GETFLD and its related subroutines.

The actual screen display, as seen by the user, has several definite patterns. Row 1 is the name of the current MTEN Command in excution. Row 2 is a line of dashes to separate the MTEN Command Name from the list of prompts displayed on the screen. The rows 3 thru 22 are used to prompt the user for any and all items required for data entry, selected listings, and or computations. The last two rows 23 and 24 are set aside for the MTEN system to write out messages to the user. If an error is found by the execution of a MTEN Command, an error message will flash to the screen on row 23 and in some cases the terminal's bell will ring. The system will then wait for the user to make a decision on what to do next. Row 24 in almost every case is reserved to prompt the user if the command is to be repeated or stopped.

These basic patterns are displayed for each data entry program. The prompt patterns are displayed between rows 3 and 22 in one of two modes. The character subset used in both modes is restricted to only 47 characters. They are the alphabetic characters (letters A through Z), the numeric characters (numbers 0 through 9), and the eleven special characters (asterisk, blank, comma, period/decimal point, dollar sign, plus and minus signs, equal sign, slash, left parenthesis, and the right parenthesis).

Mode one or data entry, the cursor moves down the right side of the

screen just off to the right of each prompt. After each prompt statement and just before where the actual data entry is made, a data definition is provided along with the type of units that are required. The data definition has three basic types:

(1) (30A) -- alphanumeric characters a maximum of thirty allowed.
(2) (LLL) -- alphabetic characters a maximum of three allowed.
(3) (NNN) -- numeric characters a maiximum of three allowed.

The third type has several options beyond strictly numeric. If the data definition can be both positive or negative, then (SNNN) the letter "S" is used to denote an optional + or - sign. If the data definition is a floating point number then the data entered must have a decimal character in it and keyed as (SNNNN.NNN). The data definition format (SNNNN.NNN) should be viewed as an example format and not as fixed. The maximum field length for the entry is expressed on the screen by a line of dashes, "---------". In the above example the decimal character, ".", can appear anywhere in the field length (e.g. -0.1456).

Some entries such as time and position require hours/degrees, minutes, and seconds, therefore the data definition must include comma characters and be keyed as (NNN,NN,NN.NNN). However any leading zeros maybe omitted, (i.e. zero degrees, minutes and seconds fully keyed as 000,00,00.00 could be keyed as follows 0,0,0.0 without loss of accuracy. In addition to the data definition formats, help aids or examples of the data are flashed off-and-on to the screen for the user's examination before the field is keyed. These aids are then removed from the screen at the conclusion of a prompt or the current screen.

Mode two, where the data has previously been entered by some MTEN Command the system will fill the screen with both the prompts and its adjacent data. Then display the following message in the upper left corner of the screen:

CHANGE
(Y/N)?

This indicates to the user any data displayed on the screen can now be altered by advancing down the left side of the screen until the desired row is reached. Throughout all MTEN programs the user will encounter the prompt (Y/N)? in most cases the NO CHANGE response, "N", can be answered by touching only the carriage return <cr> key. Once the desired row is located the response of YES, "Y", will return the user to the data entry mode on the right side of the screen for only that item, and then return control back to the alters' prompts on the left side of the screen.

Additional prompts are flashed at the conclusion of each screen on row 24 to allow changes for that screen to be made before a new set of screen prompts are flashed to the user. Once a screen has been successfully completed and a new set of prompts have been displayed the only way to return to the completed screen is to reenter the command by repeating it from the start.

The following message will be flashed to the screen on row 24 by all MTEN Commands which can be repeated:

```
REPEAT THIS ENTRY COMMAND (Y/N)?   N
```

A "Y" YES answer will restart the MTEN Command at the very beginning. The "N" NO answer will stop the program and exit the command.

Initialization of Survey Project Data and Files

2.1 Survey Project Data

Each survey project for the purposes of identification must have a Jobcode (JC) which is a two-character alphanumeric code assigned to it where the first character must be alpha. However, for the simplicity of naming and managing files within the operating system, both characters used in MTEN Jobcodes are alphabetical. Once a Jobcode for a project has been decided upon, certain other options must be selected before the actual project files can be initialized. These options are required to properly format the fields set forth in the "Input Formats and Specifications of the NGSDB" for the Data Set Identification Record and the Project Data Records (*10*, *12*, and *13*). They are, the abbreviation and name of the submitting agency, the Project Title, the date field operations commenced, the chief-of-party, the type of survey, the primary state code, the order-and-class of survey, the datum designation, ellipsoid name, semi-major axis, and the inverse flattening or the semi-minor axis. Other entries are also prompted, but being non-mandatory they can be omitted or reentered later.

MTEN (Columbia) SYSTEM

The MTEN Commands ABSINX and GETREC can be run at the survey project initialization time without first creating a filename on the operating system's directory.

MTEN (IBM PC) SYSTEM

The MTEN Commands ABSINX and GETREC cannot be run to initialize the survey project unless the filename exist on the operating system's directory. To enter a new name into the directory, use the MS-DOS (version 2.0) program "EDLIN" to create required entry name by typing the following:

```
EDLIN FILEINXX.JC<cr>   (JC is the selected Jobcode)
```

The system will reply with "New file" and prompt the user with an "*", at this point, the user types an "E"<cr> as shown below:

```
EDLIN FILEINXX.JC
New file
*E<cr>
```

The system's program will end and the user can now continue.

2.2 ABSINX

The command ABSINX is the first MTEN Command that must be executed in order to create an "INX File" (project INdeX) for the survey and its observational data. To enter the program type ABSINX <cr>. The program will respond with the following prompt:

```
ENTER YOUR JOB CODE/JC/ (LL)?   --
```

At this point the user must select/enter the project Jobcode for this project. Next the program will prompt the default drive assignment by:

```
"INX FILE" DRIVE IS =          A        CHANGE IT (Y/N)?  N <cr>
```

Then to see if this is a new "INX File", the user is prompted the following:

```
INITIALIZE A BRAND NEW "INX FILE" (Y/N)?                  Y <cr>
```

```
   +-------------------------------------------------------------------------+
01|                      DATA ENTRY ----  ABSINX                             |
02|                   ------------------------------                         |
03|                                                                          |
04|        JOB CODE                                          AA              |
05|        DATE FIELD WORK COMMENCED/YEAR MM DD/(NNNN NN NN)? 1982 09 04     |
06|        DATE FIELD WORK COMPLETED(ESTIMATED)              1984 06 04     |
07|                                                                          |
08|        AGENCY/FIRM NAME (42A) NATIONAL GEODETIC SURVEY                   |
09|        AGENCY ABBREVIATION (LLLLLL)?   NGS                               |
10|        WORK LOCATED IN STATE (LL)?     NY                                |
11|        TYPE OF SURVEY (N)?             1                                 |
12|        ORDER + CLASS OF SURVEY (NN)?   21                                |
13|                                                                          |
14|        PERSON IN-CHARGE-OF JOB (30A)?  MR J GARY FREDERICK               |
15|        IST CHIEF-OF-PARTY (18A)?       FREDERICK J G                     |
16|        2ND CHIEF-OF-PARTY (18A)?       SAFFORD R W                       |
17|                                                                          |
18|        STREET ADDRESS (25A)?           6001 EXECUTIVE BLVD               |
19|        NAME OF CITY   (25A)?           ROCKVILLE                         |
20|        NAME OF STATE  (15A)?           MARYLAND                          |
21|        ZIP CODE (9A)?                  20852                             |
   ...
24|      CHANGE SCREEN INFORMATION (Y/N)?  N                                 |
   +-------------------------------------------------------------------------+
```

Figure (2.01) ---- ABSINX First Screen

The project index is constructed on the first ten records of the "INX File". Using the system's filename convention, the structure for any MTEN file is as follows:

```
FILExxxX.JC
```

where FILExxxX is the primary filename and JC (the two-letter Jobcode selected for the project) is the file type. To designate which file is to be used the characters "xxx" are replaced with one of the five file types. Therefore, the filename for the "INX File" becomes FILEINXX.JC. The program prompts the user

record-by-record beginning with record 1 to record 8. If a particular entry is a non-mandatory item, a simple carriage return <cr> will allow the user to continue. However if it is mandatory, the user will be prompted until an entry is made.

Records 9 and 10 in the "INX File" contain the current system totals and the status of all files in use by MTEN. Record 9 keeps the upper limit (total number of records initialized), the number of records used in the files---INX, GPN, and DAT---, the disk drive they are located (e.g. A:, B:, C:, etc.), and the total number of abstracts, combined lists, triangles, and descriptions that have been entered for the project. Record 10 is used to keep track of the tweleve possible "DES Files" that can be created. See Figures (2.01), (2.02), and (2.03) for sample screens for the program ABSINX.

At the time of the first "INX File" initialization, nine records will be initializied for the Job Specific Instrument (JSI) Table. These nine entries are initialized on records 11 thru 19 see Figure (4.01). To enter new survey equipment or additional JSI codes, see the Command STRJSI.

```
+------------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSINX                              |
02|                      ------------------------------                         |
03|                                                                              |
04|          PROJECT TITLE RECORD (69A)                                          |
05|       UPPER NEW YORK BAY--G 18345--NY                                        |
06|                                                                              |
07|                                                                              |
08|                                                                              |
09|          DATUM NAME (24A)                NAD 1927                            |
10|          ELLIPSOID  (16A)                CLARKE 1866                         |
11|          MAJOR AXIS/A/(NNNNNNN.NNNN)?   6378206.400              METERS      |
12|          MINOR AXIS/B/ DEFINED (Y/N)?   6356583.800              METERS      |
13|          FLATTENING   (NNN.NNNNNNNN)?   294.978698213                        |
14|                                                                              |
15|          MEAN GEOID HEIGHT (NNN.NNNN)?    0.0000                 METERS      |
16|                                                                              |
17|          RECORDS FOR THESE FILES:         MAXIMUM    USED     FILE          |
18|                                                                              |
19|          GPN/NAME        FILE/ (NNNN)?        146     127      A            |
20|          INX/INSTRUMENT  FILE/ (NNNN)?         51      50      A            |
21|          DAT/OBSERVATION FILE/ (NNNN)?        552     516      A            |
22|          NDX/INDEX       FILE/ (NNNN)?                         A            |
23|                                                                              |
24|       CHANGE SCREEN INFORMATION (Y/N)?  N                                    |
+------------------------------------------------------------------------------+
```

Figure (2.02) ---- ABSINX Second Screen

The last four prompts on the second screen for ABSINX are used to assign which disk drives the files---GPN, INX, DAT, NDX---, will be located. The following statement will flash to the screen:

```
CHANGE THE "xxx" FILE DRIVE NAME (Y/N)?                    Y
```

where "xxx" will be each of the four files one-at-time. A answer "Y" YES will allow the user to assign a drive name (e.g. A, B, C, etc.). On the other hand

a "N" NO reply will cause the system to assign drive name A: for that file.

MTEN (Columbia) SYSTEM

The selection of "MAXDES" is not possible, it is set for the user by the program to be units of 4000 records and cannot be altered. The value of 4000 is safe number of records to be put onto a 600K floppy disk which is used with the Columbia operating system. A sample screen is shown on Figure (2.03).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSINX                          |
02|                     ------------------------------                      |
03|                                                                         |
04|       MAXDES  (NUMBER OF RECORDS/FILE) =    4000                        |
05|                                                                         |
06|        -NAME-      -MAXIMUM-   -USED-   -DRIVE-                         |
07|                                                                         |
08|   N   FILEDESX        4000       975       B                            |
09|   N   FILEDES1        8000       270       B                            |
10|   N   FILEDES2       12000         0       A                            |
11|                                                                         |
   ....
24|       CHANGE SCREEN INFORMATION (Y/N)   N                               |
  +-------------------------------------------------------------------------+
```

Figure (2.03) ---- ABSINX Third Screen

MTEN (IBM PC) SYSTEM

The selection of "MAXDES" is variable and will depend on the capacity of the floppy disk used by the operating system. Once "MAXDES" has been set by the user it cannot be altered. Therefore the value of "MAXDES" must be determined so that a safe number of records can be put onto the floppy disk without overflowing the disk. The following message will flash on the screen and the user must determine the value of "MAXDES":

MAXDES (NUMBER OF RECORDS/FILE) = ?????

To compute the value of "MAXDES" the following information is flashed on the screen for the user:

$$\text{COMPUTE:}\quad \frac{\text{FLOPPY(Kbytes)*1000}}{\text{128 bytes/record}} = \text{POSSIBLE RECORDS}$$

After the number of "POSSIBLE RECORDS" have been determined for the floppy disk, round the value down to the nearest 500 as shown by the following example:

EXAMPLE: DISKETTE CAPICITY 600K then (600K)*1000/128 = 4687

or for the value of "MAXDES", it is 4500 records.

2.3 GETREC

The second command used to complete the initialization of MTEN Files is GETREC. To enter the program type GETREC <cr>. The program will prompt the user for the default drive, and the two-letter Jobcode. After this entry the program will flash to the screen a list of files. See Figure (2.04) for a sample GETREC Screen.

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  GETREC                          |
02|                     ------------------------------                      |
   ...
06|                                                                         |
07|       OPEN WHICH FILE?                                                  |
08|                                                                         |
09|                  EXIT     (X)                                           |
10|                  INX FILE (I)                                           |
11|                  NDX FILE (N)                                           |
12|                  GPN FILE (G)                                           |
13|                  DAT FILE (D)                                           |
14|                  DES FILE (T)                                           |
15|                                                                         |
16|       TYPE WHICH LETTER (?)            I                                |
17|                                                                         |
18|       INCREASE FILE BY HOW MANY RECORDS (NNNN)?        10               |
19|                                                                         |
   ...
24|   ?   TOUCH <SPACE BAR + CR> ... WHEN YOU ARE READY                     |
  +-------------------------------------------------------------------------+
```

Figure (2.04) ---- GETREC Screen

This program is used to create a file for the very first time or if the file exists, the program will increase the file by adding on additional records. Any of the five MTEN File types---INX, NDX, GPN, DAT, and DES---, can be increased.

```
FILEINXX.JC
FILENDXX.JC
FILEGPNX.JC
FILEDATX.JC
FILEDESX.JC or  FILEDES1.JC,
                FILEDES2.JC,
                FILEDES3.JC,
                   ...
                FILEDES9.JC,
                FILEDESA.JC, and
                FILEDESB.JC
```

The first file to be increased should be "INX File" in order to allow enough space to insert all equipment that will be used during the survey project. For most survey projects, 50 to 80 records should be enough to hold all the types of equipment used. A table, see Figure (2.05), shows the approximate number of records for each of the MTEN Files depending on the number of stations in the survey project. However, the size of files should

not be initialized to the full limits stated, but rather increased as more space is needed so the time spent in making routine backup files for the project will be kept to a minimum.

Total Number of Stations	MTEN File & (Number of Records)				
	GPN	INX	NDX	DAT	DES
1 - 10	10	50	40	100	600
11 - 50	50	50	200	500	3000
51 - 100	100	60	400	900	6000
101 - 200	200	60	800	1800	11000
201 - 500	500	70	2000	4600	28000
501 - 999	999	80	3900	8000	48000

Figure (2.05) ---- Approximate Size for MTEN Files

The next file which should be created is the "NDX File" (Numeric Data indeX) which stores the location addresses of all data items entered for the survey project. The length of the "NDX File" varies with the size of the "GPN File" and the number of records entered in both the "DAT and DES Files". An approximate method for figuring the number of records for the "NDX File" is as follows:

(1) One record for each 10 triangles in the survey project.
(2) One record for each 10 instruments put into the JSI Table.
(3) One record for each standpoint with observations from it.
(4) One record for each of the seven types observable data, namely abstracts of AST, DST, EDM, HGT, HZT, LGH, and ZEN data.
(5) One record for each standpoint SPN which has a description.

As observational survey data are entered, the "NDX File" will begin to fill up and it will have to be increased anytime the file becomes full. The system will not allow additional data to be entered into the "DAT and DES Files" until records are available in the "NDX File" to store the location addresses.

The "GPN File" (Geographic PositioN) can be any length. However, in accordance with the "Input Formats and Specifications of the NGSDB" only three digits are allowed for any Station Serial Number (SSN), therefore the MTEN system should be kept to less than or equal to 999. A one-to-one correspodence is maintained between the "GPN File" and each Survey Point Number (SPN) selected. Therefore the number of records in the "GPN File" must have as many records in it as the numerical address of the largest SPN selected.

The "DAT File" (DATa) is used to store all observational data related information generated or observed during the period of the survey project.

The "DAT File" also contains the records for all triangles and combined lists. An approximate method of figuring the number of records for the "DAT File" is as follows:

(1) One record for each triangle in the survey project.
(2) One record for each standpoint GPN File entry with a LST
(3) One record for each abstract
(4) One record for each comment keyed
(5) One record for each forepoint (SPN) observed on an abstract

As stated, this is only a minimum since the abstract type entries--- LST, LGH, and AST--, use anywhere from 1 to 32 additional records depending on the number of directions on a combined list, number of taped bays used on a short traverse obervation, and the number of (D/R) pointings taken on an astronomical azimuth observation.

The last file needed is the "DES File" (DEScription). Each "DES File", when it is created has a fixed number of records. The intent was to put all descriptive text on floppy disks in order to save space on the hard disk. Then as one floppy disk is filled a second, third, and etc., additional files are generated as they are needed by the user until all twelve "DES Files" have been created.

MTEN Program Structure and Execution

3.1 Program Structure

To use MTEN Programs, the user must follow a logical program sequence to complete a survey project. The hierarchy of MTEN Commands is shown in Appendix A. To start a project the user must begin at the upper left hand corner (See page A-1) with the programs BBKDOC and ABSINX. To continue, each program to the right of the last one must be completed to finish that data item (e.g. GETABS + ABSHZT to enter a horizontal abstract of directions and then ADJSTA + GETSTA + LSTSTA to make a final combined list of directions). Or the user may drop down to any program command below the current command at the same level (e.g. GETABS, GETTRI, and GETDES). Therefore, the user should plan to use the following format to enter all data for a given survey project:

1) Enter Instruments (JSI)
2) Enter Points (SPN)
3) Enter Observations (ABStracts), and
4) Enter Descriptions (DES)

The organization of all observational data within a survey project is structured by abstracts at a given Standpoint SPN. That is there are 99 possible abstracts for each of the seven types of data (AST, DST, EDM, HGT, HZT, LGH, and ZEN) for a given Standpoint SPN. The Standpoint is always taken as the station where the observer is standing with the given instrument and where the observations are being performed. Therefore, all initial information about the observation are recorded at that Standpoint by assigning an unique "SET NUMBER/ABStract/" to that particular observational set.

The "NDX File" is used to record each abstract's location within the "DAT File" as abstracts are collected during the obsevational phase of the survey. An abstract can be any number between 1 thru 99 but must be used only once so that each number is unique for a given SPN. If an abstract number is created which is less than or greater than one that already exists, it will be sorted and automatically placed in numerical order by the system in the "NDX File". Thus no requirement is made that each new abstract created be assigned the next numerical higher number. Once a number has been selected it cannot be reassigned as the system will show an error message that this "SET NUMBER" already exists.

3.2 Program Execution

All MTEN programs, at initial entry, will prompt the user for the default drive by the following message:

CHANGE DEFAULT DRIVE=* (Y/N)? <cr>

where "*" will be the label (A: B: C: etc). The second prompt of each program is the two-letter Jobcode for the project by:

ENTER YOUR JOB CODE/JC/ (LL)? ??

where "??" is the user selected Jobcode (JC) for the project. The "JC" will

be used in order to identify which set of user files to work from during the execution of the program.

There are five programs which insert address pointers into the NDX File, namely STRJSI, STRNAM, GETABS, GETTRI, and GETDES. The program STRJSI handles all instrument data entries and STRNAM handles all SPN Suffix data entries for a given survey project. The last three programs---GETABS, GETTRI, and GETDES---, respectively manage the standpoint's observational data entry, the standpoint's the initial triangle assignments, and descriptive text entry.

3.2.1 Instruments -- (STRJSI)

The JSI numbers of all instruments, i.e., those used to make observations and to be keyed on an abstract, must be entered first into the JSI Table before the current abstract can be completed.

3.2.2 Points -- (STRNAM STRGPN STRHGT)

All Points used within a survey project are unique and must be initialized by one or all of the above commands. Each unique point is identified by a SPN entry and will be prompted by the program by the following:

```
SURVEY POINT NUMBER/          /SPN (NNN)?   ---
```

after the SPN entry, the corresponding standpoint's name, state, and OT code will flash to the screen:

```
STATION NAME (30A)?                Name ........................
STATE OR COUNTRY CODE (LL)?                 xx
ORDER-AND-TYPE (OT) CODE (NN)?              xx
```

The program will then prompt the user whether or not selected SPN and the name are correct before it will continue by:

```
                                   CHANGE NAME (Y/N)? <cr>
```

3.2.3 Observations -- (GETABS)

Standpoint Information

During the entry of observational data and after the type of data has been selected, see Figure (5.01), each standpoint SPN will be prompted by the GETABS program to properly identify the station. After the SPN entry, the corresponding standpoint name will flash to the screen as follows before the use can continue:

```
SURVEY POINT NUMBER/STANDPOINT/SPN (NNN)?   ---
STATION NAME---                    Name ........................
```

Forepoint Information

Forepoint SPN information is entered at the abstract level. Each of the seven ABStract (AST - DST - EDM - HGT - HZT - LGH - ZEN) programs will prompt for the standpoint as shown above. Once the proper standpoint and proper abstract have been selected, the program will flash the "ABSTRACT NO." to the upper left hand corner of the screen. Then the forepoint SPN(s) will be identified. If there are more than one, as with horizontal directions, a message will flash to the screen in the upper right hand corner to show which one "DIRECTION = " is to be entered, see Figure (3.01) for an example.

```
  +-------------------------------------------------------------------------+
01|       ABSTRACT NO. 1    DATA ENTRY ----  ABSHZT   DIRECTION =  4          |
02|                        ----------------------------                      |
03|       SURVEY POINT NUMBER/FOREPOINT /SPN (NNN)?    73                     |
04|       STATION NAME---                     POUCH RM 2                     |
05|       STATE OR COUNTRY CODE                          NY                   |
06|       ORDER-AND-TYPE CODE                            43                   |
07|                                                                           |
  ...
  +-------------------------------------------------------------------------+
```

Figure (3.01) ---- Sample Command Screen

after each forepoint SPN entry, the corresponding forepoint name and related station information will flash to the screen as follows:

```
SURVEY POINT NUMBER/FOREPOINT /SPN (NNN)?   ---
STATION NAME ---                     Name ........................
STATE OR COUNTRY CODE                          xx
ORDER-AND-TYPE (OT) CODE                       xx
```

at this point the screen help aid asks if the SPN's state and order-and-type codes are correct by:

```
                                        NAME  CHANGE (Y/N)? <cr>
                                  STATE & OT  CHANGE (Y/N)? <cr>
```

if either of these are incorrect the current program will be terminated and the correct state or order-and-type codes must be entered/corrected by using the program STRNAM before the abstract can be continued.

3.2.4 Descriptions -- (GETDES GETTXT GETBOX)

Be sure the proper "DES File" has been created with GETREC before any attempt is made to enter descriptive data with program GETDES. If more than one "DES File" has been created, be sure to insert the correct floppy disk (with the correct "DES File" on it) in the drive and that the floppy disk drive has been reset before entering any of the programs.

The two basic requirements before executing the GETDES program are, (1) the Standpoint SPN being described must have had a name entered with STRNAM, and (2) at least an approximate greographic position entered with

STRGPN so the program can generate the Quad Identifier.

After the standpoint has been determined and the type of description has been selected, the program will check the disk drive assignment and flash the following message to the screen for the user upon every entry into these programs as a double check:

... "DES FILE" ... CHANGE DISK DRIVE (Y/N)? <cr>

In the program GETTXT the following gereral NOTE is given for the user, if the remaining line of text after the program's prompt is too short to complete the full statement and more line space is needed, just continue typing until the program's buffer for the current line has overflowed. The program will flash the message:

ERROR 001 ----TOO MANY CHARACTERS IN FIELD

Now and only now touch the carraige return <cr>, and the program will erase the last letters keyed by backspacing over the text until it reaches the last BLANK SPACE entered. The program will then record this line of text and allow the user to enter an additional line of text to complete this statement.

PLEASE NOTE, if a carraige return <cr> is keyed before the buffer has overflowed and before the error message has flashed to the screen, the current line of text will be terminated. To create a new line of text so the current unfinished statement can be completed, the user must:

first -- complete this paragraph,
second -- reenter the same paragraph, and
third -- while in the "ALTERS mode" create a new line of text to complete the unfinished statement.

Equipment and Survey Point Initialization Commands

4.1 STRJSI

The MTEN Command STRJSI (SToRe a Job Specific Instrument) is the only method by which Survey Equipment Data can be entered. A JSI number must exist in the JSI Table for an instrument that is to be used. That is the observational data can not be entered into the DAT File with any MTEN Command unless first the equipment observed with has a JSI Number and valid JSI Table entry.

To execute the program just type STRJSI <cr> and the program will prompt for all required entries to complete the *70* Survey Equipment Data Records. At the time the INX File is initialized, JSI Numbers 1 thru 9 are formatted to setup a default target set. The following nine default targets are initialized.

JSI Number	Serial Number	Model Class	Manufacturer of Equipment	Resolution NN.NN	Unit	NGS Code
III	AAAAAAAAAA	AAAAAAAA	AAAAAAAAAAAAAAAAAA	XX.XX	AA	III
1		LIGHT	SOURCE			911
2		TARGET	(WITH HEIGHT)			912
3		OBJECT	(NO HEIGHT)			913
4		TOP OF	A MARK (DISK)			914
5		TOP OF	A BENCHOVER			915
6		TOP OF	A STAND			916
7		TOP OF	A TRIPOD			917
8		TOP OF	THE WELDED SECTION			918
9		TOP OF	THE LIGHT PLATE			919

Figure (4.01) ---- Table of Initial Default JSI Targets

```
 +-------------------------------------------------------------------------+
01|                  EQUIPMENT ENTRY ----  STRJSI                           |
02|                    ----------------------------                         |
03|       INSTRUMENT---                                                     |
04|           JOB SPECIFIC NUMBER (NNN)?       105                          |
05|           NAME OF MANUFACTURER (18A)?      WILD                         |
06|           TYPE/TRADE NAME/ (22A)?          DIR THEODOLITE               |
07|           MODEL OR CLASS (8A)?             T-3                          |
08|           EQUIPMENT CODE/ANNEX F/ (NNN)?   123                          |
09|           RESOLUTION (NN.NN)?                0.200      UNITS SA        |
10|           SERIAL NUMBER (10A)?             74532                        |
11|           CONSTANT (SNN.NNNN)?               7.68100    UNITS SA        |
12|                                                                         |
   .....                                                                    |
22|                                                                         |
23|                                                                         |
24|       CHANGE JSI INFORMATION (Y/N)      N                               |
 +-------------------------------------------------------------------------+
```

Figure (4.02) ---- STRJSI Screen

If a special target is used other than those listed above, then a new JSI Number must be created to record it. A sample STRJSI Screen for JSI=105 is given on Figure (4.02).

Additional information and greater details about *70* Records are contained in chapter 2, Horizontal Observation (HZTL OBS) Data, "Input Formats and Specifications of the NGSDB" and in Annex F.

4.2 STRNAM

The MTEN Command STRNAM (SToRe a NAMe) is the only method by which Station Serial Numbers (SSN), a Survey Point Name or a Bench Mark designation is keyed; and a station suffix, an U.S. State Abbreviations, State Plane Coordinates (SPC) Zone Codes, Station Order-and-Type (OT) Codes, Mark Type or Landmark Code with a appropriate Setting Code can be entered. All data keyed using this command is stored in the GPN File. To execute the program just type STRNAM <cr> and the program will prompt for all data required. A sample STRNAM Screen for SPN=70, station BORO HALL 1931, is given by Figure (4.03).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  STRNAM                          |
02|                     ------------------------------                      |
03|       SURVEY POINT NUMBER/          /SPN (NNN)? 70                      |
04|       NAME (30A)? ---                  BORO HALL 1931                   |
05|       STATE OR COUNTRY CODE (LL)?                 NY                    |
06|       ORDER-AND-TYPE (OT) CODE (NN)?              21                    |
07|                                                                         |
08|       POINT RECOVERABLE (Y/N)?          YES                             |
09|       MARK CODE (L)?                    D                               |
10|       SETTING CODE (NN)?                08                              |
11|       M-CODE/MAGNETIC PROPERTY/ (L)?    N                               |
12|                                                                         |
13|       PLANE COORDINATE ZONE (NNNN)?     3104                            |
14|       IS THIS POINT A PERIPHERAL (Y/N)? NO                              |
15|       YEAR POSITIONED (NNNN)?           1931                            |
16|                                                                         |
17|       PARENT/STATION SERIAL NBR/ (NNN)?                                 |
18|       SUFFIX (L)?                                                       |
19|                                                                         |
   ...
23|                                                                         |
24|       NAM-CHANGE INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (4.03) ---- STRNAM Screen

During the excution of the program several help aids will flash off-and-on the screen. These aids are by no means a complete list of all options, but rather a few selected examples which are more commonly used by NGS Field Parties.

Additional information, pertaining to the data items above, is fully explained in the annex's of the "Input Formats and Specification of the NGSDB" listed below.

Annex A - NGS State and Country Codes
Annex B - State Plane Coordinates Zone Codes
Annex D - Guidelines for Survey Point Names and Designations
Annex E - Station Order-and-Type Codes
Annex I - Summary of Codes Used in Station Descriptions

4.3 STRGPN

The MTEN Command STRGPN (SToRe a Geographic PositioN) is the only method by which a geographic position (the latitude and the longitude of a station) and NGS Source "G-Number" can be initialized to a Survey Point Number (SPN). However, if this GPN File Record has not first been initialized by the program STRNAM, no entry is allowed. Besides the geographic position two codes are also prompted. These single digit codes are used to identify the agency establishing the position and the accuracy of the stored geographic postion. To execute the program just type STRGPN <cr> and the program will prompt the user for all required data entries. A sample STRGPN Screen for SPN=70, station BORO HALL 1931, is given by Figure (4.04).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  STRGPN                          |
02|                     -----------------------------                       |
03|       SURVEY POINT NUMBER/          /SPN (NNN)? 70                      |
04|       STATION NAME---                  BORO HALL 1931                   |
05|       STATE OR COUNTRY CODE                      NY                     |
06|       ORDER-AND-TYPE (OT) CODE                   21                     |
07|                                                                         |
08|       LATITUDE/DMS/  (NN,NN,NN.NNNNN)?   40-38-32.15600   NORTH         |
09|               /NORTH OR SOUTH/  (N/S)?                                 |
10|       LONGITUDE/DMS/(NNN,NN,NN.NNNNN)?  074-04-35.58500   WEST          |
11|                /EAST OR WEST/   (E/W)?                                  |
12|       POSITION CODE (N)?                9                               |
13|       SOURCE "G" NUMBER (NNNNN)?        02477                           |
14|       DEFLECTION OF VERTICAL INFORMATION AVAILABLE (Y/N)?       NO       |
15|                                                                         |
    .....
23|                                                                         |
24|       GPN-CHANGE INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (4.04) ---- STRGPN Screen

Help aids will flash off-and-on the screen during the execution of the program. The help aid for the geographic position codes listed below allows the following numeric values, see Figure (4.05).

The GPC is hierarchical, that is, a lower GPC can never replace a higher GPC unless the user specifically overrides it. One other data item is prompted with each geographic position that is entered. That is if the position has deflection of vertical information available. If so, a flag is set, then later after the survey project is completed and the final HZTL OBS Data Set is to be created, the user will be prompted to enter the two components Xi (meridional) and Eta (prime-vertical). All information keyed using STRPGN is added to the existing GPN File Record created by STRNAM and

resaved at the same GPN File Record location.

GPC		Code Definition
0	-	Blank (This SPN Has No Geographic Position Information)
1	-	No Check Position
2	-	Scaled Map Position or Approximately Computed (by WRKGPN)
3	-	Non NGSDB Position
4	-	Computed from a Triangle Computation (by WRKTRI)
5	-	Computed from a Traverse Computation (by WRKGPN)
6	-	Not Used
7	-	Not Used
8	-	An Adjusted Position computed by an Adjustment Program
9	-	A NGSDB Position (To be Held Fixed)

Figure (4.05) ---- Table of Geographic Position Codes (GPC)

4.4 STRHGT

The MTEN Command STRHGT (SToRe a HeiGTh or elevation) is the only method by which an elevation and geoid height can be initialized to a Survey Point Number (SPN). However, if the GPN File Record has not been initialized by the program STRNAM, no entry is allowed. Besides the elevation and geoid height information, three data codes are also prompted. These single digit codes are used to identify the agency establishing the elevation, the source of the geoid height, and the accuracy of the elevation. To execute the program just type STRHGT <cr> and the program will prompt for all required data entries. A sample STRHGT Screen for SPN=130, station CITADEL 1932, is given by Figure (4.06).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  STRHGT                          |
02|                     ------------------------------                      |
03|       SURVEY POINT NUMBER/          /SPN (NNN)?  130                    |
04|       STATION NAME---                   CITADEL 1932                    |
05|                                                                         |
06|       STATION MARK (ABOVE/BELOW) MEAN SEA LEVEL (MSL) DATUM             |
07|       ELEVATION CODE (N)?               9                --UNITS--      |
08|       ELEVATION OF MARK (SNNNN.NNN)?       7.3060             METERS    |
09|       SOURCE OF ELEVATION (N)?          1                               |
10|                                                                         |
11|       MSL DATUM /GEOID/ (ABOVE/BELOW) THE REFERENCE ELLIPSOID           |
12|       GEOID HEIGHT KNOWN (Y/N)?         NO                              |
13|       GEOID HEIGHT (SNNN.NN)?                                           |
14|       SOURCE OF GEOID HEIGHT (N)?                                       |
15|                                                                         |
   ......                                                                   |
23|                                                                         |
24|       HGT-CHANGE INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (4.06) ---- STRHGT Screen

Help aids will flash off-and-on the screen during the execution of the program. The help aid for the elevation codes is listed below and allows the

following numeric values.

NGSDB	MTEN		Code Definition
	0	-	Blank (This SPN Has No Elevation Information)
A	1	-	Barometric or Altimetry
M	2	-	Scaled from map or Approximately Computed (by WRKGPN)
P	3	-	Photogrammerty
V	4	-	Non-reciprocal Vertical Angles
R	5	-	Reciprocal Vertical Angles
T	6	-	A Spirt Level Tie run between two Horizontal Control Points which may or may not be connected to an established Vertical Control Point (Bench Mark)
G	7	-	Elevation determined from an ellipsoidal height
L	8	-	Levels Run between two Horizontal Control Points, one of which is also a Vertical Control Point (Bench Mark on a Level Line)
B	9	-	A NGSDB or Published Elevation (To be Held Fixed)

Figure (4.07) ---- Table of MTEN Elevation and NGSDB Codes

The Elevation Code is hierarchical, that is, a lower code can not replace a higher code unless the user specifically overrides it. All information keyed using STRHGT is added to the existing GPN File Record created by STRNAM and resaved at the same GPN File Record location.

One note of caution about the geoid heights used by MTEN Commands. When the System's INX File was created, the system prompted for an Average Geoid Height. This initial Average Geoid Height created a single entry in the INX File. If the Average Geoid Height was entered as a zero (0.0), then this value will be used by the system in all computations where a geoid height is required. However, if a geoid height is keyed for a given SPN, then that value will be used for that station only.

MTEN (Columbia) SYSTEM

Any time a geoid height is entered/removed/changed for a given SPN by the STRHGT command, the value will be added/subtracted/altered in the Average Geoid Height Summation Table. A new average will be computed to represent the Average Geoid Height for the whole survey project area.

MTEN (IBM PC) SYSTEM

Any time a geoid height is entered/removed/changed for a given SPN by the STRHGT command, the value will br added/subtracted/altered for only the given SPN. The Average Geoid Height for the project will remain unchanged unless it is reentered by the Command ABSINX.

Standpoint Initialization Entry Commands

5.1 GETABS

The MTEN Command GETABS (GET an ABStract) is used to initialize all observational survey project data collected for a given standpoint. This command prompts for all data required at the standpoint SPN to complete the header records *20*, *40*, and *50* which pertain to a station occupation as outlined in Chapter 2, Horizontal Observation (HZTL OBS) Data in the "Input Formats and Specifications of the NGSDB".

To enter the program type GETABS <cr>. A help aid will flash onto the screen and ask the user to select which type of abstract is to be entered, see example screen shown by Figure (5.01).

```
+-----------------------------------------------------------------------------+
|                        DATA ENTRY ----  GETABS                              |
|                      ------------------------------                         |
|                                                                             |
|                                                                             |
|      SELECT AN ABSTRACT ENTRY NUMBER (N)?                          5        |
|                                                                             |
|      ENTRY NUMBER       ENTER AN ABSTRACT OF                                |
|                                                                             |
|        AST  1  AN ASTRONOMIC AZIMUTH                                        |
|        DST  2  HORIZONTAL MEASUREMENTS TO REFERENCE OBJECTS                 |
|        EDM  3  AN ELECTRONIC DISTANCE MEASUREMENT                           |
|        HGT  4  A DIFFERENCE OF ELEVATION                                    |
|        HZT  5  HORIZONTAL DIRECTIONS                                        |
|        LGH  6  A SHORT TRAVERSE OR PRECISE BASELINE                         |
|        ZEN  7  ZENITH DISTANCES OR ELEVATION/DEPRESSION ANGLES              |
|                                                                             |
|        XIT  0  EXIT THE PROGRAM                                             |
|                                                                             |
  ....
|                                                                             |
|                                                                             |
+-----------------------------------------------------------------------------+
```

Figure (5.01) ---- GETABS First Screen

Following this abstract selection the program will prompt for a standpoint SPN to be entered. The last check made before the program actually goes into execution is to display on the screen for the user the existing abstract numbers created. As an example see Standpoint SPN=50 displayed below.

```
ABSTRACT(S) FOR THIS STATION
  1  3  4  5  6  7  8  9
```

The user is then prompted to select an existing abstract number or create a new one. In this example for Standpoint SPN=50, a new abstract number 2 was selected, see screen shown by Figure (5.02) where the "SET NUMBER/ABSTRACT/" is 2. Since this abstract does not exist, the user will be

prompted as follows:

```
NO ABSTRACT EXISTS ... CREATE ONE (Y/N)?                    Y
```

a second level of protection within GETABS is to prompt the user to verify the type of abstract data to be entered by the following prompt:

```
HZT  -- DATA TO BE ENTERED -- CORRECT (Y/N)?                Y
```

GETABS will prompt for nine items of information and an optional comment, see Figure (5.02).

1) The standpoint survey point number (SPN),
2) The set or abstract number,
3) The data source or record volume number,
4) The weather code and a possible problem flag,
5) The initials of the observer,
6) The job specific instrument number (JSI),
7) The height of the instrument,
8) The local date of the observation, and
9) If a time is to be recorded for each observation.

Each type of abstract (AST, DST, EDM, HGT, HZT, LGH, and ZEN) has mandatory or optional data entry prompts. If a prompt is mandatory, the system will continue to prompt until a valid data entry is made, however if the prompted item is non mandatory a simple carraige return <cr> will allow the user to pass onto the next prompt. If the problem flag was set in the weather code, then a maximum of three lines of comment text can be keyed with each abstract.

```
+-----------------------------------------------------------------------------+
|          ABSHZT       DATA ENTRY ----  GETABS                               |
|                    ------------------------------                           |
|      SURVEY POINT NUMBER/STANDPOINT/SPN (NNN)?  50                          |
|      STATION NAME---                     PELLOW 1976                        |
|      STATE OR COUNTRY CODE                        CT                        |
|      ORDER-AND-TYPE (OT) CODE                     11                        |
|                                                                             |
|      SET NUMBER/ABSTRACT/ (NN)?          2                                  |
|      RECORD SOURCE (LLLLLL)?             V  2                               |
|      WEATHER CODE (NNNNN)?                0211                              |
|      INITIALS OF OBSERVER (LLL)?         DJN                                |
|      JOB INSTRUMENT NUMBER (NNN)?         15                                |
|      HEIGHT OF INSTRUMENT KNOWN (Y/N)?   N                                  |
|      LOCAL DATE/YYMMDD/ (NNNNNN)?        820630                             |
|                                                                             |
|      DO YOU WANT TO ENTER A TIME FOR EACH OBSERVATION (Y/N)?   N            |
|      ENTER PROBLEM COMMENT (MAXIMUM THREE LINES):                           |
|                                                                             |
   ......
|      CHANGE--SCREEN INFORMATION (Y/N)? N                                    |
+-----------------------------------------------------------------------------+
```

Figure (5.02) ---- GETABS Second Screen

5.2 GETTRI

The MTEN Command GETTRI (GET a TRIangle) is used to initialize one triangle at a time. Thus a computational triangle chain layout can be established for the survey project area before any observations are actually taken by just defining the three verticies of each triangle in the chain. To enter the program type GETTRI <cr>. Once the entry is completed the user is prompted as follows:

```
                                    NEW TRIANGLE (Y/N)?        Y
```

The program then flashes to the screen a sample triangle layout. At the time the trangle is first defined, the user is prompted as to the uniqueness of the position computed for the unknown vertex which is labeled one (1). That is, will this triangle computation create the first geographic position for the SPN labeled one (1), if so, then this triangle should be coded as unique. Last the program will prompt the user one-by-one for each vertex SPN and then ask the user to look at each station name before it is used as a vertex entry. As an example see Figure (5.03) where SPN's 84, 83, and 70 are used.

```
 SPN  Station Name
----  ----------------------
 84   H 53 NY                                  CHANGE (Y/N)? N
 83   H 52 NY                                  CHANGE (Y/N)? N
 70   BORO HALL 1931                           CHANGE (Y/N)? N

  +-------------------------------------------------------------------------+
01|                        ENTRY     ----  GETTRI                            |
02|                    ------------------------------                       |
03|                                                                         |
04|              UNKNOWN                TRIANGLE NUMBER (NNN)?    3         |
05|                SPN                                                      |
06|              (  84 )                                                    |
07|                /\                    SPN *1* UNIQUE (Y/N)?     Y       |
08|               /*1*\                                                     |
09|              /     \                                                    |
10|             /       \                  VERTEX  SPN  DEG MN  SEC        |
11|        SIDE13       SIDE12                                              |
12|           /           \                  *1*     84   44 22 51.758      |
13|          /   (  3 )    \                 *2*     83   61 14 55.737      |
14|         /   TRIANGLE    \                *3*     70   74 22 14.620      |
15|        /     NUMBER      \                          --------------      |
16|       /                   \              SUM          180 00 02.116      |
17|      /*3*               *2*\             EXCESS               0.030      |
18| (  70 )-------SIDE23--------(  83 )      CLOSURE              2.085      |
19|   OLD                        OLD                                        |
20|   SPN        INVERSED        SPN         SIDE23           3180.6781      |
21| >>>>>>>>>>>>> LENGTH <<<<<<<<<<<<<<       SIDE12           3986.9190      |
22|                                          SIDE13           4379.4146      |
   ....
24|      CHANGE--TRI INFORMATION (Y/N)?    N                                |
  +-------------------------------------------------------------------------+
```

Figure (5.03) ---- GETTRI Screen

The actual triangle will be computed at a later time by executing the Command WRKTRI. The WRKTRI computation will be based on the triangle's structure as provided by GETTRI and the observations keyed by the programs GETABS + ABSHZT. The vertex angles are taken from the combined lists generated by the program ADJSTA for each vetrex SPN.

If a triangle structure layout is found to be incorrect during the execution of the command WRKTRI, exit WRKTRI and reenter GETTRI to make the proper corrections to that triangle layout.

5.3 GETDES

The MTEN Command GETDES (GET a DEScription) is used to initialize one of the four types of descriptions supported by the MTEN system. The four types of descriptions are divided into two sets of descriptive data, horizontal and vertical. The first set, horizonal and doppler/satellite descriptive data, is formated as described in Chapter 3, Horizontal Descriptive (HZTL DESC) Data; and the second set, bench mark and gravity descriptive data, is formated as in Chapter 7, Vertical Descriptive (VERT DESC) Data in the "Input Formats and Specifications of the NSGDB".

```
HORIZONTAL   DESCRIPTION (Y/N)?     Y       Program will use a
GPS/DOPPLER  DESCRIPTION (Y/N)?             Horizontal Format
-----------------------------------------------------------------------
BENCH MARK   DESCRIPTION (Y/N)?             Program will use a
GRAVITY      DESCRIPTION (Y/N)?             Vertical Format
-----------------------------------------------------------------------
```

Once the type of description has been selected, the program prompts for all data required at the standpoint to complete the header records *10*, *11*, *12*, *13*, *14*, *15*, the monumentation data *20*, *21*, *22*, *23*, or the recovery data *24*, *25*, *26*, and *27*.

```
+-----------------------------------------------------------------------+
01|                    DATA ENTRY ----  GETDES                            |
02|                 ------------------------------                        |
03|      SURVEY POINT NUMBER/STANDPOINT/SPN (NNN)?  50                    |
04|      STATION NAME---                   PELLOW 1976                    |
05|                                                                       |
06|      DESCRIPTION "ORIGINAL"            CHANGE (Y/N)?          N       |
07|                                                                       |
08|      INITIALS OF OBSERVER (LLL)?       DLM                            |
09|                                                                       |
10|                                                                       |
11|                                                                       |
12|      MARK ALSO A "BENCH MARK" (Y/N)?   N                              |
13|                                                                       |
  ...
23|                                                                       |
24|      CHANGE--SCREEN INFORMATION (Y/N)? N                              |
+-----------------------------------------------------------------------+
```

Figure (5.04) ---- GETDES First Screen

The three example screens of GETDES for Standpoint SPN=50 are shown by Figures (5.04, 5.05, and 5.06). In order to determine the correct Quad Identifier (QID) the GETDES program checks to see if a geographic position has been established for the station; if no position, is available the program is terminated. If the standpoint is also a vertical mark the program will prompt for all vertical data items with the exception of the *26*, *27*, and *28* codes. These codes will be prompted for by the GETTXT Command. After GETDES has been completed the remaining descriptive text is entered by executing the MTEN Command GETTXT.

```
+-----------------------------------------------------------------------------+
01|                        DATA ENTRY ----  GETDES    HORIZONTAL STATION       |
  ...
07|                                                                             |
08|   *11*QUAD IDENTIFIED /QID/             N41072341                           |
09|                                                                             |
10|                                                                             |
11|   *13*UNDERGROUND MARK TYPE (L)?        D                                   |
12|       SETTING CODE (NN)?                04                                  |
13|       M-CODE/MAGNRTIC PROPERTY/ (L)?    N                                   |
14|                                                                             |
15|   *15*COUNTY NAME OR EQIVALENT (20A)?   NEW HAVEN                           |
16|                                                                             |
17|                                                                             |
18|   *16*AREA (32A)?                       <SPACE BAR + CR>                    |
19|                                                                             |
20|   *17*NEAREST CITY/TOWN (32A)?          <SPACE BAR + CR>                    |
21|   *18*AIRLINE DISTANCE/DIRECTION (32A)? <SPACE BAR + CR>                    |
22|                                                                             |
23|                                                                             |
24|       CHANGE--SCREEN INFORMATION (Y/N)? N                                   |
+-----------------------------------------------------------------------------+
```

Figure (5.05) ---- GETDES Second Screen

```
+-----------------------------------------------------------------------------+
01|                        DATA ENTRY ----  GETDES    HORIZONTAL STATION       |
  ...
07|                                                                             |
08|   *20*MONUMENT-BY-AGENCY (20A)?         NGS                                 |
09|                                                                             |
10|   *21*MONUMENTATION DATE (NNNN)?        1976                                |
11|       CHEIF-OF PARTY (LLL)?             JLC                                 |
12|                                                                             |
13|   *22*MARKER TYPE    (L)?               H                                   |
14|       TRANSPORTATION CODE (L)?          X                                   |
15|       PACK TIME /HHMM/                                                      |
16|                                                                             |
17|   *23*HEIGHT OF INSTRUMENT KNOWN (Y/N)? Y 19.7    UNITS (M/F)?  M           |
  ...
24|       CHANGE--SCREEN INFORMATION (Y/N)? N                                   |
+-----------------------------------------------------------------------------+
```

Figure (5.06) ---- GETDES Third Screen

Observational Data Entry Commands

6.1 ABSAST + GETAST

The MTEN Commnd ABSAST (ABStract of an ASTronomical azimuth) will enter an azimuth observation. To enter the program type ABSAST <cr>. After the SPN entry the corresponding standpoint name will appear on the screen and the program will prompt if it is correct or has to be changed before continuing on to prompt for the number of the desired set/abstract. A sample screen is shown on Figure (6.01).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSAST                          |
   ...
07|                                                                         |
08|       JOB CHRONOMETER NUMBER (NNN)?     951                             |
09|       VISIBILITY CODE KNOWN (Y/N)?        N                             |
10|       NUMBER OF REPLICATIONS (NN)?        4    /D & R PAIRS/            |
11|       REJECTION LIMIT /SECONDS/(NN.NN)?   4.0                           |
12|                                                                         |
13|       TYPE OF TARGET TAKEN CODE (NN)?     1                             |
14|       JOB INSTRUMENT NUMBER (NNN)?        1                             |
15|       HEIGHT OF TARGET (SNNN.NNN)?       30.512         (M/F)?  M       |
16|       ORIGIN OF  AZIMUTH (N/S)?           N                             |
17|       ASTRONOMIC AZIMUTH (NNN,NN,NN.N)?  147,38,18.00                   |
18|       PRIME VERTICAL DEFLECTION OF THE VERTICAL COMPONENT               |
19|       ETA/SECONDS/ (NN.NN)?              0.0            (E/W)?  E       |
20|                                                                         |
   ...
24|       CHANGE AST INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (6.01) ---- ABSAST Screen

The Laplace azimuth data, *60* records as set forth in the "Input Formats and Specifications of the NGSDB", requires the mean observed azimuth observation be converted to a astronomic azimuth by the application of the following corrections:

1) Time signal propagation delay
2) U.T. correction
3) Durnial Aberration
3) Elevation of the forepoint station
4) Standpoint eccentricities
5) Variation of the Pole

These five corrections are part of the MTEN Commands ASTCHK and WRKAST. The astronomic azimuth can be converted to a corresponding geodetic azimuth by the application of the Laplace Correction. If the Laplace Correction is unknown at the standpoint where the azimuth was observed, a predicted value can be obtained at a small cost from the National Geodetic Information Center, NOAA (N/CG174), 6001 Executive Boulevard, Rockville, Maryland 20852.

If however, the complete astronomical azimuth observation is to be computed by the system, the following MTEN Command GETAST must also be completed to enter the actual observations.

The MTEN Command GETAST (GET an ASTronomical azimuth) will first enter the observed "time checks" and then the observed direct/reverse (D/R) readings of the mark station, the observed star, the time tips, and the West/East bubble readings or level corrections. To enter the program type GETAST <cr>.

The first GETAST screen is used to establish the source of the time signal. Before GETAST can be properly executed, the time signal source, see Figure (6.03), must have had its name entered using STRNAM and a geographic position stored using the command STRGPN. Once the actual "time source" is established the program prompts the user for the number of observed time checks; and then, they are entered one-by-one. The last screen prompt is whether the West/East bubble readings were taken or the level correction observed. An example screen is shown on Figure (6.02).

```
+-----------------------------------------------------------------------------+
|                        DATA ENTRY ----  GETAST                              |
|                     ------------------------------                          |
|      TIME SIGNAL/FOREPOINT/SPN (NNN)?          11                           |
|      TIME SIGNAL CALL LETTERS KNOWN (Y/N)?  Y     (LLLLLL)?  WWV            |
|      TIME SIGNAL FREQUENCY KNOWN (Y/N)?     Y     (NNNN.NN)? 10.0           |
|                                                                             |
|      MAKE ALL TIME COMPARISONS CONSISTENT FOR ONE GIVEN DATE                |
|      GREENWICH DATE OF FIRST TIME CHECK/YYMMDD/ (NNNNNN)?    791108         |
|      NUMBER OF TIME CHECKS (N)?                              3              |
|                                                                             |
|      OBSERVATION TIMES/USE A 24-HOUR CLOCK OR LONGER IF NEEDED/             |
|                                                                             |
|      TIME      GREENWICH  TIME      LOCAL  TIME                             |
|      CHECK         /HMS/              /HMS/                                |
|                                                                             |
|                                                                             |
|      -1-         22,50,0.0          22,49,59.90                            |
|      -2-         23,51,0.0          23,50,59.89                            |
|      -3-         24,46,0.0          24,45,59.90                            |
|                                                                             |
|                                                                             |
|      WERE THE BUBBLE ENDS READ (Y/N)?  Y                                    |
   ...
+-----------------------------------------------------------------------------+
```

Figure (6.02) ---- GETAST First Screen

CALL SIGN	LOCATION COUNTRY	LATITUDE LONGITUDE (DDD MM)	CARRIER FREQUENCY (kHz)
CHU	Ottawa Canada	45 18 N 75 45 W	3330 - 7335 - 14670
NBA	Balboa Canal Zone USA	9 04 N 79 39 W	24 - 147.85 - 5448.5 11080 - 17697.5 22515
NPG	Mare Island CA USA	38 06 N 122 16 W	114.95 - 4010 - 6428.5 9277.5 - 12966 17055.2 - 22635
NPN	Guam USA	13 27 N 144 43 E	484 - 4955 - 8150 13530 - 17530 21760 - 24.4
NSS	Annapolis MD USA	38 59 N 76 27 W	162 - 5870 - 9425 13575 - 17050.4 23650
WWV	Ft. Collins CO USA	40 41 N 105 02 W	2500 - 5000 - 10000 15000 - 20000 25000
WWVH	Maui HI USA	20 46 N 156 28 W	2500 - 5000 - 10000 15000

Figure (6.03) ---- Common North American Time Signal Stations

The second GETAST screen is used to enter the actual observations. This screen will loop through as many (D/R) pairs as were called for on this set/abstract. Each pair of (D/R) readings starts with the instrument-in-direct and prompts for the following entries:

Mark Station
Star
Local Time
Bubble (West/East) or the Bubble correction

It continues with the second set of identical prompts for the instrument-in-reverse. This looping will continue until the total number of (D/R) pairs is complete, see the sample screen shown by Figure (6.04).

```
+-----------------------------------------------------------------------------+
|                        DATA ENTRY ----  GETAST                              |
|                     ------------------------------                          |
|                 AZIMUTH OBSERVATIONS /D & R PAIRS/                          |
|                                                                             |
|            ---------------------------------------------                     |
|       POSITION NUMBER (NN)?                                          13     |
|                                                                             |
|            **** INSTRUMENT-IN-DIRECT                                        |
|                                                                             |
|       MARK STATION/DMS/(NNN,NN,NN.N)?   269,49,34.7                         |
|       STAR        /DMS/(NNN,NN,NN.N)?          123,05,28.4                  |
|       LOCAL TIME  /HMS/ (NN,NN,NN.N)?                   24,18,56.3          |
|       BUBBLE (NNN.NN)?          /WEST/ =   2.90                             |
|                                 /EAST/ =        24.10                       |
|                                                                             |
|            **** INSTRUMENT-IN-REVERSE                                       |
|                                                                             |
|       MARK STATION/DMS/                   89,49,27.5                        |
|       STAR        /DMS/                         303,05,06.1                 |
|       LOCAL TIME  /HMS/                                 24,19,51.2          |
|       BUBBLE (NNN.NN)?          /WEST/ =  27.4                              |
|                                 /EAST/ =        6.0                         |
|                                                                             |
|       CHANGE AST INFORMATION (Y/N)?     N                                   |
+-----------------------------------------------------------------------------+
```

Figure (6.04) ---- GETAST Second Screen

To actually compute the astronomic azimuth observational data keyed on this abstract, the azimuth must be processed by executing three MTEN programs in the following order:

(1) ASTCHK
(2) ASTTME
(3) ASTRAD

Once all three programs have been completed for each individual astronomic azimuth set/abstract existing at the standpoint, the abstracts can then be combined into one mean azimuth determination by executing the MTEN Command WRKAST.

6.2 ABSDST

The MTEN Command ABSDST (ABStract of reference object DiSTances) will enter two types of measurements. The first type of distance measurement is in feet and meters or feet only. The second distance type measurement is an approximate distance in kilometers or miles. To enter the program type ABSDST <cr>.

These two types of measurements are between the parent station and reference marks and nearby ground visible objects. Always enter the measured distance as the standpoint being the parent station and the reference mark/object as the forepoint regardless of the fact that the zero end of the

tape may have been at the reference mark/object. The first type of distance measurement is station reference marks or reference points. The measurement can be either in feet or in both meters and feet. However, if both meters and feet are entered then the absolute difference between the two entries must be less than 3.45 millimeters before the data will be accepted. A maximum of 20 observations can be entered on a given abstract. The second type of distance measurement is to a reference object such as a nearby landmark or azimuth mark which has a distance of over 168 meters (or 550 feet). This distance measurement must be submitted as an approximate kilometers/miles distance. A sample screen is shown on Figure (6.05).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSDST                          |
   ...
07|                                                                         |
08|       TIME/HHMM/ OR ZONE KNOWN (Y/N)?   N                               |
09|       VISIBILITY CODE KNOWN (Y/N)?      Y  (V,N, ,R,Z) (L)?     R       |
10|       NUMBER OF REPLICATIONS (NN)?      1                               |
11|       REJECTION LIMIT KNOWN (Y/N)?      N                               |
12|                                                                         |
13|       APPROXIMATE DISTANCE/KM,MI/(Y/N)? N                               |
14|       MEASURED IN FEET ONLY (Y/N)?      N                               |
15|       HORIZONTAL FEET   (NNN.NNN)?      8.658                           |
16|       HORIZONTAL METERS (NNN.NNN)?      2.639                           |
17|                                                                         |
   ...
24|       CHANGE DST INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (6.05) ---- ABSDST Screen

6.3 ABSEDM

The MTEN Command ABSEDM (ABStract of Electronic Distance Measurements) will enter any measured slope distance after it has been first properly corrected for all atmospheric conditions. To enter the program type ABSEDM <cr>.

A slope measurement can be one or more sheets (to a maximum of five sheets) where each sheet (an instrument or mirror offset) should be the mean of at least 10 determinations of the measured slope distance. The slope distance must be corrected for ambient conditions and the mode of measurement. The program allows two options to be keyed. The first option is to enter only the corrected mean slope distance for all sheets if more than one was taken. The second option allows each sheet measured up to a maximum of five to be entered. A sample screen is shown on Figure (6.06).

If the second option is selected, a residual table for the individual sheets will be printed for this abstract in the format as shown below on Figure (6.07). The two terms SE (standard deviation of a single sheet) and SM (standard deviation of the mean) will then be computed for the number of sheets entered.

```
+-----------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSEDM                              |
  ...
07|                                                                             |
08|      TIME/HHMM/ OR ZONE  (NNNN)?        1201                        R       |
09|      VISIBILITY CODE KNOWN (Y/N)?       N                                   |
10|      NUMBER OF REPLICATIONS (NN)?       10                                  |
11|      REJECTION LIMIT /M OR FT/          0.006 (NN.NNN)?  (M/F)? M           |
12|                                                                             |
13|      TYPE OF TARGET TAKEN CODE (NN)?    2                                   |
14|      JOB INSTRUMENT NUMBER (NNN)?       2                                   |
15|      HEIGHT OF TARGET (SNN.NNN)?        1.495            (M/F)? M           |
16|      ENTER ONE MEAN SLOPE DISTANCE FOR ALL SHEETS (Y/N)?        N           |
17|                                                                             |
18|      DISTANCE/SHEET # 1 /(NNNNN.NNN)?   3437.714         (M/F)? M           |
19|      DISTANCE/SHEET # 2 /(NNNNN.NNN)?   3437.717                            |
20|      DISTANCE/SHEET # 3 /(NNNNN.NNN)?   3437.716                            |
21|      DISTANCE/SHEET # 4 /(NNNNN.NNN)?   3437.713                            |
22|                                                                             |
23|                                                                             |
24|      CHANGE EDM INFORMATION (Y/N)?      N                                   |
+-----------------------------------------------------------------------------+
```

Figure (6.06) ---- ABSEDM Screen

SHEET NBR	SLOPE DISTANCE (M)	V (MM)	VV (MM)
1	3437.7140	1.00	1.00
2	3437.7170	-2.00	4.00
3	3437.7160	-1.00	1.00
4	3437.7130	2.00	4.00
MEAN	3437.7150	SUM =	10.00
		SE =	1.8 SHEET
		SM =	0.9 MEAN

Figure (6.07) ---- Residual Table

6.4 ABSHGT + GETROD

The MTEN Commnd ABSHGT (ABStract of a HeiGhT or a difference of elevation) will enter an observed elevation difference. To enter the program type ABSHGT <cr>.

The difference of elevation data, *45* records as set forth in the "Input Formats ans Specifications of the NGSDB", requires only the observed elevation difference and the forepoint SPN be keyed. This difference of elevation information between two SPN's can be entered with just the command ABSHGT. If this difference of elevation is to be used to establish the end-point heights of "Benchovers" for the inclination correction on a short

traverse, then the MTEN program GETROD must also be completed. The GETROD Command must be entered and completed before the MTEN Command GETBAY can be used to enter the taping observations/measurements made over a short traverse. A sample screen for ABSHGT is shown on Figure (6.08).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSHGT                          |
   ...
07|                                                                         |
08|       TIME/HHMM/ OR ZONE KNOWN (Y/N)?   N                               |
09|       VISIBILITY CODE KNOWN (Y/N)?      N                               |
10|       NUMBER OF REPLICATIONS (NN)?      1                               |
11|       AGENCY WHO DID WORK KNOWN (Y/N)?  N                               |
12|       NUMBER OF SETUPS KNOWN (Y/N)?     Y   (NN)?  2                    |
13|       SECTION LENGTH /KM OR MI/         0.1 (NN.NNN)?    (K/M)? K       |
14|       ESTIMATED ACCURACY/M OR FT/       0.003 (N.NNN)?   (M/F)? M       |
15|       LEVEL ROD (JSI) NUMBER (NNN)?     252                             |
16|                                                                         |
17|       ELEVATION DIFFERENCE (SNNN.NNN)?  10.111                          |
18|                                                                         |
19|       WILL A SHORT TRAVERSE-BASELINE USE THIS LEVELING (Y/N)?   N       |
   ...
24|       CHANGE HGT INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (6.08) ---- ABSHGT Screen

The MTEN Command GETROD (GET/enter ROD readings for a difference of elevation) will enter the rod readings to establish the heights for the beginning benchover, intermediate stake(s), and the ending benchover. The program will loop through as many short traverse "bays" as the number of "SETUPS" called for by the entry made in the program ABSHGT. To enter the program type GETROD <cr>.

The first section on the screen is used to check the number of bays, for which there will be an established difference of elevation. The next entry is used to enter the rod readings for the elevation difference between the beginning mark (BEG MK) and the first beginning benchover (BEG BO).

HGTBEG - The actual taped distance between the beginning mark <BEG MK> on the ground and the height of the beginning benchover <BEG BO> directly above it.

HGTEND - The actual taped distance between the last benchover <END BO> above the mark to the ending mark <END MK> on the ground.

```
                 |<----BAY 1---->|<----BAY 2---->|
                 |               |               |

    <BEG BO>                                      <END BO>
"Beginning     _                                 _ "Last
 Benchover"    ^                                 ^
               |                 _ <STAKE BO>    |    Benchover"
               + <HGTBEG>        ^
               |                 |               |
               |                 |               + <HGTEND>
 *************MK*********        |               |
               /            ***********          |
    <BEG MK> +                Ground   ***       |
"Beginning Mark"                Level     *******MK*******************

                                                  + <END MK>
                                                    "Ending Mark"
```

Figure (6.09) ---- Sample Two-Bay Short Traverse Configuration

The second section on the screen will loop through each bay one-by-one until an elevation difference has been established for each bay. In each bay within this looping the program prompts for two rod readings, first the backsight (BS) and then the foresight (FS). After each bay BS and FS entry, the elevation difference is computed and flashed onto the screen. A sample screen is shown on Figure (6.10).

```
+-----------------------------------------------------------------------------+
|                        DATA ENTRY ----  GETROD                              |
|                     ------------------------------                          |
|       NUMBER OF TAPING BAYS (NN)?                                  5        |
|       LEVEL OBSERVING UNITS/METERS OR FEET/                (M/F)? M        |
|                                                                             |
|       OFF THE BEGINNING MARK   /BEG MK/                                     |
|       UP TO THE FIRST BENCHOVER/BEG BO/              DIFFERENCE             |
|       BACKSIGHT/ON BEG MK  / (NN.NNN)?    1.550                            |
|       FORESIGHT/ON BEG BO  / (NN.NNN)?    0.300       1.250                |
|                                                                             |
|       BAY NUMBER (NN)?                    5                                 |
|       BACKSIGHT/ON STAKE   / (NN.NNN)?    1.000                            |
|       FORESIGHT/ON END BO  / (NN.NNN)?    2.000      -1.000                |
|                                                                             |
|       OFF THE LAST BENCHOVER   /END BO/                                     |
|       DOWN TO THE ENDING MARK  /END MK/                                     |
|       BACKSIGHT/ON END BO  / (NN.NNN)?    9.040                            |
|       FORESIGHT/ON END MK  / (NN.NNN)?    1.000       8.040                |
|                                                                             |
|       ELEVATION DIFFERENCE /MARK TO MARK/ =            8.590                |
|       ELEVATION DIFFERENCE ON "ABSHGT"    =            8.590                |
|   ...                                                                       |
|       CHANGE HGT INFORMATION (Y/N)?     N                                   |
+-----------------------------------------------------------------------------+
```

Figure (6.10) ---- GETROD Screen

The third and last section on the screen is used to establish the elevation difference between the last benchover (END BO) and the ending mark (END MK). As a check on the entered difference of elevation between the (BEG MK) and the (END MK) the program will flash to the screen the computed difference using the observations entered on this set/abstract along with the difference of elevation keyed on the corresponding set/abstract using the ABSHGT command.

6.5 ABSHZT

The MTEN Command ABSHZT (ABStract of HoriZonTal directions) will enter any set/abstract of observed directions. To enter the program type ABSHZT <cr>.

The ABSHZT program, at initial entry, will prompt for the number of observed directions to be keyed for this abstract. Once this number has been selected it cannot be changed. Therefore make sure the count, that is the number of directions, is correct before it is keyed. Now that the total number of observed directions has been established, the program will loop through each observed direction one-by-one until the set/abstract is complete. A sample screen for ABSHZT is given by Figure (6.11).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSHZT                           |
   ...
07|                                                                         |
08|       TIME/HHMM/ OR ZONE KNOWN (Y/N)?   N                               |
09|       VISIBILITY CODE KNOWN (Y/N)?      Y  (V,N, ,R,Z)   (L)?   R       |
10|       NUMBER OF REPLICATIONS (NN)?      1                               |
11|       REJECTION LIMIT/SECONDS/(NN.NN)?  20.0                            |
12|                                                                         |
13|       TYPE OF TARGET TAKEN CODE (NN)?   4                               |
14|       JOB INSTRUMENT NUMBER (NNN)?      4                               |
15|       HEIGHT OF TARGET KNOWN (Y/N)?     N                               |
16|                                                                         |
17|       DIRECTION/DMS/ (NNN,NN,NN.NN)?    53,44,29.50                     |
18|       ECCENTRICITY (Y/N)?               N                               |
   ...
24|       CHANGE HZT INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (6.11) ---- ABSHZT Screen

6.6 ABSLGH + GETBAY

The MTEN Commnd ABSLGH (ABStract of a LenGtH or short traverse measurement) will enter a short traverse (or a base line) observation. To enter the program type ABSLGH <cr>.

The MTEN Command ABSLGH, upon initial entry, establishs first the temperature units--Celsius/Fahrenheit (C/F)--to be used when the data is entered and how many temperatures (1 or 2) are to be entered for each bay. Next the program prompts the user for the units--Meters/Feet (M/F)--to be used for the taping measurement and assumes the same units will be used to apply

the tape corrections. The last prompt is to note and record the type of metal the tape is made of so a computational check can be made on the value of the corrections that are entered for each bay measurement. A sample screen is shown by Figure (6.12).

```
+-----------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSLGH                              |
  ...
07|                                                                             |
08|       TIME/HHMM/ OR ZONE KNOWN (Y/N)?   N                                   |
09|       VISIBILITY CODE KNOWN (Y/N)?      N                                   |
10|       NUMBER OF REPLICATIONS (NN)?      1                                   |
11|       REJECTION LIMIT /M OR FT/         0.001 (NN.NNN)   (M/F)? M           |
12|                                                                             |
13|       TEMPERATURE UNITS /CELSIUS OR FAHRENHEIT/          (C/F)? C           |
14|       TEMPERATURE READING(S) FOR EACH BAY /1 OR 2/         (N)? 1           |
15|                                                                             |
16|       TAPING AND TAPE CORRECTION UNITS /METERS OR FEET/  (M/F)? M           |
17|       WHAT TYPE OF TAPE WAS USED /0,1,2, OR 3/             (N)? 2           |
18|                                  /0-OTHER   3-LOVAR   2-INVAR   1-STEEL/    |
19|                                                                             |
20|       REDUCED TRAVERSE LENGTH (NNNNN.NNNN)? METERS      172.0170            |
  ...
24|       CHANGE LGH INFORMATION (Y/N)?     N                                   |
+-----------------------------------------------------------------------------+
```

Figure (6.12) ---- ABSLGH Screen

The GETBAY program, at initial entry, will prompt the user for the Standpoint SPN, from which the leveling was started, so that the correct height's are associated with the correct short traverse abstract. The last items prompted, before the program goes into a loop for the bays, are the height of the beginning benchover <HGTBEG> and the height of the last benchover <HGTEND>. As a SPECIAL NOTE to the user, when the abstract is entered for the measurement in the opposite direction, the values of these heights are then reversed.

The second full screen, see Figure (6.13), is used to enter each measured bay one-by-one until as many bays as were called for in the program ABSLGH. At the beginning of each bay's entry, the program prompts as to whether or not the tape was changed. If it has, then a new Job Specific instrument (JSI) number must be entered and verified before the program can continue. What this prompt means, is that, say the observer was measuring a 815.8-meter base line with a 50-meter tape (graduation marks at only 0-25-50 meters). Then the first 800 meters or for sixteen bays the tape remained unchanged. However, to measure the last 15.8 meters of the base line, the observer would have to "CHANGE" the tape used because it would be impossible to measure the distance with the 50-meter tape. Therefore in order to complete this bay, there must be a second tape (graduated in smaller units) and an entry in the JSI table for it. In addition, the user is required to enter the second tape's metal type. Once the proper tape and it's metal are completed the program will continue to step through each set of tape corrections for this bay.

```
+------------------------------------------------------------------------+
|                    DATA ENTRY ----  GETBAY                             |
|                 ------------------------------                         |
|      TAPING (BAY NUMBER)                                          3    |
|      DID YOU CHANGE TAPES ON THIS BAY (Y/N)?                      N    |
|                                                                        |
|                                                  METAL =          2    |
|                              CELSIUS                                   |
|      WILL BAY "ADD TO" THE TOTAL LENGTH OF THE TRAVERSE (Y/N)? Y       |
|      TEMPERATURE(S) (SNN.NN)?  -6.67                                   |
|      TWO (2) TAPE SUPPORTS USED (Y/N)? Y                          2    |
|      OBSERVED DISTANCE/BETWEEN TAPE MARKS/ (NNN.N)?    50.0            |
|                                                                        |
|           --------------TAPE CORRECTIONS-------------- METERS          |
|      TAPE & CATENARY (SN.NNNNN)?       -0.00385                        |
|      TEMPERATURE     (SN.NNNNN)?       -0.00048                        |
|      SETUP   MEASURED     (Y/N)? N                                     |
|      SETBACK MEASURED     (Y/N)? N                                     |
|      INCLINATION                       -0.00452                        |
|      HEIGHT ABOVE SEA LEVEL            -0.00026                        |
|      REDUCED LENGTH OF THIS BAY                        49.99089        |
|           ---------------------------------------------                |
|      REDUCED LENGTH OF THE TRAVERSE =                 149.96998        |
|                                                                        |
|      CHANGE LGH INFORMATION (Y/N)?     N                               |
+------------------------------------------------------------------------+
```

Figure (6.13) ---- GETBAY Screen

The first correction prompt for each bay asks the user to determine whether or not the measured tape length (plus the tape corrections) will add "ADD" to the overall length of this short traverse; or whether it will subtract "SUB" that is reduce the overall length of the short traverse. Next having already selected the temperature units and how many readings, the user is prompted for the temperature(s). Following the temperature(s), the user must enter the number of tape supports used and the nominal tape length, e.g. 30 or 50 meters. After the nominal length entry has been completed, the user will be prompted to enter four separate corrections be applied to the nominal tape measurement.

The four separate corrections--tape+catenary, temperature, setup, and setback--must all be computed/observed by the user and then keyed into the program. The tape+catenary corrections for a given tape are generally provided in a table when the tape is issued and the computation should be computed using this table. The temperature correction for the taped length must be computed using the observed temperature and coefficient of expansion for the tape as provided in the tape's calibration data. The setup or setback measurements are keyed for each bay as required.

6.7 ABSZEN

The MTEN Command ABSZEN (ABStract of ZENith distances) will enter any set/abstract of observed angles of elevation/depression or zenith distances. To enter the program type ABSZEN <cr>.

The ABSZEN program, at initial entry, will prompt for the number of observed verticals to be associated with this set/abstract. Once this number has been selected it cannot be changed. Therefore make sure the count, that is the number of verticals, is correct before it is keyed. Now that the total number of observed verticals has been established the program will loop through each observed vertical one-by-one until the set/abstract is complete. Note if the vertical observations are entered as angles of elevation or depression the program will convert these observations to zenith distances before storing them as records. Therefore in the future, any use of these verticals by the MTEN System, they will appear only as zenith distances. A sample screen for ABSZEN is shown on Figure (6.14).

```
  +-------------------------------------------------------------------------+
01|                        DATA ENTRY ----  ABSZEN                          |
    ...
07|                                                                         |
08|       TIME/HHMM/ OR ZONE KNOWN (Y/N)?   Y  (NNNN)?  1413   (L)? R       |
09|       VISIBILITY CODE KNOWN (Y/N)?      N                               |
10|       NUMBER OF REPLICATIONS (NN)?      3                               |
11|       REJECTION LIMIT /SECONDS/ (NN.N)? 10.0                            |
12|                                                                         |
13|       TYPE OF TARGET TAKEN CODE (NN)?   1                               |
14|       JOB INSTRUMENT NUMBER (NNN)?      1                               |
15|       HEIGHT OF TARGET (SNN.NNN)?       1.539            (M/F)? M       |
16|                                                                         |
17|       VERTICAL/DMS/ (NNN,NN,NN.N)?      90,27,38.5     (E/D/Z)? Z       |
    ...
24|       CHANGE ZEN INFORMATION (Y/N)?     N                               |
  +-------------------------------------------------------------------------+
```

Figure (6.14) ---- ABSZEN Screen

Reference Objects and Descriptive Text

7.1 Introduction

Before either of these programs can by run, program GETDES (Section 5) must have been completed. The program GETBOX in it's execution will use only those stations that are found on the combined list "LST" generated with the program ADJSTA. Also make sure each object selected from the combined list to be a Reference Object Record (*30*) has both a direction and a distance to it. The basic requirement for execution of the program GETTXT is, that all Reference Objects (RM's) to be described in the descriptive text must first have had their names entered with STRNAM before they can used.

7.2 GETBOX

The MTEN Command GETBOX (GET the BOX score or reference object records) will take the objects listed on the combined list "LST" generated by the ADJSTA command and format Reference Object Records (*30*) as set forth in the "Input Formats and Specifications of the NGSDB", Chapter 3 Horizontal Descriptive (HZTL DESC) Data. To enter the program type GETBOX <cr>. The user is next prompted to select one of the two types of descriptive text.

```
HORIZONTAL   DESCRIPTION (Y/N)?   Y
GPS/DOPPLER  DESCRIPTION (Y/N)?
```

Once the type of descriptive text has been selected, the program will flash to the screen the DES File Name and drive where the previous descriptive data was stored when it was created by GETDES. Both of these should be the same as the floppy disk inserted, if not EXIT the program, insert the proper floppy disk and reset the drive again before entering the program.

```
FILE = FILEDESX          DRIVE = B

... "DES FILE" ... CHANGE DISK DRIVE (Y/N)?                N
```

An answer of "N" means the correct DES File is available, the program will flash to the screen for the user all visible objects, those coded as "V" for ground visible, all azimuths coded as "Z", and the initial used on the combined list "LST". A sample screen for SPN=50 is shown by Figure (7.01). The program then prompts the user to select a SPN to be the initial.

Most often the combined list "LST" initial is used, however, any Forepoint SPN from the list can be selected as the initial. As a SPECIAL NOTE to the user, select a Forepoint SPN that has a geographic position because the program will compute an inverse to the forepoint so the compass headings to the reference objects can be generated.

```
+-----------------------------------------------------------------------------+
01|          "ORIGINAL"    DATA ENTRY ----  GETBOX    HORIZONTAL STATION        |
02|                      ------------------------------                         |
03|       SURVEY POINT NUMBER/STANDPOINT/SPN (NNN)?  50                         |
04|       STATION NAME---                    PELLOW 1976                        |
05|        VG   NBR   REFERENCE OBJECTS                                         |
06|       CODE  POS                        -SPN-                                |
07|                                                                             |
08|         V    57   FROM "LST" INITIAL   54                                   |
09|         Z     4   AZIMUTH              57                                   |
10|         V     4   GROUND VISIBLE       58                                   |
11|         V     4   GROUND VISIBLE       59                                   |
12|         V     4   GROUND VISIBLE       53                                   |
13|         V    64   GROUND VISIBLE       56                                   |
14|         V     4   GROUND VISIBLE       61                                   |
  ....
23|                                                                             |
24|       PLEASE SELECT AN "INITIAL STATION" (NNN)?  54                         |
+-----------------------------------------------------------------------------+
```

Figure (7.01) ---- GETBOX First Screen

```
+-----------------------------------------------------------------------------+
01|          "ORIGINAL"    DATA ENTRY ----  GETBOX    HORIZONTAL STATION        |
  ...
05|                                                                             |
06|       MARK         GROUND VISIBLE                    BY-QUADRANT            |
07|       TYPE -SPN-   REFERENCE OBJECTS                 (270 - 360)            |
08|                                                                             |
09|       L53    58    WINDFIELD MUN TANK                  5.60 KM              |
10|       L57    59    WINDFIELD LOT                       5.90 KM              |
11|                                                                             |
  ...
21|                                                                             |
22|       SKIP ...  THIS QUADRANT (Y/N)?                                  N     |
23|       SELECT A MAXIMUM OF TWO PER QUADRANT (NNN)?  58                       |
24|       STOP SELECTION (Y/N)?                                           N     |
+-----------------------------------------------------------------------------+
```

Figure (7.02) ---- GETBOX Second Screen

To avoid getting too many reference objects in the (*30*)-code records, the user is prompted to select only two ground visible from each of the four quadrants. All objects visible in each quadrant are flashed to the screen along with it's mark type, SPN, name, and how far away it is. The four quadrants in azimuth from north are as follows:

BY-QUADRANT (000 - 090) (090 - 180) (180 - 270) (270 - 360)

The user may skip the quadrant all together or select one or no more than two before the program continues to the next quadrant. A sample quadrant selection is shown by Figure (7.02).

After the quadrant selection is completed, the program will generate the full Reference Object Records and flash them to the screen for the user.

Also at this time, all objects coded as "Z" (azimuth marks), and all objects coded as "R" (reference marks) will automatically be inserted into the list of objects selected by quadrant. The HSV Code (H,S,V, or N) is not flashed to the screen but inserted on the records to be saved on the DES File. The screen will continue to fill until the list of objects has been exhausted. Then the program will search for all measurements between the reference marks. While the search is being made the following message will appear on the screen.

```
      SEARCHING DAT FILE FOR ... "RM-TO-RM" ... MEASUREMENTS

  +-------------------------------------------------------------------------+
01|          "ORIGINAL"    DATA ENTRY ----  GETBOX    HORIZONTAL STATION      |
02|                      ------------------------------                      |
03|         SURVEY POINT NUMBER/STANDPOINT/SPN (NNN)?  50                     |
04|         STATION NAME---                    PELLOW 1976                    |
05|                                                                           |
06| SPN MARK      REFERENCE            COMPASS  ------DISTANCES------ DIRECTION|
07| NBR CODE       OBJECTS             HEADING METERS  FEET   APPROX.  DDDMMSS |
08|          ---------------------------------------------------------        |
09|  54 D08N RIDGE 1976                   W                   12.09 KM  00000000|
10|  57 D08N PELLOW 1976 AZ MK            W                   0.800 KM  00312458|
11|  58 L53  WINDFIELD MUN TANK           WNW                 5.600 KM  02004568|
12|  51 D08N PELLOW 1976 RM 1             NW   20.749  68.07            0400757 |
13|  52 D08N PELLOW 1976 RM 2             NE   42.848 140.57            1255047 |
14|  51      PELLOW 1976 RM 1                                                 |
15|  52 -TO- PELLOW 1976 RM 2                         151.55                  |
16|                                                                           |
   ...
24|       CHANGE--SCREEN INFORMATION (Y/N)? N                                 |
  +-------------------------------------------------------------------------+
```

Figure (7.03) ---- GETBOX Third Screen

A completed sample GETBOX screen is shown by Figure (7.03). A SPECIAL NOTE for the user, the GETBOX program will expect to find for each reference object coded the following information.

VISIBILITY CODE	REFERENCE OBJECT TYPES	REQUIREMENTS or OPTIONS
R	REFERENCE MARKS	Must find a distance entered with ABSDST ABSEDM or ABSLGH
Z	AZIMUTH MARKS	Must find a distance entered with ABSDST ABSEDM or ABSLGH Or have a geographic position so an inverse distance can be computed

V	GROUND VISIBLE	Have a geographic position so an inverse distance can be computed An approximate distance entered with ABSDST Or a measured distance entered with ABSDST ABSEDM or ABSLGH

7.3 GETTXT

The MTEN Command GETTXT (GET the descriptive TeXT) will allow the user to enter narrative paragraph(s) of a description while at the same time the keyed records will be reformated into the Descriptive Text Records (*40*) as set forth in the "Input Formats and Specifications of the NGSDB", Chapter 3 Horizontal Descriptive (HZTL DESC) Data. To enter the program type GETTXT <cr>. Next the user is prompted to select one of the four types of descriptive text.

```
HORIZONTAL   DESCRIPTION (Y/N)?   Y       Program will use a
GPS/DOPPLER  DESCRIPTION (Y/N)?           Horizontal Format
-------------------------------------------------------------------
BENCH MARK   DESCRIPTION (Y/N)?           Program will use a
GRAVITY      DESCRIPTION (Y/N)?           Vertical Format
-------------------------------------------------------------------
```

Once the type of descriptive text has been selected, the program will flash to the screen the DES File Name and drive previously used by the program GETDES when data was stored at the initialization of the description. Both of these items should be the same as the inserted floppy disk, if not EXIT the program, insert the proper floppy disk, and reset the drive again before entering the program.

```
FILE = FILEDESX          DRIVE = B

... "DES FILE" ...  CHANGE DISK DRIVE (Y/N)?                N
```

An answer of "N" means "NO CHANGE" and the correct DES File is available and it does not need to be changed. The program then reads the description format created by GETDES to determine the type and kind of description it has. The type of descriptive text will flash to the upper right corner of the screen and the kind of description either a -- "ORIGINAL" or "RECOVERY" -- will flash to the upper left corner of the screen. See Figures (7.04) and (7.05) where standpoints SPN=82 and SPN=50 are used as examples.

The bench mark or gravity description requires additional formated records. If this description type is being entered, the program will prompt the user to enter the following vertical data codes:

26 - Setting Classification and Code
27 - Monumentation Code / Quality Code and Point Origin
28 - Stamping Record

These three items are mandatory upon entry into the program GETTXT for any bench mark or gravity description. An example screen for Standpoint SPN=82 is shown by Figure (7.04).

```
+-----------------------------------------------------------------------+
01|          "RECOVERY"    DATA ENTRY ----  GETTXT    BENCH MARK DESCRIPTION |
02|                    ------------------------------                     |
03|       SURVEY POINT NUMBER/STANDPOINT/SPN (NNN)?  82                   |
04|       STATION NAME---                    BOLT                         |
05|                                                                       |
06|   *26*CODE (NN)?                         44                           |
07|       SETTING CLASSIFICATION (32A)       CONCRETE SEAWALL SLAB        |
08|                                                                       |
09|   *27*MONUMENTATION CODE (L)?            D                            |
10|       DISK TYPE (NN)?                    03                           |
11|       ORIGIN (26A)?                      NOS                          |
12|                                                                       |
13|   *28*STAMPING (50A)?  BOLT 1980                                      |
14|                                                                       |
   ...
23|                                                                       |
24|       CHANGE--SCREEN INFORMATION (Y/N)? N                             |
+-----------------------------------------------------------------------+
```

Figure (7.04) ---- GETTXT Screen, Bench Mark (*26*/*27*/*28*) Codes

Following the vertical format screen entries, if any, the program will prompt the user to step through all possible paragraphs that can be entered on a Horizontal/GPS or a bench mark/gravity type description and then to select one. The following tables list which paragraphs are possible for each type of description. The letter "M" used in the tables below shows which paragraphs are considered to be mandatory for each type of description. Whereas, the dash character "-" is used to show which paragraphs are optional.

Horizontal Format

PARAGRAPH TYPE	HORIZONTAL		LANDMARK		GPS/DOPPLER	
	D	R	D	R	D	R
RECOVERY NOTE		M		-		M
GENERAL LOCATION	M	-	M	-	M	-
TO REACH MARK	M	-	M	-	M	-
STATION/BENCH MARK	M	M			M	M
REFERENCE OBJECTS (RMs)	-	-			-	-
-MAIN- AZIMUTH MARK	-	-			-	-
SECOND AZIMUTH (If one)	-	-			-	-
THIRD AZIMUTH (If one)	-	-			-	-
ADDITIONAL TEXT (HZTL)	M	M	M	M	M	M

Vertical Format

PARAGRAPH TYPE	BENCH MARK		GRAVITY	
	D	R	D	R
RECOVERY NOTE		M		M
GENERAL LOCATION	M	-	M	-
TO REACH MARK	M	-	M	-
STATION/BENCH MARK	M	M	M	M
BM ADDITIONAL TEXT (VERT)	M	M	M	M

After the mandatory paragraphs are entered, the user may continue to the next or any other of the following paragraphs by typing a single carriage return <cr> to step through each paragraph that is not wanted.

```
   +-------------------------------------------------------------------------+
01|          "ORIGINAL"    DATA ENTRY ----  GETTXT     HORIZONTAL STATION     |
   ...
05|                                                                          |
06|       ENTER PARAGRAPH TEXT FOR RECOVERY NOTE            (Y/N)? N         |
   |                                                                         |
   |                                or one of the following                  |
   |                                                                         |
   |                               GENERAL LOCATION                          |
   |                               TO REACH MARK                             |
   |                               STATION/BENCH MARK                        |
   |                               REFERENCE OBJECTS (RM)                    |
   |                               -MAIN- AZIMUTH MARK                       |
   |                               SECOND AZIMUTH MARK                       |
   |                               THIRD  AZIMUTH MARK                       |
   |                               ADDITIONAL TEXT                           |
   |                               BM ADDITIONAL TEXT                        |

   ...
24|       CHANGE--SCREEN INFORMATION (Y/N)? N                                |
   +-------------------------------------------------------------------------+
```

Figure (7.05) ---- GETTXT Paragraph Selection Screen

The termination marker for the end-of-paragraph is a single character, the dollar sign "$". This termination character is placed at the end of each paragraph by the program and cannot be keyed by the user. The only execption to this termination marker is at the very end of each description, where two dollar signs "$$" are inserted after the "ADDITIONAL TEXT" and the "BM ADDITIONAL TEXT" paragraph to flag the end-of-text. The termination markers are not flashed to the screen. They are only used by the program to flag that an end-of-paragraph or end-of-text has been reached.

"RECOVERY NOTE", is the first paragraph in any recovery description. This paragraph can be keyed only for those descriptions which are labeled as "RECOVERY". The prompt is as followings:

THE STATION (Was/Not) RECOVERED AT THIS DATE.

The user must choose either "W" or "N" (Was/Not) recovered to describe whether or not the station mark was found. This one line of recovery text is all that can be stated about a bench mark recovery. Because when the final listing for this description is printed by the program BBKDES, only that one line is used. However, if the description is both a "RECOVERY" and a horizontal format, then additional lines of recovery descriptive text are allowed to describe the recovery of other marks found at the station site. But remember this additional recovery text will be printed only for a horizontal format and not for the vertical format descriptions.

"GENERAL LOCATION", the second paragraph of a "RECOVERY" description or the first paragraph for an "ORIGINAL" description is written out in two sections. The first section contains the approximate (airline) reference distances and directions to the station location. The second section contains the property ownership. Once this paragraph has been selected the user is asked whether or not the program prompts are to be used by the following:

SKIP THE PROMPTS (Y/N)? N

If the prompts are omitted with a "Y" YES response, the user is in a free form text entry. That is, the program's default prompts for descriptive text will not be flashed to the screen nor will they be pre-loaded into the record fields for the user. In this mode of text entry, the user must make sure the data keyed are correct and conform to the formats setforth in the "Input Formats and Specifications of the NGSDB". However, with a "N" NO response the program will flash to the screen the "Optional Partially Coded Text" headings that appear in the NOAA "Station Description" booklet Form 75-82. At the same time it will pre-load the record fields for the user so only a minimum number of key strokes are required for each line of descriptive text.

One of the following prompts will appear for the "GENERAL LOCATION" paragraph:

THE STATION IS LOCATED ABOUT (Meters/Km/Cm) or

THE STATION, (For Landmarks only)

The user at this point must select which type of units are to be used to enter the following approximate reference distances, that is, either a "M" Meters, "K" Kilometers, or "C" Centimeters. To be consistent with the National Geodetic Survey description writing policy, at least three distance entries should be made. In this way a triangle of position, using the three reference distances as arcs, can be constructed at a later time on a map for the location being described. The program will prompt one-by-one for each approximate reference distance; and then at the end of a completed cycle, it will prompt the user whether or not to stop. The order-of-entry for all approximate reference distances is as follows:

First - A Metric Distance and then the English equivalent
Second - The Compass Direction for the Measurement, and
Third - Then Describe from where is it measured

The program will flash to the screen the following prompt:

THE STATION IS LOCATED ABOUT ? (Meters/Km/Cm)

The user responds with a "K" for kilometers and a carriage return <cr>. The program will in return prompt the user to enter the first metric approximate reference distance by:

THE STATION IS LOCATED ABOUT -----

The at this point, the user must key the Metric distance as 12 <cr>, to which the programs responds with the following:

THE STATION IS LOCATED ABOUT 12 KM (-----

The user must now supply the English equivalent distance in miles as 7.5 <cr>. Thus completing the first of a three-part entry that must be made for each approximate reference distance. The line of descriptive text now appears as follows:

THE STATION IS LOCATED ABOUT 12 KM (7.5 MI) -

Next, the program prompts for the direction "OF" the measurement. That is (7.5 MI) "WEST" OF some town or city. On the screen, the prompt appears as:

? (North/South/East/West)

To this prompt, the user must first select one of the four listed compass directions. The program will then continue to prompt the user to enter any one of the possible 16 inter-cardinal points of the compass.

N <cr> W <cr>

The last prompt of the three-part entry is to establish the location "OF" the origin of the approximate reference distance measurement.

THE STATION IS LOCATED ABOUT 12 KM (7.5 MI) NORTHWEST OF ----------

Here, the user should select a local town, city, or prominent object to be keyed. This concludes the three-part entry for an approximate reference distance. The program will prompt the user to answer the following question:

STOP (Y/N)?

A "N" NO response will cause the program to recycle and reprompt the user for a second, third, or as many approximate reference distances as are needed until a "Y" YES response is made. Once a "Y" YES response is made, the program continues to the second section of the "GENERAL LOCATION" paragraph, that is, the ownership of the property. The program prompts the user by flashing this to the screen:

OWNERSHIP-- ?

The descriptive text for the ownership prompt is free form and any name and address can be entered. The listing below shows the complete paragraph with both sections of the "GENERAL LOCATION". Lines of overflowed text while typing are indicated by <++>.

```
THE STATION IS LOCATED ABOUT 12 KM (7.5 MI) NORTHWEST OF THE      <++>
VILLAGE OF GREENWICH,                                             <cr>
3 KM (1.9 MI) NORTH OF THE TOWN OF WALLNUT RIDGE,                 <cr>
0.6 KM (0.4 MI) WEST OF COUNTY ROAD 201, AND ON THE SUMMIT OF A   <++>
GRASSY KNOB IN THE SE 1/4 QUARTER OF SECTION 2, T-6-N AND R-24-W. <cr>
OWNERSHIP--STATE HIGHWAY 459 RIGHT-OF-WAY.                        <cr>
$
```

"TO REACH MARK", this paragraph is a narrative description of how to get from a prominent place or "Point of Beginning" to the station site. The paragraph is divided into two sections. The first section describes the "Point of Beginning", that is, exactly place to start. While the second section contains as many routes listed one after the other until the station site is reached and the station mark located. Once this paragraph has been selected the user is asked whether or not the program prompts are to be used:

```
SKIP THE PROMPTS (Y/N)?                                    N
```

If the prompts are omitted with a "Y" YES response, the user is in a free form text entry. In this mode of text entry, the user must make sure the data keyed are correct and conform to the formats setforth in the "Input Formats and Specifications of the NGSDB". However, with a "N" NO response the program will flash to the screen the "Optional Partially Coded Text" headings.

The following prompt will appear for the "TO REACH MARK" paragraph and the "Point of Beginning" can be described to completed the first section:

```
TO REACH THE STATION FROM ----------------------------------------
```

To be consistent with the National Geodetic Survey description writing policy the "Point of Beginning" should be a prominent location that is well known. A prominent location would be, e.g., one o.. the following:

A LOCAL POST OFFICE,
A COUNTY COURTHOUSE,
A MAJOR HIGHWAY INTERSERTION LOCATED IN or NEAR A CITY.

This place, the "Point of Beginning", will be full" described before any entry is made as to how to get to the station site. As a SPECIAL NOTE for the user, do not key a carriage return <cr> until the the "Point of Beginning" statement has been finished. If more lines of text are needed to describe it, they will be allowed only by typing to the end of the text line. Once the end of the text line has been passed, the program will record the current line of text and reprompt for another new line of text. After the "Point of Beginning" has been completly described, type a comma "," and then touch carriage return <cr>. This will complete the first section of the "TO REACH MARK" paragraph.

```
TO REACH THE STATION FROM THE INTERSECTION OF U.S. HIGHWAY 435 AND <++>
INTERSTATE HIGHWAY 70 LOCATED NORTH OF THE VILLAGE OF GREENWICH,   <cr>
```

The second section of the paragraph is made up of a set of "To Reach Instructions", where each instruction has five parts to it. All five parts of an instruction is constructed by completing each one of the items listed:

```
First  -  An instructive course of ...ACTION...,
Second -  A cardinal ... DIRECTION ... to follow,
Third  -  A measured ... DISTANCE ... to indicate the length of travel,
Fourth -  A description of the ... ROUTE ... used or path traveled on, and
Fifth  -  A description of the ... TERMINUS ... point for this instruction.

ACTION..    GO
DIRECTION..    EAST FOR
DISTANCE..              1 KM (0.6 MI) ON
ROUTE..                                HIGH STREET
TERMINUS..                                         TO A CROSSROAD,    <cr>
```

The above example shows the order-of-entry for one set of "To Reach Instructions". The user will be prompted for each of the five different parts one at a time.

The ACTION part of the "To Reach Instruction" will appear on the screen as follows:

```
-   (Stop/Go/Turn/Continue/Follow/Using)
```

The user must select and key one of the options --S, G, T, C, F, or U-- and then type a carriage return <cr>. The list below will explain which option should be selected and what type of response will be expected from the user.

```
S  - Stop .. and exit the cycle of "To Reach Instructions"
G  - GO ..
T  - TURN (Left/Right) AND GO ..
C  - CONTINUE STRAIGHT AHEAD AND GO ..
F  - FOLLOW THE (Left/Middle/Right) FORK AND GO ..
U  - USING THE -(FIRST/SECOND/THIRD etc.) FROM THE LEFT- FORK AND GO..
```

The DIRECTION part of the "To Reach Instruction" will appear on the screen as follows:

```
?   (North/South/East/West)
```

To this prompt, the user must first select one of the four cardinal points of the compass listed. The program will then prompt the user to decide whether or not to continue entering one of the other possible 16 inter-cardinal points of the compass or just skip to the next prompt by keying a <cr>.

The DISTANCE part of the "To Reach Instruction" will appear on the screen as follows:

```
-   (Meters/Km/Cm)     K <cr> for Kilometers
```

The user must now supply both the Metric distance and the English equavelent. These two entries are keyed as characters of text, therefore the program makes no attempt to check the arithmetic correctness of the two distances.

```
1 <cr>        and the program prints  1 KM (----

0.6 <cr>      and the program prints  1 KM (0.6 MI) ON
```

The ROUTE and TERMINUS part of the "To Reach Instruction" will appear on the screen as free form text as follows:

```
GO EAST 1 KM (0.6 MI) ON ------------------------------------------
```

The user must at this point, give a description of the ROUTE on which the travel was made and then describe the end or TERMINUS point of this "To Reach Instruction." This concludes a single (five-part entry) instruction. The program will reprompt the user to again select an "ACTION". To STOP the cycle just type a S <cr>.

The following shows both sections of a completed "TO REACH MARK" paragraph. The lines of text that overflowed while typing are indicated by <++>. Those lines of text which made a complete statement were ended by typing a period "." or a comma "," and then a carraige return <cr>.

```
TO REACH THE STATION FROM THE INTERSECTION OF U.S. HIGHWAY 435 AND <++>
INTERSTATE HIGHWAY 70 LOCATED NORTH OF THE VILLAGE OF GREENWICH,   <cr>
GO NORTH FOR 8 KM (5 MI) ON U.S. HIGHWAY 439 TO U.S. HIGHWAY 459,  <cr>
TURN LEFT AND GO WEST FOR 7.9 KM (4.9 MI) ON U.S. HIGHWAY 459 TO A <++>
PAVED CROSSROAD (COUNTY ROAD 201) USED AS A POINT OF REFERENCE,    <cr>
CONTINUE STRAIGHT AHEAD AND GO WEST FOR 0.6 KM (0.4 MI) ON U.S.    <++>
HIGHWAY 459 TO THE STATION ON THE NORTH SIDE OF THE HIGHWAY ON TOP <++>
OF A GRASSY KNOB.                                                  <cr>
$
```

"STATION/BENCH MARK", this paragraph is a detailed description of the type of monument or marker established at the location site and describes where to find it. The paragraph is divided into two or three sections. The first section describes, the type of marker used, the exact name or designation stamped on the it, a description as to the monument's size and shape, and how the marker was set. The second section contains a list of any local reference measurements (at least two) which were made to help recover the station monument and it's marker at a later date. The third section describes the underground monument and its marker if one was set. Once this paragraph has been selected the user is asked whether or not the program prompts are to be used by:

```
SKIP THE PROMPTS (Y/N)?                                    N
```

If the prompts are omitted with a "Y" YES response, the user is in a free form text entry. In this mode of text entry, the user must make sure the data keyed are correct and conform to the formats setforth in the "Input Formats and Specifications of the NGSDB". However, with a "N" NO response the program will flash to the screen the "Optional Partially Coded Text" headings.

One of the following prompts will appear for the "STATION/BENCH MARK" paragraph depending of the "Mark Code" coded by the STRNAM Command. If the "Mark Code" was coded anything other than a "D" (any Survey Disk) or "L" (Landmark) the user will be in free form entry. The "L" code will flash the two-digit landmark code to the screen to help the user describe it.

```
THE STATION IS A STANDARD NGS DISK.....CHANGE (Y/N)?       N <cr>

THE LANDMARK IS ----------------------------------------------------
```

THE STATION IS ----------

Next, if the station is not a "L" (Landmark Code), the program will prompt the user the following:

MARK IS ---UNSTAMPED--- (Y/N)? N <cr>

To which the program will respond with

STAMPED--- ?

the user then keys the stamping as it appears on the marker, that is, e.g.:

BOLT 1980 <cr>

the program will then finish the stamping prompt as shown below and go to the next item.

STAMPED---BOLT 1980---,

After the stamping prompt, the program will flash to the screen the "Setting Code" for the marker, if it has been coded as one of the following.

D08 - SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
D09 - SET INTO THE TOP OF A SQUARE CONCRETE MONUMENT
D04 - SET INTO THE TOP OF AN IRREGULAR MASS OF CONCRETE
D55 - SET INTO A DRILL HOLE IN ROCK OUTCROP.
D65 - SET INTO A DRILL HOLE IN A ROCK LEDGE.
D75 - SET INTO A DRILL HOLE IN A BOULDER.
D05 - SET INTO A DRILL HOLE IN BEDROCK.
D80 - SET INTO PARTIALLY EXPOSED BOULDER xxx LARGEST DIMENSION.

At this point, if either "D08" or "D09" were coded with the STRNAM Command, the program will prompt the user to complete the following statement:

- (Meters/Km/Cm)

only a "C" can be used. The line of text now appears as:

-----FIRST ENTER CM

This will allow the user to enter the width or diameter of the monument, be sure the entry is made in centimeters only. Type a dimension say, e.g. 30 <cr>, the program will respond as follows for a "ROUND" (D08) monument:

30 CM IN DIAMETER -

or for a "SQUARE" (D09) monument by:

30 CM ON SIDE -

The "-" dash at the end of each statement above is for the next and last prompt for the first section of the paragraph. The full prompt displayed will be:

- (Flush/Projecting/Recessed)

The user must now describe the relationship of the monument with respect to the surronding ground around it. One of the three options appearing below must be selected and followed by a carriage return <cr>.

F - FLUSH WITH GROUND. LOCATED
P - PROJECTING xxxxx CM ABOVE GROUND. LOCATED
R - RECESSED xxxxx CM BELOW GROUND. LOCATED

The word "LOCATED" is added by the program to prefix the beginning of the second section of the paragraph. This will complete the first section of the "STATION/BENCH MARK" paragraph.

THE STATION IS A STANDARD NGS DISK
STAMPED---BOLT 1980---,
SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
30 CM IN DIAMETER FLUSH WITH GROUND. LOCATED

The second section of the paragraph contains all the "Local Reference Measurements" listed one after another. Each "Local Reference Measurement" is a three-part instruction. Every instruction is constructed by completing the following basic list of items:

First - A measured ... DISTANCE ... from a local object to the mark,
Second - A cardinal ... DIRECTION ... to follow from the local object, and
Third - A description of local ... OBJECT ... from which it was measured.

DISTANCE.. 37.5 METERS (123 FT)
DIRECTION.. EAST FROM
OBJECT.. A POWER POLE, <cr>

The above example shows the order-of-entry for one set of "Local Reference Measurement" instructions. The user will be prompted for each of the three different parts one at a time.

The DISTANCE part of the "Local Reference Measurement" will appear on the screen as follows:

- (Meters/Km/Cm) M <cr> for Meters

The user must now supply both the Metric distance and the English equavelent. These two entries are keyed as characters of text, therefore the program makes no attempt to check the arithmetic correctness of the two distances.

4.6 <cr> the program prints 4.6 METERS (----

15 <cr> and the program prints 4.6 METERS (15 FT) -

The DIRECTION part of the "Local Reference Measurement" will then appear on the screen as follows:

? (North/South/East/West)

To this prompt, the user must first select one of the four cardinal points of the compass listed. The program will then prompt the user to decide whether or not to continue entering one of the possible 16 inter-cardinal points of the compass or just skip to the next prompt by keying another <cr>.

N <cr> <cr>

The OBJECT part of the "Local Reference Measurement" will appear on the screen as follows:

4.6 METERS (15 FT) NORTH FROM - (A/aN/The)

The user must at this point select an article, then give an accurate description of the OBJECT (from which) the "Local Reference Measurement" was made to the station mark. This concludes one single three-part entry. The program will prompt the user to continue or

STOP (Y/N) ?

To stop the cycle and get out of this set of prompts, type a "Y" YES <cr>.

The program will now prompt the user for the third and last section of this paragraph, that is, to describe the underground mark if one exists by the following:

UNDERGROUND MARK (Y/N)? <cr>

The following lines show two sections of a completed "STATION/BENCH MARK" paragraph. The lines of text that overflowed while typing the second section are indicated by <++>. Those lines of text which make a complete statement were ended by typing a "," comma or a "." period, and then a carraige return <cr>.

```
THE STATION IS A STANDARD NGS DISK
STAMPED---BOLT 1980---,
SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
30 CM IN DIMETER FLUSH WITH GROUND.  LOCATED
37.5 METERS (123 FT) EAST FROM A POWER POLE,                          <cr>
27.1 METERS (89 FT) SOUTHWEST FROM THE SOUTHWEST CORNER LEG OF A      <++>
STEEL WINDMILL,                                                       <cr>
15.2 METERS (50 FT) NORTH FROM THE CENTER OF U.S. HIGHWAY 459, AND <cr>
4.6 METERS (15 FT) NORTH FROM A RIGHT-OF-WAY FENCE LINE.              <cr>
$
```

"REFERENCE OBJECTS (RMs)" paragraph(s), these paragraphs are detailed descriptions of the type of monuments and markers established at the reference mark location sites and describes where to find them. Each paragraph is divided into three sections. The first section describes the type of marker used, the exact name or designation stamped on the it, a description as to the monument's size and shape, and how the marker was set. The second section contains a list of any local reference measurements (at least two) made to help recover the reference monument and it's marker at a later date. The third section describes the relationship of the reference mark in elevation to the station mark.

```
  +-------------------------------------------------------------------------+
01|          "ORIGINAL"    DATA ENTRY ----  GETTXT     HORIZONTAL STATION     |
   ...
05|                                                                         |
06|       ENTER PARAGRAPH TEXT FOR REFERENCE OBJECT (RM)     (Y/N)? Y        |
07|                                                                         |
08|       -SPN- FOR ... THE MARKS                                           |
09|                                                                         |
10|          84 --- BOLT RM 2                                               |
11|          83 --- BOLT RM 1                    ENTER A RM (Y/N)? Y        |
12|                                              CHANGE SPN (Y/N)? N        |
13|                                                                         |
   .....
24|       CHANGE--SCREEN INFORMATION (Y/N)? Y                               |
  +-------------------------------------------------------------------------+
```

Figure (7.06) ---- GETTXT Paragraph Reference Object (RMs) Screen

The program will accept up to but not more than seven (7) Reference Objects per station. To see the DES File record for this data entry, see Section 3.2.5 Format "RECORD RO". This record in the DES File keeps track of which SPN's were selected for the reference marks and sorts them in numerical order as to SPN. That is say e.g., SPN=84 (reference mark BOLT RM 2) was entered first then SPN=83 (reference mark BOLT RM 1) was entered, the program would then reorder it's list so that SPN=83 was first and then SPN=84 second. This way, when the description is printed with the BBKDES Command, reference marks will be in order of SPN.

As a SPECIAL NOTE for the user, in order to have reference marks listed in numerical order on the printed station description, be sure to store the reference marks in numerical order with the STRNAM Command.

SPN --	NAME OF MARK (Entered with STRNAM)
82	BOLT
83	BOLT RM 1
84	BOLT RM 2
85	BOLT AZ MK

Once this paragraph has been selected the user is asked whether or not the program prompts are to be used:

```
SKIP THE PROMPTS (Y/N)?                                          N
```

If the prompts are omitted with a "Y" YES response, the user is in a free form text entry. In this mode of text entry, the user must make sure the data keyed are correct and conform to the formats setforth in the "Input Formats and Specifications of the NGSDB". However, with a "N" NO response the program will flash to the screen the "Optional Partially Coded Text" headings.

On the screen, see Figure (7.06), the user is first prompted to enter the SPN for the reference mark to be described. Once selected the program will flash the SPN name to the screen and ask the user if it is correct before it will continue:

83 --- BOLT RM 1 CHANGE (Y/N)? N

The initial reference object prompt is used to describe the type of reference monument and it's number by the following:

REFERENCE - (Mark/Point/Object)

where the user must key a -M, P, or O- and touch carraige return <cr>.

M <cr>

REFERENCE MARK NO. --

1 <cr>

REFERENCE MARK NO. 1

The following prompts will then appear for the "REFERENCE OBJECT (RMs)" paragraph depending on how the "Mark Code" was entered by the STRNAM Command.

REFERENCE MARK NO. 1 IS A STANDARD NGS DISK.....CHANGE (Y/N)? N <cr>

MARK IS ---UNSTAMPED--- (Y/N)? N <cr>

To which the program will respond with

STAMPED--- ?

the user must key the stamping as it appears on the marker, that is, e.g.:

BOLT NO 1 1980 <cr>

the program will then finish the stamping prompt as shown below and go to the next item.

STAMPED---BOLT NO 1 1980---,

After the stamping prompt, the program will flash to the screen the "Setting Code" for the marker and continue as in the same patterns used for the "STATION" paragraph.

At this point, if either "D08" or "D09" were coded with the STRNAM Command the program will prompt the user to complete the following statement for the diameter of the monument or the length of the side dimension:

- (Meters/Km/Cm)

only a "C" can be used. The line of text now appears as:

-----FIRST ENTER CM

This is to allow the user to enter the width or diameter of the monument, be sure the entry is made in centimeters only. Type a dimension say, e.g. 30 <cr>, the program will respond as follows for a "ROUND" (D08) monument:

30 CM IN DIAMETER - (Flush/Projecting/Recessed)

The "-" dash at the end of the statement above is for the next and last prompt for the first section of the paragraph. The user must now describe the relationship of the monument with respect to the surronding ground around it. One of the three options appearing below must be selected and followed by a carriage return <cr>.

F - FLUSH WITH GROUND. LOCATED
P - PROJECTING xxxxx CM ABOVE GROUND. LOCATED
R - RECESSED xxxxx CM BELOW GROUND. LOCATED

R <cr>

30 CM IN DIAMETER RECESSED - (Meters/Km/Cm)

and then key the dimension if any by the following:

C <cr> 4 <cr>

30 CM IN DIAMETER RECESSED 4 CM BELOW GROUND. LOCATED

The word "LOCATED" is added automatically by the program to prefix the beginning of the second section of the paragraph. This will complete the first section of the "REFERENCE OBJECTS (RMs)" paragraph and it appears as follows:

REFERENCE MARK NO. 1 IS A STANDARD NGS DISK
STAMPED---BOLT NO 1 1980---,
SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
30 CM IN DIAMETER RECESSED 4 CM BELOW GROUND. LOCATED

The second section of the paragraph contains all the "Local Reference Measurements" listed one after another. Each "Local Reference Measurement" is a three-part instruction that is constructed just as they were in the "STATION" paragraph. As many instructions as needed can be entered. After each instruction the user is prompted whether or not to stop by:

STOP (Y/N) ?

To stop the cycle and get out of this set of prompts, type a "Y" YES <cr>.

The program will now prompt the user for the third and last section of the paragraph, that is, to describe the relationship between the reference mark and the station mark in elevation to each other by the following:

MARK IS - (Above/Below/Level)

The user must select one -A, B, or L- and touch carriage return <cr>.

B <cr> the program prints

- (Meters/Km/Cm)

```
M <cr>        0.5 <cr>
```

and then the program completes the statement as follows:

```
MARK IS 0.5 METERS BELOW THE STATION.
```

This completes the last section of this paragraph. The following lines of text show all three sections of a completed "REFERENCE OBJECT (RMs)" paragraph. The lines of text which overflowed while typing the second and third sections are indicated by <++>. Those lines of text which made a complete statement were ended by typing a "," comma or a "." period, and then a carraige return <cr>.

```
REFERENCE MARK NO. 1 IS A STANDARD NGS DISK
STAMPED---BOLT NO 1 1980---,
SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
30 CM IN DIAMETER RECESSED 4 CM BELOW GROUND.  LOCATED
27.1 METERS (89 FT) SOUTH-SOUTHWEST FROM THE SOUTHWEST CORNER OF   <++>
SOUTHWEST LEG OF A STEEL WINDMILL,                                 <cr>
9.8 METERS (32 FT) NORTH FROM THE CENTERLINE OF U.S. HIGHWAY 459,  <cr>
0.9 METERS (3 FT) WEST FROM A POWER POLE, AND IN THE EAST-WEST     <++>
RIGHT-OF-WAY FENCE LINE.                                           <cr>
MARK IS 0.5 METERS BELOW THE STATION.
$
```

"AZIMUTH -(MAIN/SECOND/THIRD)- MARK" paragraph, this paragraph is a detailed description of the type of monument and marker established at the azimuth location site and describes where and how to find it. The paragraph is divided into three or four sections. The first section describes the type of marker used, the exact name or designation stamped on the it, a description as to the monument's size and shape, and how the marker is set. The second section contains a list of any local reference measurements (at least two) made to help recover the azimuth monument and it's marker at a later date. The third section is the same as the "TO REACH MARK" paragraph described above. However, it describes instead how to locate the azimuth mark from the station loction site. The fourth section describes the azimuth underground monument and it's marker if one is set. Once this paragraph has been selected the user is asked whether or not the program prompts are to be used:

```
SKIP THE PROMPTS (Y/N)?                                    N
```

If the prompts are omitted with a "Y" YES response, the user is in a free form text entry. In this mode of text entry, the user must make sure the data keyed are correct and conform to the formats setforth in the "Input Formats and Specifications of the NGSDB". However, with a "N" NO response the program will flash to the screen the "Optional Partially Coded Text" headings.

The first prompt to the user is as follows:

```
-SPN- FOR  ... THE AZIMUTH
```

to which, the user must select the SPN for the aziumth to be described. Once selected the program will flash the SPN name to the screen and ask the user if it is correct before continuing:

85 --- BOLT AZ MK CHANGE (Y/N)? N

The initial azimuth prompt is used to describe the type of monument used and it is determined by:

AZIMUTH - (Mark/Point/Object)

where the user must key a -M, P, or O- and touch carraige return <cr>.

M <cr>

AZIMUTH MARK NO. --

and it's number is keyed by:

1 <cr>

AZIMUTH MARK NO. 1

The following prompt will appear for the "AZIMUTH MARK" paragraph depending of the "Mark Code" coded by the STRNAM Command.

AZIMUTH MARK NO. 1 IS A STANDARD NGS DISK.....CHANGE (Y/N)? N <cr>

MARK IS ---UNSTAMPED--- (Y/N)? N <cr>

To which the program will respond with

STAMPED--- ?

the user must key the stamping as it appears on the marker, that is, e.g.:

BOLT AZ MK 1980 <cr>

the program will then finish the stamping prompt as shown below and go to the next item.

STAMPED---BOLT AZ MK 1980---,

After the stamping prompt, the program will flash to the screen the "Setting Code" for the marker in the same patterns as were used for the "STATION" paragraph.

At this point, if either "D08" or "D09" were coded with the STRNAM Command the program will prompt the user to complete the following statement for the diameter of the monument or the length of the side dimension:

- (Meters/Km/Cm)

only a "C" can be used. The line of text now appears as:

-----FIRST ENTER CM

This is to allow the user to enter the width or diameter of the monument, be sure the entry is made in centimeters only. Type a dimension say, e.g. 29

<cr>, the program will respond as follows for a "ROUND" (D08) monument:

29 CM IN DIAMETER - (Flush/Projecting/Recessed)

The "-" dash at the end of the statement above is for the next and last prompt for the first section of the paragraph. The user must now describe the relationship of the monument with respect to the surronding ground around it. One of the three options appearing below must be selected and followed by a carriage return <cr>.

F - FLUSH WITH GROUND. LOCATED
P - PROJECTING xxxxx CM ABOVE GROUND. LOCATED
R - RECESSED xxxxx CM BELOW GROUND. LOCATED

P <cr>

29 CM IN DIAMETER PROJECTING - (Meters/Km/Cm)

and the dimension is keyed if one by the following:

C <cr> 13 <cr>

29 CM IN DIAMETER PROJECTING 13 CM ABOVE GROUND. LOCATED

The word "LOCATED" is added by the program to prefix the beginning of the second section of the paragraph. This will complete the first section of the "AZIMUTH MARK" paragraph.

AZIMUTH MARK NO. 1 IS A STANDARD NGS DISK
STAMPED---BOLT AZ MK 1980---,
SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
29 CM IN DIAMETER PROJECTING 13 CM ABOVE GROUND. LOCATED

The second section of the paragraph contains all the "Local Reference Measurements" listed one after the other. Each "Local Reference Measurement" is a three-part instruction is constructed just as they were in the "STATION" paragraph. As many instructions as needed can be entered. After each instruction the user is prompted to stop or not by:

STOP (Y/N) ?

To stop the cycle and get out of this set of prompts, type a "Y" YES <cr>.

The program will, at this point, prompt the user to enter a "TO REACH MARK" paragraph for the azimuth. The "To Reach" description is entered the same way as given in the above "To Reach" paragraph for the station. The first prompt of section three is as follows:

TO REACH THE AZIMUTH FROM THE STATION,
- (Stop/Go/Turn/Continue/Follow/Using) ?

This sequence of prompts will be continued until the azimuth mark location site has been reached. The order-of-entry is the same as that given for the "To Reach" of the station.

The program will now prompt the user for the fourth and last section of the paragraph, that is, to describe the underground mark if one exists by the following:

```
UNDERGROUND MARK (Y/N)?                                    Y <cr>
```

To which the program responds with

```
THE UNDERGROUND MARK IS A STANDARD NGS DISK...CHANGE (Y/N)  N <cr>

STAMPED--- ?
```

After the stamping prompt, the user is asked to select the type of "Setting Code" for the marker by:

```
- (Ground/Rock/Boulder/Concrete) ?
```

Where the four options have the following meanings:

```
G  - IMBEDDED IN THE GROUND,
R  - SET INTO BEDROCK,
B  - SET INTO A BOULDER, or
C  - SET INTO AN IRREGULAR MASS OF CONCRETE
```

For this example, a "C" was keyed and the program will flash the following to the screen:

```
SET INTO AN IRREGULAR MASS OF CONCRETE -  (Meters/Km/Cm)

M <cr>        1.1 <cr>
```

and the program will complete the statement by printing the following:

```
SET INTO AN IRREGULAR MASS OF CONCRETE 1.1 METERS BELOW THE SURFACE.
```

This completes the fourth and last section of the azimuth paragraph. The following lines show all four sections of a completed "AZIMUTH MARK" paragraph. The lines of text that overflowed while typing the third and fourth sections are indicated by <++>. Those lines of text which made a complete statement were ended by typing a "," comma or a "." period, and then a carraige return <cr>.

```
AZIMUTH MARK NO. 1 IS A STANDARD NGS DISK
STAMPED---BOLT AZ MK 1980---,
SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
29 CM IN DIAMETER PROJECTING 13 CM ABOVE GROUND.  LOCATED
19.0 METERS (62.3FT) SOUTH FROM A POWER POLE WITH TAG NUMBER 332,  <cr>
9.6 METERS (32 FT) WEST FROM THE CENTERLINE OF COUNTY ROAD 201, AND<cr>
0.1 METERS (0.3 FT) WEST FROM THE NORTH-SOUTH FENCE LINE.          <cr>
TO REACH THE AZIMUTH FROM THE STATION,
GO EAST FOR 0.6 KM (0.4 MI) ON U.S. HIGHWAY 459 TO THE POINT OF    <++>
REFERENCE AT COUNTY ROAD 201,                                      <cr>
GO SOUTH FOR 0.8 KM (0.5 MI) ON COUNTY ROAD 201 FROM THE POINT OF  <++>
REFERENCE TO THE AZIMUTH MARK ON THE RIGHT, WEST SIDE, OF COUNTY   <++>
ROAD 201 NEXT TO THE FENCE LINE.                                   <cr>
```

```
THE UNDERGROUND MARK IS A STANDARD NGS DISK
STAMPED---BOLT AZ MK 1980---,
SET INTO AN IRREGULAR MASS OF CONCRETE 1.1 METERS BELOW THE SURFACE.
$
```

"ADDITIONAL TEXT" or "BM ADDITIONAL TEXT" paragraphs are very simular, as they both are free form text entry. However upon the first entry into the horizontal "ADDITIONAL TEXT" paragraph, the program will prompt the user whether or not a height of light shown above the station is to be entered by flashing this message to the screen:

```
SKIP HEIGHT OF LIGHT (Y/N)?                                    N
```

If the reply is "Y" YES, the user is in free form test entry. The reply "N" NO will cause the program to prompt the user to enter a height of light shown above the station. The completed statement is as follows:

```
HEIGHT OF LIGHT SHOWN WAS 31.4 METERS ABOVE THE MARK.
```

The user is then asked if a new paragraph is to be started by:

```
START A NEW PARAGRAPH (Y/N)?                                   Y
```

If the reply is "Y" YES, the program will insert the paragraph marker "+" on the screen to indicate a break between this text and the beginning of the new paragraph. After the entry of each line of text, the user is asked to stop or continue. When the entry is stopped, the program will insert an end-of-text termination flag "$$" after the last line of text keyed. A sample paragraph, where both paragraph markers were used is shown below:

```
HEIGHT OF LIGHT SHOWN WAS 31.4 METERS ABOVE THE MARK.
+
DESCRIBED BY R.W. SMITH.
$$
```

7.4 Change Descriptive Text Created by GETTXT

The MTEN Command is the same GETTXT. To enter the program type GETTXT <cr>. The same prompts must be entered as if GETTXT were being entered the very first time. However, when a paragraph type has been selected, see Figure (7.05), the screen will appear as shown on Figure (7.07). Notice the upper left corner of the screen, it is in the alters or "CHANGE" mode. The first line of desriptive text will appear on the screen and the user must respond to the following question:

```
CHANGE
(Y/N)?

  N <cr>
```

A simple <cr> NO reply will step the program to flash the next or second line of text to the screen. This procedure must be continued until all lines of text for the paragraph have listing on the screen.

```
   +-------------------------------------------------------------------------+
01 |CHANGE   "ORIGINAL"     DATA ENTRY ----  GETTXT       HORIZONTAL STATION  |
02 |(Y/N)?                 ------------------------------                    |
03 |       SURVEY POINT NUMBER/STANDPOINT/SPN (NNN)?  82                      |
04 |       STATION NAME---                    BOLT                            |
05 |                                                                          |
06 |       ENTER PARAGRAPH TEXT FOR GENERAL LOCATION            (Y/N)? Y      |
07 |                                                                          |
08 |  N    THE STATION IS LOCATED ABOUT 12 KM (7.5 MI) NORTHWEST OF THE       |
09 |  N    VILLAGE OF GREENWICH,                                              |
10 |  Y    3 KM (1.9 MI) NORTH OF THE TOWN OF WALLNUT RIDGE,                  |
11 |                                                                          |
12 |                                                                          |
13 |  D      (Delete/Replace/Insert)a character (Create/Scratch)a line        |
14 |                                                                          |
15 |  ?      STOP (Y/N)?                                                      |
16 |                                                                          |
   ....
23 |                                                                          |
24 |       CHANGE--SCREEN INFORMATION (Y/N)  Y                                |
   +-------------------------------------------------------------------------+
```

Figure (7.07) ---- "CHANGE" Screen for GETTXT

If however, the user makes a "Y" YES reply to the question, the program will prompt the following statement:

```
?   (Delete/Replace/Insert)a character (Create/Scratch)a line
```

The user must select one of the options --D, R, I, C, or S--, key it and type a carriage return <cr>. The options and what the user can do are listed below:

D - Delete a single character in the current text line,
R - Replace a single character in the current text line,
I - Insert a single character in the current text line,
C - Create a whole new text line (just after the current line), and
S - Scratch (remove from the paragraph text) the current text line.

As soon as either a "D", "R", or "I" and a <cr> has been typed, the program will flash to the screen the marker "^" just below the first character in the current line of text. For an example, say a "D" was keyed as shown by Figure (7.07), then the program will reprompt the user, is this the character to be deleted?

```
CHANGE
(Y/N)?

  N <cr>
```

If it is the character to be deleted, then type "Y" YES and it will be removed from the current line of text on the screen, or if not key a <cr> and the "^" marker will move right one space to the next character. To continue, moving to the right, just touch carriage return <cr> as many times as needed to place the "^" marker just below the desired character to be deleted. Then touch the carriage return <cr> a second time. See Figure (7.07) and the line of text below, where the "^" marker is located on line 11 of the screen and just below the first character "L" of the word "WALLNUT":

```
        3 KM (1.9 MI) NORTH OF THE TOWN OF WALLNUT RIDGE,
                                           ^

    Y   STOP (Y/N)?
```

Only a single character deletion is made by the "Y" YES reply, if however, more characters are to be deleted to the right of the "^" marker, just continue touching the carriage return <cr> key and one-by-one a character at a time will be deleted.

Once the text editing for this line has been completed, the program will display the current status of the edited line. At this point, the user will be returned to the initial prompt:

```
CHANGE
(Y/N)?

  N <cr>
```

If the line is now correct, touch carriage return <cr> to continue to the next line of the paragraph. To exit the program the user must step though each line of text until the program finds an end-of-paragraph or an end-of-text termination marker.

Computational Commands

8.1 WRKAST Introduction

The MTEN Command WRKAST (WoRK an ASTronomic azimuth) is the only method by which previously entered astronomical observations can be calculated. Each astronomic azimuth "AST" abstract (one observer and instrument) is entered by using GETABS to record the Standpoint SPN information about that date of occupation. The actual observations, that is, the pointings on the mark station, star, recorded times, and the bubble readings or instrument dislevelment, are entered by using the two commands ABSAST + GETAST. Before the actual computations of an astronomic azimuth can be performed, additional information must be made available. This information is data dependent and thus, can be calculated. The following programs will have to be run in sequence:

1. ASTCHK -- Corrects the observed time signal and local chronometer observations.

2. ASTTME -- Computes local apparent sidereal time (LAST).

3. ASTRAD -- Computes right ascension and declination of star the for each (D/R) pointing

WRKAST can combine up to six astronomic azimuth "AST" abstracts. The limit for a single "AST" abstract is no more than 25 observations. While the total number of observations on all six "AST" abstracts can not exceed 100 meaned (D/R) pointings. The program will rework all the "AST" abstracts and print the statistics for each individual group (single "AST" abstract) and the statistics for the grand mean (all groups combined).

8.1.1 ASTCHK

The MTEN Command ASTCHK (ASTronomic azimuth CHecK) will use the data entered by GETABS, ABSAST, and GETAST to compute the corrections to be applied to the observed times. The two corrections which ASTCHK can apply are, the (UT1-UTC) correction to the signal time entered by the user and compute the propagation delay. To enter the program type ASTCHK <cr>. The program will load the ASTCHK entry to the screen, see Figure (8.01). The first prompt made by the program is for the user to select a Standpoint SPN. In the documentation for this command, the Standpoint SPN=30 was selected.

Now that the SPN has been selected, the program will flash to the screen all "AST" abstracts that are available. In this example there are four abstracts which are available and can be worked. The user is then prompted to select which one of the abstacts is to be computed or reworked by the following message:

SET NUMBER/ABS/ (NN)? 4

The fourth abstract, "AST- 4", will be used as an example for the computations shown in this command. A rigorous astronomic azimuth computation requires that the bias in the radio clock time be corrected by appling the (UT1-UTC) correction and the propagation delay of the time signal. Once the radio clock time comparisons have been corrected, the individual observation

times made with the chronometer can be corrected for this bias and the chronometer's drift rate. In general, the (UT1-UTC) correction is not known at the time of observation so it is not applied; but it can be applied easily, at a later date, when it becomes available. The program will prompt the user to enter a value for the (UT1-UTC) correction by:

```
?   UTC CORRN FOR SIGNAL TIME  /SECONDS/  (SN.NNNN)
```

```
+-----------------------------------------------------------------------+
|                        ENTRY     ----  ASTCHK                          |
|                    ------------------------------                     |
|      STANDPOINT NUMBER /SPN/ (NNN)?                          30       |
|      STATION NAME---                  WHITES                          |
|                                                                       |
|  ABSTRACT(S) FOR THIS STATION          SET NUMBER/ABS/ (NN)?   4      |
|                                                                       |
|    ABS  SET  VOL #                                                    |
|    AST-   1  V  28                                                    |
|    AST-   2  V  28                                                    |
|    AST-   3  V  28                                                    |
|    AST-   4  V  28                                                    |
|  ...                                                                  |
|                                                                       |
|  Y    UTC CORRN FOR SIGNAL TIME  /SECONDS/  (SN.NNNN)      -0.21980    |
|                                                                       |
|  N    SIGNAL PROPAGATION DELAY   /SECONDS/  (SN.NNNN)       0.01015    |
|                                                                       |
|  N    CHANGE THE STAR FROM "POLARIS" (Y/N)?                    N      |
|  ...                                                                  |
|      COMPUTE ANOTHER TIME CHECK (Y/N)? N                              |
+-----------------------------------------------------------------------+
```

Figure (8.01) ---- ASTCHK Screen

Daily Values of CIO Pole and (UT1-UTC)

YEAR	MM	DD	MJD	X	Y	(UT1-UTC)
1979	11	07	2444184	0.145	0.365	-0.2145
1979	11	08	2444185	0.146	0.363	-0.2172
1979	11	09	2444186	0.147	0.361	-0.2198
1979	11	10	2444187	0.148	0.359	-0.2225
1979	11	11	2444188	0.149	0.356	-0.2251

Figure (8.02) ---- 1979 Polar Motion (X,Y) and (UT1-UTC) Corrections

A response of "N" NO to the prompt will set the value of the correction to zero. However, if a response of "Y" YES is keyed, the user must enter a value for the (UT1-UTC) correction in seconds of time. The correction is applied by adding it to the radio time, see the listing given by Figure (8.03).

On the other hand, the propagation delay correction will be computed by the program only once (the first time the ASTCHK command is entered) for each "AST" abstract. An internal flag is set within the astronomic data so it will not be computed again the next time ASTCHK is entered unless the following prompt is answered with a "Y" YES. If the following prompt is

answered by "N" NO, the program will flash to the screen the current value of the propagation delay to the screen and continue.

N SIGNAL PROPAGATION DELAY /SECONDS/ (SN.NNNN)

The computation of the propagation delay correction is computed and then applied by adding it to the radio time. The computation for the delay is given by Mueller in the book "Spherical and Practical Astronomy as Applied to Geodesy", page 372.

DT = DIST / VOS

where,

DT = Propagation delay Correction for the Time Signal
DIST = Distance between Transmitting station and the Chronometer
VOS = Velocity of the Transmitting Signal

The VOS is computed by the formula:

VOS = (290.0 - A / (G + B)) km/ms

where,

A = 139.41
B = 2.9
G = (DIST in km) / 1000
S = Inverse distance between stations (in Meters)

Thus the propagation delay correction (in Decimal Hours) becomes:

DT = (S/(290.0 - 139.41/(S/1000000 + 2.9)))/3600000000.0
DT = DT*3600.0 (in Seconds of Time)

As a SPECIAL NOTE to the user, if any of the observed bubble readings or the bubble constant for the instrument were changed or corrected in the programs ABSAST, GETAST or STRJSI, the user must answer "Y" YES to the above prompt in order to have the program update the current "AST" abstract records with these changes. The program will, at this point, start printing the Standpoint occupation information; and just in case the star observed was not Polaris, the program will allow the user to enter the correct star name and FK4 Number by the following:

N CHANGE THE STAR FROM "POLARIS" (Y/N)?

If a different star was observed, it's name can be entered by a "Y" YES response. The program will then prompt the following message:

ENTER THE STAR AND "FK4" NUMBER (20A) ----------

However, if a "N" NO response is made, the program will complete the ASTCHK listing of the Standpoint occupation information as shown by Figure (8.03). All corrections computed by the program or entered by the user in the ASTCHK program will be resaved in the DAT File and will be used later by the commands ASTTME, ASTRAD and WRKAST. When the program ASTCHK is finished the user will see the following statement flash to the screen:

TYPE THE COMMAND ... "ASTTME"

SPN 30

AST 4 WRK

AZIMUTH BY DIRECTION

```
OCCUPIED STATION: WHITES
           STATE: CT
        LATITUDE:   42  00  17.68
       LONGITUDE:   72  43  44.76
            CODE:    4 POSITION
  INSTRUMENT HGT:    0.000 METERS
       ELEVATION:  173.630 METERS
            CODE:    4 HEIGHT
       GEOID HGT:    0.000 METERS

     MARK STATION: TAINTOR
           STATE: CT
      TARGET HGT:   30.512 METERS
       ELEVATION:   56.130 METERS
            CODE:    4 HEIGHT
       GEOID HGT:    0.000 METERS

            STAR:  POLARIS (FK4 - 907)
-------------------------------------------------------------
            DATE:  791108
          SOURCE:  V  28
        OBSERVER:  RLR
       FREQUENCY:  10.0
   SIGNAL STATION:  WWV
CHRONOMETER (JSI):  951
INSTRUMENT SERIAL NO:  74708
  INSTRUMENT (JSI):  121
   INSTRUMENT CODE:  123
      BUBBLE VALUE:  7.321
-------------------------------------------------------------

GREENWICH CIVIL DATE:  791108
SIGNAL PROPAGATION DELAY:  0.0102
        U.T. CORRECTION: -0.2198
```

--- COMPARISON OF RADIO SIGNAL & CHRONOMETER TIME ---

TIC	RADIO + H M S	(DELAY+UT1) (SEC)	(SEC)	= SIGNAL H M S	CHRONOMETER H M S	CLOCK CORRN H M S	DRIFT RATE (SEC/HR)
1	22 50 00.00	.010	-.220	= 22 49 59.79	22 49 59.90	- 00 00 00.11	0.000
2	23 51 00.00	.010	-.220	= 23 50 59.79	23 50 59.90	- 00 00 00.11	0.000
3	24 46 00.00	.010	-.220	= 24 45 59.79	24 45 59.90	- 00 00 00.11	0.000

Figure (8.03) ---- Azimuth Observation (Time & Chronometer Comparison)

8.1.2 ASTTME

The MTEN Command ASTTME (ASTronomic TiME computation) will use the data entered by GETABS, ABSAST, and GETAST to compute the Local Apparent Sidereal Time (LAST). The program will then, compute the correct radio times by appling the corrections entered by ASTCHK, compute the chronometer drift rate, and apply it to each observed time for all the observations contained in the current "AST" abstract. To enter the program type ASTTME <cr>. The program will load the ASTTME entry to the screen. The first prompt made by the program is for the user to select a Standpoint SPN, e.g. the Standpoint SPN=30 was selected. However, before the program will continue, the following prompt must be answered:

HAS ... "ASTCHK" ... BEEN COMPLETED (Y/N)? Y

Now that the SPN has been selected and ASTCHK completed, the program will flash to the screen all "AST" abstracts that are available. In this example there are four abstracts which are available and can be worked. The user is then prompted to select which one of the abstacts is to be computed or reworked by the following message:

SET NUMBER/ABS/ (NN)? 4

The "AST" abstract selection (SET NUMBER) is also an entry point to the program. After the abstract has been completed the user will be prompted to select another ASTTME abstract for this Standpoint SPN, if so selected, the user will be allowed to reenter the program at the current Standpoint SPN location and to continue to execute computations for other "AST" abstracts by selecting a new "SET NUMBER".

The fourth abstract, "AST- 4" see Figure (8.01), will be used as an example for the computations shown in this command. At this time the program will read the records for the DAT File in order to get the corrections to be applied to the radio times and flash these corrections to the screen for a few seconds.

UTC CORRN FOR SIGNAL TIME /SECONDS/ (SN.NNNN) -0.21980

SIGNAL PROPAGATION DELAY /SECONDS/ (SN.NNNN) 0.01015

After the two corrections have been flashed to the screen, the user is prompted to select which star was used by the following message:

N CHANGE THE STAR FROM "POLARIS" (Y/N)?

The normal reply is "N" NO or <cr>, which will allow the program to continue by using the default parameters AO (Right Ascension) and DO (Declination) for the star "POLARIS" for the 1950.0 Epoch as follows:

AO	=	1 Hour	48 Minutes	48.784	Seconds	(1950.0 Epoch)
DO	=	89 Degrees	1 Minute	43.74	Seconds	(1950.0 Epoch)

With the following proper motion values (MU and MU') used for AO and DO:

UO (MU) = +18.107 Seconds of Time / Century

U1 (MU') = -0.43 Seconds of Arc / Century

However, if POLARIS the default star is not selected, the following prompts will flash to the screen:

```
        ENTER "FK4 STAR PARAMETERS" FOR EPOCH 1950.0
STAR RIGHT ASCENSION/HMS/ (NN,NN,NN.NNN)
STAR DECLINATION    /DMS/ (NN,NN,NN.NNN)

        PROPER MOTION        COMPONENTS
MU  (R.A.)  /SECONDS,HMS/      (SNN.NNN)
MU' (DEC.)  /SECONDS,DMS/      (SNN.NNN)
```

To which the user must enter the FK4 Star Parameters of the star selected for the Epoch 1950.0.

Now that the star has been selected, the program will enter a repetitive process, by which, all pointings both D/R are computed one-by-one until the "AST" abstract is completed. The first computation made for each pointing, is to correct the observed chronometer time for the clock offset (BIAS) and then chronometer drift between two consecutive clock comparisons. The Radio Signals of the transmitting station have been corrected for (UT1-UTC) and propagation delay, therefore the Greemwich Civil Time (GCT) is available and a Clock BIAS can be computed by:

BIAS = GCT(1) - CHT(1) (in Hours)

Where

GCT(1) = Corrected Radio Signal for the First Time Check
CHT(1) = Observed (Chronometer) Time at the first Radio Time Check

and

BIAS = The Chronometer Offset

Then the drift for the chronometer (DRIFT) can be computed by:

DRIFT = (GCT(2) - CHT(2)) - BIAS (in Hours)

where,

GCT(2) = Corrected Radio Signal for the Next Time Check
CHT(2) = Observed (Chronometer) Time at the Next Radio Time Check

and

DRIFT = Total Drift of the Chronometer

and the difference in time (DELT) between time checks is computed by:

DELT = GCT(2) - GCT(1) (in Hours)

Now the clock drift rate (CLKRTE), between the two time checks, can be computed by th following:

CLKRTE = DRIFT / DELT (in Hours)

A correction (CORRN) to be applied to each D/R pointing observed time (T) can be computed by finding the length of time between the beginning time check and the time of observation, and then applying the clock drift rate to it:

CORRN = CLKRTE*(T - CHT(1)) (in Hours)

Thus the Universal Time (UTDR) for each pointing is as follows:

UTDR = T + BIAS + CORRN

The program will continue to loop back to the beginning of this repetitive process until all the pointings on this "AST" abstract are completed. During this process the following message will flash to the screen as the computations are executed:

WAIT COMPUTING "APPARENT SIDEREAL TIME" DIRECT / REVERSE

Along with the D/R message, the program will also flash to the screen the position number being computed. At the completion of this repetitive process, the following prompt will flash to the screen:

COMPUTE ANOTHER "ASTTME" /AST/ (Y/N)? Y

A reply of "N" NO will end the program for the current Standpoint SPN. However, a reply of "Y" YES will return the program to the entry point mentioned above and force the user to answer the following prompt:

STOP (Y/N)? Y

A "N" NO answer will reenter the program at the location of the current SPN, while a "Y" YES reply will prompt the user the following message whether or not the ASTTME Command is to be repeated by:

REPEAT THIS ENTRY COMMAND (Y/N)? N

A "Y" YES answer will restart the ASTTME Command at the very beginning of the program (not the entry point) and a "N" NO reply will stop the program with the following message flashed to the screen:

TYPE THE COMMAND ... "ASTRAD"

8.1.3 ASTRAD

The MTEN Command ASTRAD (ASTronomic Right Ascension & Declination computation) will use the data entered by GETABS, ABSAST, GETAST and Apparent Sidereal Time computed by the program ASTTME. Then with this information, the program will compute the right ascension and declination of the star for the time of observation contained in the current "AST" abstract and print the azimuth to the mark station. To enter the program type ASTRAD <cr>. The program will load the ASTRAD entry to the screen. The first prompt made by the program is for the user to select a Standpoint SPN, e.g. the Standpoint SPN=30 was selected. Before the program will continue, however, the following prompt must be answered:

HAS ... "ASTTME" ... BEEN COMPLETED (Y/N)? Y

Now that the SPN has been selected and ASTTME completed, the program will flash to the screen all "AST" abstracts that are available. In this example there are four abstracts. The user is then prompted to select which one of the abstacts is to be computed or reworked by the following message:

SET NUMBER/ABS/ (NN)? 4

The "AST" abstract selection (SET NUMBER) is also an entry point into the program. Once the program has completed this abstract, the user will be prompted to select another ASTRAD abstract for this Standpoint SPN, if so selected, the user will be allowed to reenter the program at the current Standpoint SPN location and continue to execute computations for another "AST" abstract by selecting a new "SET NUMBER".

The fourth abstract, "AST- 4" see Figure (8.01), will be used as an example for the computations shown in this command. At this point, same as in ASTTME, the program will look up the corrections to be applied to the radio times and flash these corrections to the screen for a few seconds.

However if Polaris, the default star, is not selected see the ASTTME program for the prompts that will flash to the screen and the entries required by the user. Now that the star had been selected, the program comes to a repetitive process where the pointings, both D/R, are computed one-by-one until the "AST" abstract is completed. The first computation made for each pointing, as in the program ASTTME, is to correct the observed time for the clock offset (BIAS) and chronometer drift (CLKRTE) between two time comparisons. The reason each observed time must be recomputed, is because only the observed chronometer times are saved in the DAT File and not the observational times corrected to the Universal Time of observation (UTDR). To see the computation of UTDR for each pointing see the ASTTME program.

In order to compute the "Right Ascension and Declination" of the star for each UTDR, the AG4APD Subroutine was used. The program AG4APD is a general purpose program which rigorously computes the apparent place of a star. It was originally part of USATOPOCOM's Geodetic Memorandum No. 1647 (dated November 1970) which has been modified for use in this azimuth computation. The AG4APD Subroutine was used by the MTEN programs has been broken up into two subroutines AST001 and AST002 due to the size of the AG4APD Subroutine and number of double precision computations required in it's

execution. The subroutine AST001 computes the Total Nutation in Longitude and the Apparent Sidereal Time. While subroutine AST002 computes the Total Nutation in Obliquity and computes both the RA (Right Ascension) and DEC (Declination) of the star for the given UTDR.

During this process the following message will flash off-and-on to the screen as the computations are executed:

WAIT COMPUTING STAR "R.A. AND DEC" DIRECT /REVERSE

Along with the D/R messages the program will also flash off-and-on to the screen the position number being computed. At the same time, the computed azimuth to the star, the direction to the mark station, the direction to the star, and the bubble / dislevelment correction for each pointing will be printed. A printed listing is shown by Figure (8.04).

However, before this line of information and the azimuth can be printed, it must first be computed. The next few steps will describe the method of computation used to compute a single D/R pointing. The constant for the instrument (the BUBBLE value) is taken from the INX File for the given instrument JSI number. Next the azimuth to the star is computed using the formula in the "Manual of Geodetic Astronomy", SPECIAL PUBLICATION NO. 237, page 90 given by:

-Tangent(A) = Sine(h) / (Sine(P1)*Cosine(h) - Cosine(P1)*Tangent(DEC))

where

ELAT	= Latitude Station	(from GPN File)
P1	= ELAT*(PI/180.0)	(in Radian Measure)
LAST	= Local Apparent Sidereal Time	(from ASTTME program)
RA	= Apparent Place of Star (R.A.)	(from ASTRAD program)
DEC	= Apparent Place of Star (Declination)	(from ASTRAD program)
h	= Local Hour Angle	

and

A	= Azimuth of the Star form North	(in Radian Measure)

The Local Hour Angle (h) computed by:

h	= (LAST - RA)	(in Radian Measure)

The azimuth to the star (AZ) computed by taking the arctangent thus:

AZ	= -Arctangent(A) / DEGRAD	(in Degrees)

Sample computations for each D/R pointing are given below under the heading of "AZIMUTH TO STAR" .

SPN 30
AST 4 WRK

	AZIMUTH TO STAR	+	DIRECTION TO MARK	-	DIRECTION TO STAR	+	CORRN (SEC)	=	AZIMUTH TO MARK
13 D+	0 54 21.05		269 49 34.70		123 05 28.40		10.74		147 38 16.62
R+	0 54 11.61		89 49 27.50		303 05 06.10		10.74		147 38 22.27
14 D+	0 53 18.00		280 49 56.00		134 04 52.40		11.08		147 38 10.52
R+	0 53 32.55		100 49 53.10		314 04 52.30		11.08		147 38 22.27
15 D+	0 51 44.42		291 50 12.00		145 03 33.00		10.08		147 38 13.34
R+	0 51 13.70		111 50 07.80		325 02 48.00		10.08		147 38 23.42
16 D+	0 50 17.25		302 50 47.40		156 02 41.60		11.60		147 38 11.45
R+	0 50 35.14		122 50 43.60		336 02 46.00		11.60		147 38 21.14

Figure (8.04) ---- Listing of Azimuth Computation

However before the "AZIMUTH TO MARK" can be computed, a step must be added to apply the level correction (CORRN) to the observed "DIRECTION TO STAR". The correction computed by the ASTRAD program used the formula in SP 237, page 92.

CORRN = (d / 4)*Tangent(a)*(WEST - EAST) (in Seconds of Arc)

where

d	=	Instrument Constant	(from INX File)
a	=	Observed Altitude of the Star	
W , E	=	Bubble Readings Before Reversal	(from DAT File)
W' , E'	=	Bubble Readings After Reversal	(from DAT File)

WEST = Absolute Value $|W - W'|$
EAST = Absolute Value $|E - E'|$

and

CORRN = Correction to the D/R Pointing on the Star
CORRN = CORRN / 3600.0 (in Degrees)

The computed value for the altitude of the star (ALTD), is computed by the ASTRAD program using the following formula for each position by:

ALTD = (PI / 2.0) - Arcsine(-Cosine(DEC)*Sine(h) / Sine(A))

However, in order to get the observed altitude of the star (a), the computed altitude (ALTD) must be corrected by adding an approximate refraction correction (REF) to it. An approximate refraction correction can be determined from a series expansion, in terms of the zenith distance, by the formula given in J.E. Willis, "A Determination of Astronomical Refraction from Physical Data", Transactions of the American Geophysical Union, 1941,page 328. The observed altitude of the star then becomes:

a = ALTD + (REF / 3600.0)*DEGRAD (in Radian Measure)

where the zenith distance (Z) is computed by the following:

Z = (PI / 2.0 - ALTD) (in Radian Measure)

The refraction correction (REF) is computed by a power series expansion in terms of Zenith Distance (Z).

REF = (Sine(Z)/Cosine(Z))*SERIES (in Seconds of Arc)

The SERIES is computed in terms of (S) by using,

S = 0.01*(Secant(Z))**2

and where S2, S3, etc. are second, third, etc. powers of S:

SERIES = (+58.1605 - 6.6921*S + 2.1528*S2 - 1.1034*S3 + 0.7783*S4
- 0.7014*S5 + 0.7661*S6 - 0.9731*S7 + 1.3905*S8)

With the observed altitude of the star (a), the correction (CORRN) to the "DIRECTION TO STAR" can be computed as shown above and the difference (DIFF) between the "DIRECTION TO MARK" and the "DIRECTION TO STAR + CORRN" can be computed by:

DIFF = MARK - (STAR + CORRN)

where

CORRN = | See Above |
MARK = Observed Direction to the Mark Station (from DAT File)
STAR = Observed Direction to the Star (from DAT File)

and

DIFF = Difference between the Mark and Corrected Star Directions

The last step, to compute the "AZIMUTH TO MARK", is computed by adding the computed difference (DIFF) to the computed azimuth to the star (AZ) by:

AZIM = AZ + DIFF

where

AZ = | See Above |
DIFF = |

and

AZIM = The "AZIMUTH TO MARK" for this D/R Pointing

The program will continue to loop back to the beginning of this repetitive process until this abstract is completed. At completion of this abstract, the following prompt will flash to the screen:

COMPUTE ANOTHER "ASTRAD" /AST/ (Y/N)? Y

A reply of "N" NO will end the program for the current Standpoint SPN. However, a reply of "Y" YES will return the program to the entry point mentioned above and force the user to answer the following prompt:

STOP (Y/N)? Y

A "N" NO answer will allow the user to reenter the program at the current Standpoint SPN location and to select another abstract for this SPN, while a "Y" YES reply will prompt the user the following message whether or not the ASTRAD Command is to be repeated by:

REPEAT THIS ENTRY COMMAND (Y/N)? N

A "Y" YES answer will restart the ASTTME Command at the very beginning of the program (not the entry point) and a "N" NO reply will stop the program with the following message flashed to the screen:

TYPE THE COMMAND ... "WRKAST"

8.1.4 WRKAST

The MTEN Command WRKAST (WoRK an ASTronomic azimuth) will use, the data entered by GETABS, ABSAST, GETAST, and the information computed by ASTCHK, ASTTME, and ASTRAD to compute the group and grand mean statistics for each "AST" abstract, and then print the results. To enter the program type WRKAST <cr>. The program will load the WRKAST entry to the screen. The first prompt made by the program is for the user to select a Standpoint SPN, e.g. the Standpoint SPN=30 was selected.

Now that the SPN has been selected, the program will flash to the screen all "AST" abstracts. There are four abstracts in this example . At this point in the azimuth computation, abstracts 1, 2, and 3 have all been completed using WRKAST. The user is then prompted to select one of the abstacts to be computed or reworked by the following message (for this example only "AST- 4" has not been worked):

```
                                        SET NUMBER/ABS/ (NN)? 4
```

After each abstract has been completed the user will be prompted to select another WRKAST abstract for this Standpoint SPN, if so selected, the user will be allowed to reenter the program at the current Standpoint SPN location and continue to execute computations for another "AST" abstract by selecting a new "SET NUMBER".

```
+-----------------------------------------------------------------------------+
|                        ENTRY     ----  WRKAST                                |
|                    ------------------------------                           |
|      STANDPOINT NUMBER /SPN/ (NNN)?                                  30      |
|      STATION NAME---                   WHITES                                |
|                                                                             |
| ABSTRACT(S) FOR THIS STATION           SET NUMBER/ABS/ (NN)?   4            |
|                                                                             |
  ...
|                                                                             |
|  Y    POLAR MOTION "X" COMPONENT /SECONDS/   (SN.NNNN)   +0.147             |
|  Y    POLAR MOTION "Y" COMPONENT /SECONDS/   (SN.NNNN)   +0.361             |
|       UTC CORRN FOR SIGNAL TIME  /SECONDS/               -0.21980           |
|  N    ECCENTRIC STATION CORRN    /SECONDS/   (SN.NNNN)                      |
|       SIGNAL PROPAGATION DELAY   /SECONDS/                0.01015           |
|  Y    POSITION REJECTION LIMIT   /SECONDS/   (NN.NN)      5.0               |
|                                                                             |
  ...
|       COMBINE ANOTHER SET /ABSTRACT/  (Y/N)?                         N      |
+-----------------------------------------------------------------------------+
```

Figure (8.05) ---- WRKAST Screen

After the "AST" abstract has been selected, the program will flash to the screen six correction messages, see Figure (8.05). The first two values, X and Y, are for the polar motion correction (PMCOR). The values for X and Y were taken from the table given by Figure (8.02) and entered as X= +0.147 and Y= +0.361 to answer the program prompts. The third and fifth correction messages are just displayed for the user, since they have already been entered or computed. The fourth message, eccentric station correction (ECCCOR), must

be computed by the user and entered here before the correction will be applied to the final azimuth. The sixth prompt is not a correction but rather a program default value. The WRKAST program has a default rejection limit (STDERR) of 5.0 seconds of arc, if this limit must be changed, it can be reset with this prompt.

Once all the prompts have been answered, the program will flash the following messages to the screen for the user:

COMPUTING THE "DIRECT" / "REVERSE"

Since each D/R pointing is independent and has had an azimuth computed and resaved, a mean value can be computed for both the "DIRECT" and "REVERSE" separately. In addition to the separate D/R means, the standard deviation and the standard deviation of the mean for each are also computed. With the rejection limit selected above, the two sets (DIRECT/REVERSE) are tested to see if any of the observations will be rejected by the following:

TEST = STDERR*CONST / 3600.0 (in Degrees)

where

STDERR = Default (5.0 seconds) or Selected Rejection Limit
CONST = Square Root of two (1.4142...)

and

TEST = Rejection Limit Used to Test the D/R Results

If a D/R azimuth value fails the test, it is flagged by printing a "R" (for rejected) to the right of that printed residual. When both the rejection tests are completed, a summary of results will be printed by the program. A sample listing for the "AST- 4" abstract is given by Figure (8.06).

The next step in the azimuth computation is to mean both the DIRECT and REVERSE values for the azimuth. Once done, the program recomputes the meaned "D/R" values for a new mean azimuth. The new value for the mean azimuth is then used to test all meaned "D/R" values using the rejection limit (STDERR) selected above. If a value fails the test, it is flagged by printing a "R" (for rejected) to the right of that printed residual. A sample listing of the meaned "D/R" results is given by Figure (8.07). During the computation of the meaned "D/R" values, the program will flash the following message to the screen.

COMPUTING THE "MEAN D/R"

```
                                                                  SPN  30
                                                                  AST   4   WRK
------------------------------- *RESULTS* ----------------------------------

      POS      DIRECT            V              REVERSE          V

       13    147 38 16.62     -3.63          147 38 22.27      0.01

       14    147 38 10.52      2.46          147 38 22.27      0.00

       15    147 38 13.34     -0.36          147 38 23.42     -1.14

       16    147 38 11.45      1.53          147 38 21.14      1.13

       MEAN OF DIRECT  147 38 12.98       MEAN OF REVERSE  147 38 22.28

       S.E.=  2.691  S.E.MN=  1.345       S.E.=  0.928   S.E.MN=  0.464

       NO(ACC)=  4   (REJ)=  0            NO(ACC)=  4   (REJ)=  0
       MAX. INC. =   6.90                 MAX. INC. =   6.90
       MEAN INC. =   6.47                 MEAN INC. =   6.47
```

Figure (8.06) ---- Azimuth Observation (Direct/Reverse Mean Results)

```
------------------------------- *RESULTS* ----------------------------------

      POS      DIRECT           REVERSE      MEAN OF D/R          V

       13    147 38 16.62   147 38 22.27   147 38 19.44       -1.81

       14    147 38 10.52   147 38 22.27   147 38 16.40        1.23

       15    147 38 13.34   147 38 23.42   147 38 18.38       -0.75

       16    147 38 11.45   147 38 21.14   147 38 16.30        1.33

      MEAN OBSERVED AZIMUTH                147 38 17.629
      DIURNAL ABERRATION                          0.323
      ELEVATION OF MARK ( 86.645)                -0.005 (NOT INCLUDED)
      ECCENTRICITIES /SECONDS/                    0.000
      VARIATION OF POLE                           0.045
          (X=   0.147 Y=   0.361)

      ASTRONOMICAL AZIMUTH                 147 38 17.996

      NO(ACC)=  4   (REJ)=  0
      SUM V SQUARED       =    7.1373
      SINGLE OBS.   S.E. =    1.542        P.E. =     1.040
      MEAN          S.E. =    0.771        P.E. =     0.520
```

Figure (8.07) ---- Azimuth Observation (Mean D/R Results)

The last step in the computation of an observed azimuth for each "AST" abstract is to apply the following corrections to the "MEAN OBSERVED AZIMUTH":

1) DIUABE -- DIURNAL ABERRATION
2) SKCOR -- ELEVATION OF MARK
3) ECCCOR -- ECCENTRICITIES (of the Station and or Mark)
4) PMCOR -- VARIATION OF POLE

These corrections are applied to the final mean observed azimuth according to A.J. Hoskinson and J.A. Duerksen, "Manual of Geodetic Astronomy", Special Publication No. 237, pages 92 and 106.

However, the Skew Normal Correction (SKCOR) is not applied to the mean observed azimuth because this correction is applied automatically later during the formation of observation equations in a final adjustment program. Therefore, the message (NOT INCLUDED) will appear next to this correction on the printed listing shown by Figure (8.07).

Eccentricities Correction (ECCCOR) is a correction applied to the mean observed azimuth in order to correct for any eccentricities at the station occupied or the mark station that was observed. The program will take this correction and add it to the mean observed azimuth by the following:

Variation of pole or the Polar Motion Correction (PMCOR) is added to the mean observed azimuth. The correction (PMCOR) is computed by the formula given in the book by I. Mueller, "Spherical and Practical Astronomy as Applied to Geodesy", pages 86-88 and 429.

The final mean observed azimuth (AZMK) for this "AST" abstract then becomes the sum of the mean observed azimuth (AZIM) and all the corrections.

AZMK = AZIM + DIUABE + SKCOR + ECCCOR + PMCOR

At this point the program will print a listing for this "AST" abstract, see Figure (8.07). The program will then flash to the screen the following message:

COMBINE ANOTHER SET /ABSTRACT/ (Y/N)? Y

A reply of "N" NO will end the input of "AST" abstracts for the current Standpoint SPN. However, a reply of "Y" YES will return the program to the entry point mentioned above and force the user to answer the following prompt:

STOP (Y/N)? Y

A "N" NO answer will allow the user to reenter the program at the current Standpoint SPN location and to select another abstract for this SPN, while a "Y" YES reply will end the input of "AST" abstracts for the current Standpoint SPN.

```
                                                                  SPN  30
                                                                  AST   4   WRK
                        GROUP AND GRAND MEAN STATISTICS
-------------------------------------------------------------------------------

 GROUP NO   4                                  GROUP  MEAN          GRAND  MEAN

NAME      =  WHITES
DATE      =  791108
INSTR NO  =  74708
BUB VAL   =   7.321
OBSERVED  =  RLR


     MEAN OBSERVED AZIMUTH                   147 38 17.629
        --CORRECTIONS--                      -------------
     DIURNAL ABERRATION                              0.323
     ELEVATION OF MARK                              -0.005 (NOT INCLUDED)
     ECCENTRICITIES /SECONDS/                        0.000
     VARIATION OF POLE                               0.045
                                             -------------
     SUM OF CORRECTIONS (CORRN)                      0.367

     ASTRONOMICAL AZIMUTH                    147 38 17.996     147  38  17.738

--GROUP-------OBSERVED-----COMPUTED ABOUT   AZIMUTH     COMPUTED ABOUT  GOOD
   SET        AZIMUTH       GROUP MEAN      CORRN       GRAND MEAN      OBS
   NBR     (DEG MN SEC)     V       VV      (SEC)       V       VV      NBR

     4     147 38 19.44   -1.81     3.29    0.37      -2.07     4.29    13
     4     147 38 16.40    1.23     1.52    0.37       0.98     0.95    14
     4     147 38 18.38   -0.75     0.56    0.37      -1.01     1.02    15
     4     147 38 16.30    1.33     1.77    0.37       1.07     1.15    16

      NO(ACC)=  4    (REJ)=  0                    NO(ACC)= 16   (REJ)=  0
      SUM V SQUARED        =     7.1373                      48.3624
      SINGLE OBS.    S.E. =     1.542                        1.796
      MEAN           S.E. =     0.771                        0.449
      SINGLE OBS.    P.E. =     1.040                        1.211
      MEAN           P.E. =     0.520                        0.303
```

Figure (8.08) ---- Azimuth Observation (Group & Grand Mean Statistics)

The final WRKAST program computation is to combine all "AST" abstracts selected by the user and compute a "Grand Mean" azimuth using all observed azimuths (AZIM) on all abstracts. No rejections are possible at this point, however if an observation was rejected in one of the "AST" abstracts above, it will be shown as rejected in the "Grand Mean" azimuth computation. The printed listing shows both the "Group" and "Grand Mean" statistics which are printed abstract by abstract. A sample listing for the "AST- 4" abstract is given by Figure (8.08).

When the "Group" and "Grand Mean" Statistics abstract listings have completed printing, the program will prompt the user with the following message:

```
REPEAT THIS ENTRY COMMAND (Y/N)?  N
```

A "Y" YES answer will restart the WRKAST Command at the very beginning of the program (not the entry point) and a "N" NO reply will stop the program.

8.2 WRKCHK

The MTEN Command WRKCHK (WoRK a CHecK) program will allow the user to select a method of computation and enter a list of selected triangle numbers. The program will then make the computation and print the results. There are three possible options for the method of computation, namely, a central point (pole check or side equation) called a SIDECK, a braced quadrangle check (pole at diagonal intersection and all four corners) called a QUADCK, or a compairson of two lengths (measured base lines) called a BASECK. To enter the program type WRKCHK <cr>. The program will prompt the user to select a method of computation by flashing the following to the screen:

```
  +-------------------------------------------------------------------------+
01|                        ENTRY     ----  WRKCHK                            |
02|                    ------------------------------                       |
03|                                                                         |
04|      SIDE EQUATION   "TEST" FOR A CENTRAL POLE     (SIDECK)    1        |
05|                                                                         |
06|      SIDE EQUATION   "TEST" FOR A QUADRILATERAL    (QUADCK)    2        |
07|                                                                         |
08|      LENGTH EQUATION "TEST" BETWEEN TWO BASES      (BASECK)    3        |
09|                                                                         |
10|      SELECT THE DESIRED TYPE OF "TEST" (N)?                    1        |
11|                                                                         |
12|      SELECT EITHER (OBSERVED,PLANE) /0,1/ ANGLES (N)?          0        |
13|                                                                         |
   ....
24|                                                                         |
  +-------------------------------------------------------------------------+
```

Figure (8.09) ---- WRKCHK Selection Screen

Using the above screen as an example the desired "TEST" selected was SIDECK (1 <cr>) and the angle option selected was OBSERVED (0 <cr>). However either option for the angles (OBSERVED/PLANE) could have been selected for any one of the three methods of computation. The only difference between a PLANE angle and an OBSERVED angle is that the PLANE angles have been corrected for triangle closure and spherical excess. Each method of computation (SIDECK-QUADCK-BASECK) will be fully described seperately. The specified limits for each method are set forth in "Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys", NOAA -- S/T 81-29, pages 3-7. A sample SIDECK or QUADCK computation is given by an example in the "Specifications to Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys", NOAA -- S/T 80-98, pages 10-11.

The SIDECK method of computation is used to compute a value for the average correction to an observed direction. With the value for the average correction the user can check to see if the specification limits have been met. The actual computation is done by starting from a common length, computing through a chain of triangles, and then closing back on the same common length.

At this point the program will clear the screen and reload it with the SIDECK prompts. The program will prompt the user to select the central pole by flashing this message to the screen:

CENTRAL POLE STANDPOINT NUMBER /SPN/ (NNN)? ----

The following example SIDECK computation is for a geometric figure which has seven triangles around the central pole Standpoint SPN=85. Figure (8.10) is the SPN configuration for the verticies of the seven triangles.

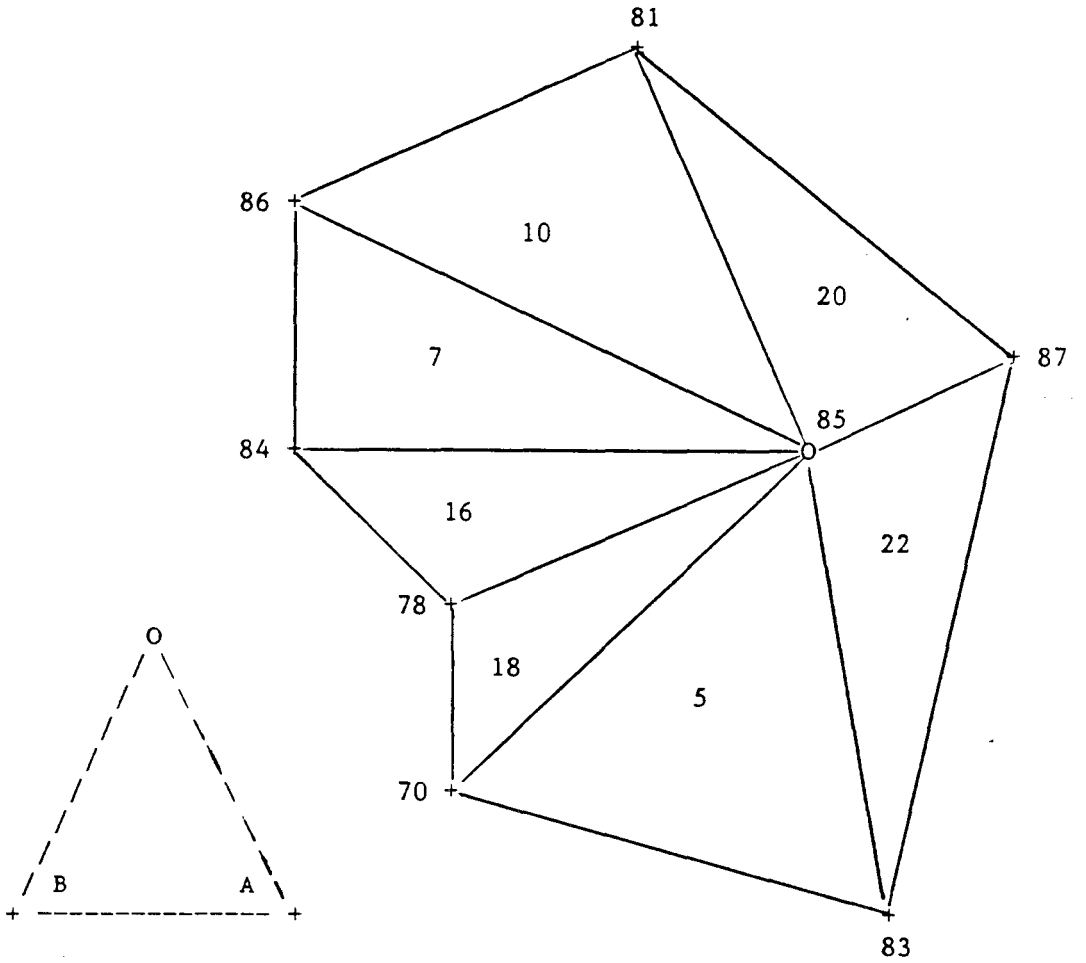


Figure (8.10) ---- SIDECK Triangle & SPN Configuration

Now that the central pole has been selected, the user must enter a chain of triangles for the geometric figure to be tested. The program will prompt the following message:

TRIANGLE NUMBER (NNN)? ---

Each triangle number is entered one at a time consecutively around the geometric figure until it is completed. The method of entry for the chain of triangles can be either clockwise or counterclockwise. However for consistency within a project area, all SIDECKs should be the same, that is for example, all clockwise. The SIDECK screen for the above configuration is given on Figure (8.11) and a printed listing of the method of computation is

given on Figure (8.12).

```
+-----------------------------------------------------------------------------+
|                         ENTRY     ----  SIDECK          ANGLES=OBSERVED      |
|                     ------------------------------                          |
|                                                                             |
|       CENTRAL POLE STANDPOINT NUMBER /SPN/ (NNN)?                 85        |
|                                                                             |
|       H 54 NY                                      CHANGE (Y/N)? N          |
|                                                                             |
|  ...                                                                        |
|                                                                             |
|       ENTER LIST OF TRIANGLE NUMBERS FOR THIS GEOMETRIC FIGURE              |
|            MAXIMUM OF 28 TRIANGLE NUMBERS                                  |
|            ENTER A ZERO TO STOP            TRIANGLE NUMBER (NNN)? 0        |
|                                                                             |
| TRI LIST   5  18  16   7  10  20  22                                        |
|                                                                             |
|                                                                             |
|                                                                             |
|                                                                             |
|       REPEAT THIS ENTRY COMMAND (Y/N)   N                                   |
+-----------------------------------------------------------------------------+
```

Figure (8.11) ---- SIDECK Screen

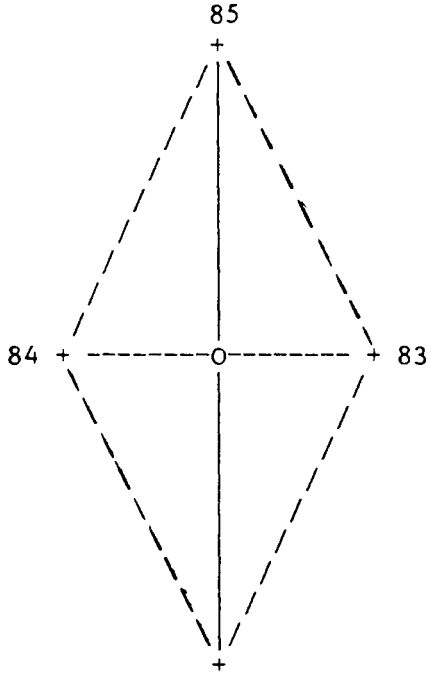
```
                                                                  SIDECK

                        STATION:  H 54 NY                        SPN  85

                        -TEST WITH OBSERVED ANGLES-

     ----------- LEFT  SIDE ------------  ----------- RIGHT SIDE ------------
TRI  STA  ("A" ANGLE)                     STA  ("B" ANGLE)
NBR  NBR  DEG MN  SEC    SIN(A)   COT(A)  NBR  DEG MN  SEC    SIN(B)    COT(B)
     ----------------------------------  ----------------------------------
  5   83 105 09 29.00  .96520818  -0.271   70  46 05 40.00  .72048388    0.963
 18   70  20 32 41.24  .35093949   2.668   78 151 13 31.40  .48136532   -1.821
 16   78  43 25 28.22  .68739822   1.057   84 111 28 32.66  .93057267   -0.393
  7   84  40 05 22.12  .64398315   1.188   86 107 56 55.37  .95133274   -0.324
 10   86  69 40 27.13  .93773263   0.370   81  37 08 55.64  .60388694    1.320
 20   81   9 19 22.98  .16200084   6.091   87 150 15 22.52  .49612170   -1.750
 22   87   6 07 21.65  .10665768   9.322   83   1 30 52.85  .02643308   37.818
                      ------------------                   ------------------
       SIN PRODUCT =   .00242954  20.968    SIN PRODUCT =   .00243150   44.389

       RHO*((LEFT/RIGHT)-ONE)              CLOSURE =    -165.66 SEC
       COT(A) + COT(B)                         SUM =      65.36
       CLOSURE / SUM          AVE CORRN/ANGLE     =      -2.53 SEC
                              AVE CORRN/DIRECTION =      -1.27 SEC
```

Figure (8.12) ---- Listing of a SIDECK Computation

The QUADCK method of computation is used to compute a value for the average correction to an observed direction for a braced quadrilateral. With the value for the average correction for the geometric figure the user can check to see if the specification limits have been met. The actual computation is done by starting from a common length, computing through a chain of triangles, and then closing back on the same common length. In the geometric structure of a braced quadrilateral, the computation through a chain of triangles can be done by five difference chains. That is to say, the poles for this method of computation can be selected at five different locations. The first location is always taken as the intersection of the two diagonals. The other four locations are taken as the four corners of the quadrilateral.

The program, for this method of computation, has a fixed format for the entry of the triangle numbers used in the geometric figure layout. First as a point of reference, one corner of the quadrilateral is selected by the user. This corner, called the "QUAD" Point, will become the guide to the entry of triangle numbers later, see the QUADCK quadrilateral below. The program will prompt the user to select a "QUAD" Point by:

QUAD STANDPOINT NUMBER /SPN/ (NNN)? 70



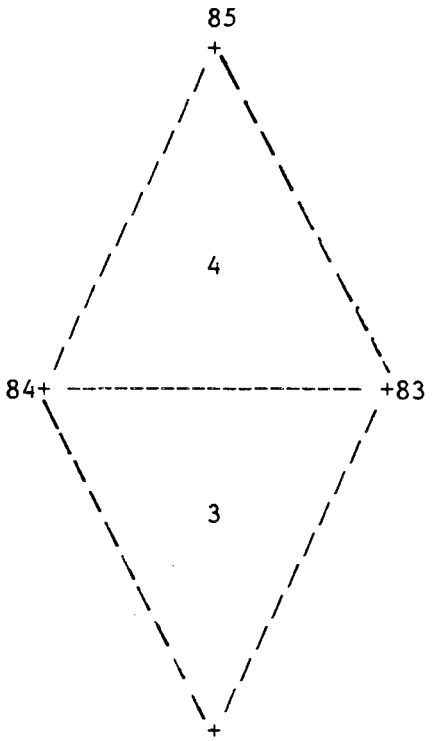
"QUAD" Point (SPN=70)

Then the chain of triangles (only four can be entered) will be prompted with the following prompt, see QUADCK Screen Figure (8.13):

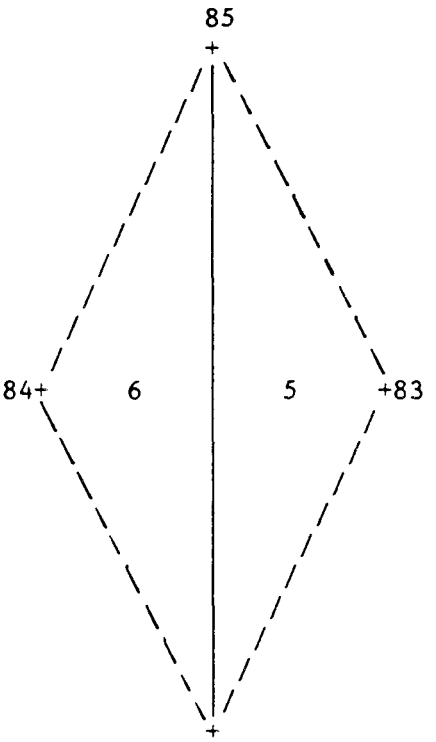
TRIANGLE NUMBER (NNN)? ---

The triangle numbers must be entered in the following order exactly. First, the triangle number which contains the "QUAD" Point and has its diagonal opposite the "QUAD" Point. Second, enter the triangle number which is

opposite to the first triangle such that it's diagonal is adjacent to the diagonal of the first triangle. The third triangle number entered must be the triangle, such that one triangle side contains the second diagonal connecting the "QUAD" Point and the quadrilateral corner opposite to it and is on the right side of the geometric figure as seen from the "QUAD" Point. The last triagle number to be entered is the triangle opposite to the third triangle such that it's diagonal is adjacent to the diagonal of the third triangle. The triangle chain order-of-entry for the figure above is; first triangle number 3, then 4, 5, and triangle 6 last.



"QUAD" Point (SPN=70)



"QUAD" Point (SPN=70)

Once the triangle number selection has been completed, the program will compute the five possible QUADCKs. The first listing, Figure (8.14), is for a pole computed at the intersection of the diagonals. While the second Figure (8.15), is located at only one of the four possible quadrilateral corners. The quadrilateral corner shown, standpoint SPN=70, is the "QUAD" Point.

```
+-----------------------------------------------------------------------------+
|                         ENTRY     ----  QUADCK          ANGLES=OBSERVED      |
|                     ------------------------------                          |
|                                                                             |
|       QUAD STANDPOINT NUMBER /SPN/ (NNN)?                          70       |
|                                                                             |
|       BORO HALL 1931                                CHANGE (Y/N)? N         |
|                                                                             |
|  ...                                                                        |
|                                                                             |
|       ENTER LIST OF TRIANGLE NUMBERS FOR THIS GEOMETRIC FIGURE              |
|            MAXIMUM OF 28 TRIANGLE NUMBERS                                  |
|            ENTER A ZERO TO STOP            TRIANGLE NUMBER (NNN)? 0        |
|                                                                             |
| TRI LIST   3   4   5   6                                                    |
|                                                                             |
|                                                                             |
|                                                                             |
|                                                                             |
|       REPEAT THIS ENTRY COMMAND (Y/N)   N                                   |
+-----------------------------------------------------------------------------+
```

Figure (8.13) ---- QUADCK Screen

QUADCK

TRI 3 4 5 6

POLE AT THE INTERSECTION OF THE DIAGONALS

-TEST WITH OBSERVED ANGLES-

TRI NBR	LEFT SIDE STA NBR	("A" ANGLE) DEG MN SEC	SIN(A)	COT(A)	RIGHT SIDE STA NBR	("B" ANGLE) DEG MN SEC	SIN(B)	COT(B)
3	70	46 05 40.00	.72048388	0.963	83	61 14 55.74	.87671682	0.549
5	83	43 54 33.26	.69351801	1.039	85	28 44 56.88	.48097550	1.823
4	85	33 19 46.50	.54945430	1.521	84	74 00 40.50	.96131580	0.287
6	84	44 22 51.76	.69942692	1.022	70	28 16 34.62	.47372370	1.859
	SIN PRODUCT =		.19202419	4.544	SIN PRODUCT =		.19203195	4.517

RHO*((LEFT/RIGHT)-ONE) CLOSURE = -8.34 SEC
COT(A) + COT(B) SUM = 9.06
CLOSURE / SUM AVE CORRN/ANGLE = -0.92 SEC
AVE CORRN/DIRECTION = -0.46 SEC

Figure (8.14) ---- QUADCK...Pole at Intersection of Diagonals

QUADCK

TRI 3 4 5 6

STATION: BORO HALL 1931 SPN 70

-TEST WITH OBSERVED ANGLES-

TRI NBR	LEFT SIDE STA NBR	("A" ANGLE) DEG MN SEC	SIN(A)	COT(A)	RIGHT SIDE STA NBR	("B" ANGLE) DEG MN SEC	SIN(B)	COT(B)
5	83	105 09 29.00	.96520818	-0.271	85	28 44 56.88	.48097550	1.823
6	85	33 19 46.50	.54945430	1.521	84	118 23 32.26	.87971253	-0.541
3	84	44 22 51.76	.69942692	1.022	83	61 14 55.74	.87671682	0.549
	SIN PRODUCT =		.37093253	2.813	SIN PRODUCT =		.37095658	2.912

RHO*((LEFT/RIGHT)-ONE) CLOSURE = -13.37 SEC
COT(A) + COT(B) SUM = 5.73
CLOSURE / SUM AVE CORRN/ANGLE = -2.34 SEC
AVE CORRN/DIRECTION = -1.17 SEC

Figure (8.15) ---- QUADCK...Pole at Standpoint SPN=70

The BASECK method of computation is used to determine the misclosure and the precision between two bases. With these values the user can check to see if the specification limits have been met. The actual computation is done by starting from a common length (Beginning Base), computing through a chain of triangles, and then closing on a second common length (Ending Base) or back on the same common length.

Once the BASECK option has been selected the WRKCHK screen will clear and the BASECK screen shown by Figure (8.16) will appear. Next the user will be prompted to enter the Standpoint SPNs for both the "BEGIN BASE" and "END BASE"and the corresponding station name will flash to the screen. This set of prompts will be followed by a set of prompts for the user to enter values to be used for the lengths of the two bases:

```
BEG BASE LENGTH (NNNNN.NNN)? ----------
END BASE LENGTH (NNNNN.NNN)? ----------
```

```
+-----------------------------------------------------------------------------+
|                        ENTRY     ----  BASECK          ANGLES=OBSERVED      |
|                    ------------------------------                           |
|      SURVEY POINT NUMBERS /BEGIN BASE/ (NNN)?      76     83                |
|           NAME: FT WADSWORTH LH ECC                                          |
|           NAME: H 52 NY                                                      |
|                                                                              |
|      SURVEY POINT NUMBERS /END   BASE/ (NNN)?      86     88                |
|           NAME: H 55 NY                                                      |
|           NAME: H 57 NY                                                      |
|                                                                              |
|      LENGTH OF THE BEGINNING AND ENDING BASES                                |
|           BEG BASE LENGTH (NNNNN.NNN)?  3976.795                             |
|           END BASE LENGTH (NNNNN.NNN)?  2861.635                             |
|                                                                              |
|      ENTER LIST OF TRIANGLE NUMBERS FOR THIS GEOMETRIC FIGURE                |
|           MAXIMUM OF 28 TRIANGLE NUMBERS                                     |
|           ENTER A ZERO TO STOP            TRIANGLE NUMBER (NNN)? 0           |
|                                                                              |
| TRI LIST   2   3   4   7   8   9                                             |
|                                                                              |
|                                                                              |
|                                                                              |
|                                                                              |
|      REPEAT THIS ENTRY COMMAND (Y/N)   N                                     |
+-----------------------------------------------------------------------------+
```

Figure (8.16) ---- BASECK Screen

After the lengths have been entered, the program will request the user to enter a chain of triangles between to two bases. To enter the chain of triangle numbers the program will prompt the followig message:

```
TRIANGLE NUMBER (NNN)? ---
```

The order of entry for the chain of triangles is to start with the triangle next to the "BEG BASE LENGTH". Then enter one-by-one each triangle number consecutively through the geometric figure to be tested to the last triangle. Make sure the last triangle entered contains the "END BASE LENGTH". The figure (8.17) below has the SPN configuration and triangle layout. For a BASECK example and listing of the actual computations see Figure (8.18).

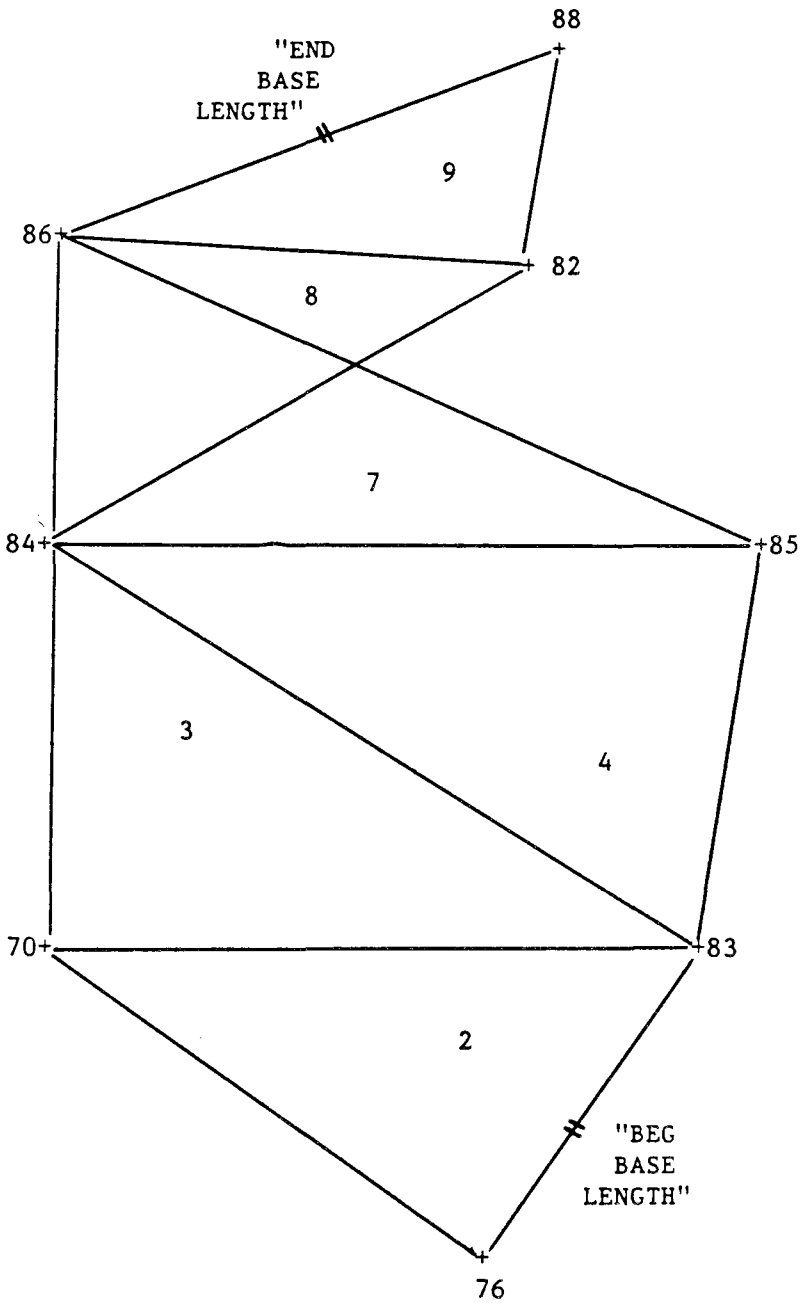


Figure (8.17) ---- BASECK Triangle & SPN Configuration

BASECK

```
BEGINNING STATIONS (  76  83)          ENDING  STATIONS (  86  88)
   FT WADSWORTH LH ECC                    H 55 NY
   H 52 NY                                H 57 NY
   LENGTH BEGIN=    3976.7954             LENGTH END=    2861.7789
```

-TEST WITH OBSERVED ANGLES-

	LEFT SIDE						RIGHT SIDE					
TRI NBR	STA NBR	("A" ANGLE) DEG	MN	SEC	SIN(A)	COT(A)	STA NBR	("B" ANGLE) DEG	MN	SEC	SIN(B)	COT(B)
2	76	43	44	22.50	.69138171	1.045	70	59	49	02.88	.86442810	0.582
3	70	74	22	14.62	.96302505	0.280	84	44	22	51.76	.69942692	1.022
4	83	43	54	33.26	.69351801	1.039	85	62	04	43.38	.88359175	0.530
7	85	31	57	39.37	.52934095	1.603	86	107	56	55.37	.95133274	-0.324
8	84	25	01	20.50	.42297194	2.142	82	32	16	14.00	.53391790	1.584
9	82	112	01	13.38	.92705053	-0.404	88	29	23	48.00	.49085306	1.775
	SIN PRODUCT =				.09584372	6.513	SIN PRODUCT =				.13319297	5.816

```
RHO*((BEG/END)*(LEFT/RIGHT)-ONE)    CLOSURE =          0.63 SEC

BEGIN LENGTH (MEASURED)                      =     3976.7950
END   LENGTH (MEASURED)                      =     2861.6350
END   LENGTH (COMPUTED)                      =     2861.6437
DIFFERENCE  (COMP-MEAS)                      =        0.0087
ONE SECOND CHANGE IN SMALLEST ANGLE          =        0.0297

1:XXX  OR  XXX=(END LENGTH)/|DIFFERENCE|     =     327400.
```

Figure (8.18) ---- Listing of a BASECK Computation

8.3 WRKEDM

The MTEN Command WRKEDM (WoRK an Electronic Distance Measurement reduction) will take a slope distance selected by the user and reduce it to the geodetic (ellipsoidal) distance. This slope disance must have previously been entered with the Commands GETABS + ABSEDM. To enter the program type WRKEDM <cr>. The program will prompt the user to select a Standpoint SPN.

Once this SPN, for example SPN=85, has been entered the program will flash to the screen all observed abstract set(s). The program will list every "EDM" abstract observed at SPN=85 in order of set number, see 1-, 2-, and 3- listed below. In addition to the set number, the Forepoint SPN is listed along with the source statement or "LINE#". The proper slope measurement should be identifiable from this given information. See Figure (8.19) for an example reduction screen and the selection of an abstract set. Once the abstract sets have been flashed to the screen, the program will prompt the user to select one. In this example the "SET NUMBER /ABS/", the second was selected.

```
                                                SET NUMBER /ABS/ (NN)?  2

  +-------------------------------------------------------------------------+
01|                        ENTRY      ----  WRKEDM                           |
02|                     ------------------------------                      |
03|            STANDPOINT NUMBER /SPN/ (NNN)?                          85   |
04|            STATION NAME---              H 54 NY                         |
05|                                                                         |
06|            FOREPOINT  NUMBER /SPN/ (NNN)?                          84   |
07|            STATION NAME---              H 53 NY                         |
08|                                                                         |
09|       ABSTRACT(S) FOR THIS STATION        SET NUMBER /ABS/ (NN)?   2   |
10|                                                                         |
11|         SET  SPN  LINE#                                                 |
12|           1-  86  14                                                    |
13|           2-  84  15                                                    |
14|           3-  83  16                                                    |
  ...
24|       CHANGE STANDPOINT /SPN/ STATION (Y/N)?                    Y      |
  +-------------------------------------------------------------------------+
```

Figure (8.19) ---- WRKEDM Screen

The reduction of the measured slope distance is done in three sections. The first section reads all data required to complete the reduction computation from the project data files. The second section does the actual reduction computation for the selected distance. While section three will take the newly reduced geodetic distance and resave it at the current data record location in DAT File.

The resaving of the current DAT File record, will occur only if the computation was completed without an error. If an error did occur, the DAT File record is left with the geodetic distance equal to zero and this will produce the following printed message anytime the command LSTDST is used. The message will indicate to the user that the observation has not yet been reduced. See Figure (10.08) where an example summary is listed.

SLOPE < 2692.0000>

However if no error occures, the program will print a listing of the reduction computation as shown by Figure (8.20). Next after the listing is printed, the program will prompt the user the following:

CHANGE STANDPOINT /SPN/ STATION (Y/N)? N <cr>

A "N" NO response will reprompt the user for additional sets, i.e., "EDM" abstract 1 and 3, to be reduced at the same Standpoint SPN. While a "Y" YES response will allow the user to select a different Standpoint SPN.

SPN 85
EDM 2 WRK

ELECTRONIC DISTANCE MEASUREMENT
TASK LINE NUMBER = 15

	SPN NBR	STATION NAME	STATE	ELEVATION OF MARK (M)	GEOID HEIGHT (M)	HEIGHT INSTR. (M)
FR	85	H 54 NY	NY	4.546	0.0	1.648
TO	84	H 53 NY	NJ	3.342	0.0	1.495

	DEG MN SEC
MEAN LATITUDE	40 40 40.03
AZIMUTH OF LINE	262 36 37.96

DATE (YYMMDD)	INSTRUMENT NUMBER	SLOPE DISTANCE (M)	
800316	97011	3437.7150	MEAN 4 SHEETS

MEAN SLOPE	3437.7150
2ND VELOCITY (K=0.18)	3437.7150
MARK TO MARK (CHORD)	3437.7141
SEA LEVEL (GEOIDAL)	3437.7117
GEODETIC (ELLIPSOIDAL)	3437.7117

Figure (8.20) ---- A WRKEDM (Reduction Computation) Listing

8.4 WRKGPN

The MTEN Command WRKGPN (WoRK a Geographic PositioN) will compute a geographic position for an unknown Forepoint SPN from a Standpoint SPN given its geographic position, the azimuth and distance to the unknown Forepoint, and print a listing of the computation. To enter the program type WRKGPN <cr>. The program will prompt the user to select a mode of computation by flashing the following message to the screen:

COMPUTE AN APPROXIMATE POSITION (Y/N)? N

A "N" NO response will enter the "Normal" mode of the WRKGPN Command, whereas, an answer of "Y" YES will enter the "Approximate" mode. Both modes operate the same for the first two steps of the computation. The SPN configuration must first be established. To do this the program prompts the user to enter three SPNs, namely, the Backpoint (STATION 1), the Standpoint (STATION 2), and the Forepoint (STATION 3) in that order. After the three SPNs have been entered, the program will establish an azimuth from the Standpoint SPN to the Forepoint SPN. The only difference between the "Normal" and "Approximate" modes at this point is the type of geodetic inverse permitted by the program. The inverse azimuth computation is computed between the Standpoint SPN (85 or 83) and the Backpoint SPN (83 or 70), see Figure (8.21) for the configuration and Figure (8.22) for the sample WRKGPN Screen.

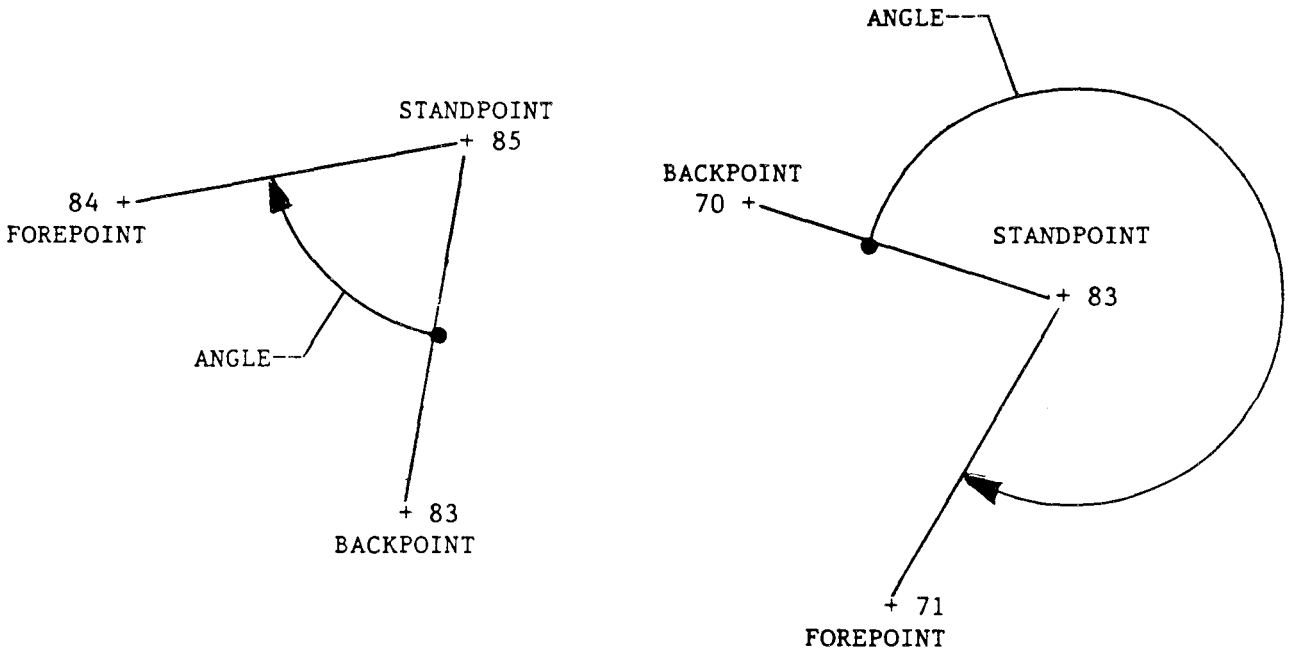


Figure (8.21) ---- WRKGPN Configuration for Standpoint SPNs

With the infomation available from the first step, the program will compute a geodetic inverse azimuth between the Standpoint and the Backpoint for the user in the "Normal" mode only if the GPCs (Geographic Position Code) for both SPN's are greater than or equal to a value of 4. However, in the "Approximate" mode the same inverse azimuth computation will be computed by

the program if both GPC values are only equal to 2 or greater.

Once the inverse azimuth has been established between the Standpoint and the Backpoint the program will check to see if a combined "LST" exists for the Standpoint SPN. If a "LST" is not available, no computation is possible. If the "LST" for the SPN does exist, the program will compute the clockwise angle from the Backpoint SPN around to the Forepoint SPN. This angle is then added to the "INITIAL AZIMUTH" of the Backpoint in order to determine the "FORWARD AZIMUTH" to the Forepoint.

The next step, the user must select which distance(s) are to be used in the computation. If more than one distance is available, the program will let the user select any one or all distances. At this point the following message will flash to the screen:

STANDPOINT-TO-FOREPOINT

The program will first search every distance record in the DAT File that was measured from the Standpoint SPN in order to find all the distances measured to the Forepoint SPN. As each distance or abstract is found it will flash to the screen. When the Standpoint search is completed, the program will flash the following message to the screen:

FOREPOINT-TO-STANDPOINT

The program at this point will begin searching every distance record measured at the Forepoint SPN in order to find all distances that were measured back to the Standpoint SPN. Each distance, as it is found, will also be flashed to the screen for the user to review.

```
+-----------------------------------------------------------------------+
01|                        ENTRY     ----  WRKGPN                        |
02|                    ------------------------------                    |
03|                                                                      |
04|      BACKPOINT  NUMBER /SPN/ (NNN)? 70   BORO HALL 1931              |
05|                                                                      |
06|      STANDPOINT NUMBER /SPN/ (NNN)? 83   H 52 NY                     |
07|                                                                      |
08|      FOREPOINT  NUMBER /SPN/ (NNN)? 71   POUCH 1931                  |
09|                                                                      |
10|      ENTER<FOREPOINT>  DISTANCE(S) (Y/N)? Y     ENTER /NBR/ (NN)?  1 |
11|                                                                      |
12|                                                                      |
13|      STANDPOINT-TO-FOREPOINT          FOREPOINT-TO-STANDPOINT        |
14|                                       NBR   ABS-SOURCE               |
15|                                        1 EDM  2-2                    |
  ....
24|      REPEAT THIS ENTRY COMMAND (Y/N)   N                             |
+-----------------------------------------------------------------------+
```

Figure (8.22) ---- WRKGPN Screen

The selection of distances can come from three types of data. There can be "DST", "LGH", and "EDM" Abstracts from which to choose. If the data used is from a "DST" Abstract, it will be reduced to a geodetic distance. If a "LGH" Abstract distance is selected, the distance will be a geodetic

distance already and no reduction will be required. However, if the distance selected is from an "EDM" Abstract, it must first be reduced by the program WRKEDM. The WRKGPN program will flag this distance as not reduced and no computation is possible.

This is the point where the two modes of computation become completely different. The "Normal" mode which will be described here first and the "Approximate" mode will be described later. In the "Normal" mode the user is prompted by the following:

ENTER <STANDPOINT> DISTANCE(S) (Y/N)? -

The user can then enter as many standpoint measurements as are listed under the "STANDPOINT-TO-FOREPOINT" heading one at a time. The program will flash to the screen the following message for the user:

ENTER /NBR/ (NN)? --

The user must now select a number from the list under the heading "NBR", then the program will reprompt if more distances are to be entered. If not, the program will then prompt the user the following message and additional distances can be selected from those distances listed under the heading "FOREPOINT-TO-STANDPOINT":

ENTER <FOREPOINT> DISTANCE(S) (Y/N)? Y

The "Normal" mode using the SPN configuration, the computed inverse azimuth, the determined forward azimuth, and distance(s) selected, will now compute the geographic position for the Forepoint SPN.

The geographic position computed with the program WRKGPN in the "Normal" mode will set the GPC to a value of 5. When the program attempts to resave the currently computed geographic position in the GPN File, it will replace any previously created or stored position whose GPC value is less than or equal to a 5. A sample printed listing of a WRKGPN computation is given by Figure (8.23).

The "Approximate" mode will compute two items. The first item is an approximate geographic position and the second item is an approximate elevation of the Forepoint SPN. However in both cases, the information will be resaved only if the GPC and Elevation Code are less than or equal to a value of 2. If either one of the codes is greater than a 2, that item will not be resaved in the GPN File. The method of computation used in the "Approximate" mode is different from that used in the "Normal" mode. In the "Normal" mode the user could select one or more distance abstracts, however in the "Approximate" mode the program will allow the user to select only one.

```
                                                          SPN  71    GPN

    ------------- TRAVERSE COMPUTATION -------------

    SPN  STATION NAME                        DEG MN  SEC

     83  H 52 NY                             200 31 53.61  INITIAL AZIMUTH
     85  H 54 NY                              62 04 43.38  ANGLE
     84  H 53 NY                             262 36 37.00  FORWARD AZIMUTH

        SPN ABS SET  LINE/VOLUME
         85 EDM   2  15           3437.7117
         84 EDM   1  10           3437.7597

                      DISTANCE USED         3437.7357  METERS   <Geodetic>


                   GEOGRAPHIC POSITION
    ------------------------------------------------
      STATION NAME           H 53 NY

                             DEG  MN  SECONDS

      LATITUDE  =             40  40  32.8448   NORTH
      LONGITUDE =             74  03  34.8600   WEST
    ------------------------------------------------

SPN   NBR        STATION NAME                FWD AZIMUTH   BACK AZIMUTH
FROM   TO                                    DEG MN  SEC   DEG MN  SEC

  85   84        H 53 NY                     262 36 37.00   82 35 02.38
```

Figure (8.23) ---- WRKGPN Listing for a "Normal" Computation

If both the approximate geographic position and elevation are needed for a Forepoint SPN, the best useable distance is an "EDM" Abstract where vertical angle observations have been observed and entered with GETABS + ABSZEN. The program will, given the Standpoint SPN geographic position, compute the space rectangular coordinates (X2-Y2-Z2) for station. Then the program will compute using, the <<SLOPE>> distance from the "EDM" Abstract, the determined azimuth to the forepoint (AZ23), and the observed zenith distance, the space rectangular coordinates (X3-Y3-Z3) for the Forepoint SPN. The geographic position of the Forepoint SPN can be computed along with and ellipsoidal height for the station from the space rectangular coordinates. If the only distance available is a "DST" Abstract, that is, a horizontal measurement, the program will set the zenith distance to a default value equal to 90 degrees for the computation. The same procedure is used when a "LGH" Abstract is available or selected.

The following method of computation is used for the WRKGPN Command in the "Approximate" mode, once the forward azimuth has been determined, the distance selected, and the zenith distance(s) computed or found. The space rectangular coordinates are first computed for the Standpoint SPN (STATION 2).

The next step is to compute the three coordinate offsets by creating three transformation equations. Then the three offsets (DX-DY-DZ) can be added to the Standpoint SPN coordinates (X2-Y2-Z2) to obtain the coordinates (X3-Y3-Z3) of the Forepoint SPN. This is done by converting the zenith distance to a vertical angle (above/below) the plane of the horizontal surface and using the distance to compute the three offsets.

At this point in the "Approximate" method of computation, the program will print the following information about the Forepoint SPN on the listing, the elevation of mark, the Elevation Code, and the GPC, see Figure (8.24) for an example.

```
--DATA CURRENTLY IN STORAGE--
ELEVATION   CODE     POSITION
   (M)                 CODE
  29.967     2          9
```

In this example the position's (GPC) has a value of 9, the approximate computed position will not be updated on the GPN File record. However, the Elevation Code for the Forepoint SPN has a value of only 2, therefore the newly computed mark elevation for the Forepoint SPN will be entered and resaved on the GPN File record. In addition to listing of the approximate computed position, the program will print for the user, the observed zenith distances, the (T-O) values, the corrections for the reduction to line joining stations, the corrected zenith distances, and the minute check. If the current elevation in the GPN File is to be replaced, the program will print the following message:

```
REPLACED WITH          29.739      2
```

This message will let the user know that the current value of the elevation of mark in the GPN File for the Forepoint SPN has been replaced by 29.739 meters and set the elevation code to a value of 2. The final message printed for the user, if the current geographic position was NOT saved, is the following:

```
GEOGRAPHIC POSITION WILL NOT BE STORED
```

Therefore in this example, since the GPC and Elevation Codes are hierachical, a GPC value of 2 can not replace the existing GPC value of 9, while the existing Elevation Code of 2 is equal to the new value set, the program will allow the new elevation to be replaced.

SPN 71 GPN

```
------------- TRAVERSE COMPUTATION -------------

SPN  STATION NAME                        DEG MN  SEC

 70  BORO HALL 1931                      275 21 37.99  INITIAL AZIMUTH
 83  H 52 NY                             311 34 38.29  ANGLE
 71  POUCH 1931                          226 56 16.28  FORWARD AZIMUTH

    SPN ABS SET  LINE/VOLUME
     71 EDM   2  2            3371.7890

                  DISTANCE USED          3371.7890  METERS   <Slope>


                   APPROXIMATE
                GEOGRAPHIC POSITION
-------------------------------------------------
  STATION NAME            POUCH 1931

                          DEG  MN  SECONDS

  LATITUDE  =              40  37  07.8968   NORTH
  LONGITUDE =              74  04  05.6147   WEST
-------------------------------------------------

                  --DATA CURRENTLY IN STORAGE--
                  ELEVATION   CODE     POSITION
                     (M)                CODE
                    29.967     2          9
```

POINT	OBSERVED ZENITH (DEG MIN SEC)	(T-O) METERS	CORRN (SEC)	CORRECTED ZENITH (DEG MIN SEC)	MINUTE CHECK (MIN)	
STAND(Z1)=	+ 89 34 05.80	0.297	-18.17	+ 89 33 47.63	1.559	COMPUTED
FORE (Z2)=	+ 90 27 38.50	-0.169	10.34	+ 90 27 48.84	1.608	OBSERVED

```
REPLACED WITH       29.739       2

GEOGRAPHIC POSITION WILL NOT BE STORED
```

Figure (8.24) ---- WRKGPN Listing for an "Approximate" Computation

8.5 WRKTRI

The MTEN Command WRKTRI (reWoRK a TRIangle computation) will take a list of triangles selected by the user, they must have previously been created by GETTRI, compute each triangle, and print a working copy of the triangle computation. If station labeled number (1) was flagged to be positioned, a geographic position will also be printed. To enter the program type WRKTRI <cr>. The program will prompt the user to select a range of triangle numbers to be computed by flashing the following message to the screen:

```
BEGIN AT TRIANGLE (NNN)? ----
END WITH TRIANGLE (NNN)? ----
```

Once the range has been selected, the program will compute each triangle in the range one-by-one. A sample WRKTRI Screen is shown on Figure (8.25) and a completed triangle computation is shown on Figure (8.26).

```
+-------------------------------------------------------------------------+
01|                      ENTRY      ----  WRKTRI                           |
02|                   ------------------------------                      |
03|                                                                        |
04|                                   CURRENT TRIANGLE NUMBER        4     |
   ...
07|       LOOK UP CURRENT TRIANGLE                                         |
08|       LOOK UP THE TRIANGLE LAYOUT                                      |
09|       LOOK UP STATION NAMES                                            |
10|       LOOK UP COMBINED LISTS                                           |
11|                                                                        |
12|       COMPUTE THE DIRECTIONS                                           |
13|       COMPUTE THE TRIANGLE                                             |
14|       COMPUTE INVERSE BETWEEN STATIONS 2 AND 3                         |
15|       COMPUTE DIRECT FROM STATION 2 TO 1                               |
16|       COMPUTE DIRECT FROM STATION 3 TO 1                               |
17|                                                                        |
18|       STORE CURRENT TRIANGLE IN FILE                                   |
19|                                                                        |
20|       PRINT THE CURRENT TRIANGLE                                       |
   ...
24|       REPEAT THIS ENTRY COMMAND (Y/N)   ?                              |
+-------------------------------------------------------------------------+
```

Figure (8.25) ---- WRKTRI Screen

TRI 4

SPN 85

(4) TRIANGLE NUMBER

*** GPN COMPUTED FOR STATION ONE ***

STATION NAME	DISTANCE METERS	OBSERVED ANGLE DEG MN SEC	CORRN SEC	SPHERICAL ANGLE SEC	SPHERICAL EXCESS SEC	PLANE ANGLE SEC
2-3	4379.4146					
1 H 54 NY		62 04 43.38	0.97	44.35	0.01	44.33
2 H 52 NY		43 54 33.26	0.97	34.23	0.01	34.21
3 H 53 NY		74 00 40.50	0.97	41.47	0.01	41.45
1-3	3437.3454					
1-2	4764.6390					
		179 59 57.14	2.90	60.04	0.04	60.00

**** GEOGRAPHIC POSITION **********
**** GPN OF SPN = (85)
**** STATION NAME: H 54 NY

	DEG	MN	SECONDS	
LATITUDE :	40	40	47.2043	NORTH
LONGITUDE:	74	01	09.6998	WEST

SPN FROM	NBR TO	STATION NAME	FWD AZIMUTH DEG MN SEC	BACK AZIMUTH DEG MN SEC	DISTANCE METERS
85	83	H 52 NY	200 31 53.61	20 31 07.28	4764.6390
85	84	H 53 NY	262 36 37.96	82 35 03.36	3437.3454

Figure (8.26) ---- Printed Listing for Computation of Triangles

Adjustment Commands

9.1 ADJSTA + GETSTA + LSTSTA

The MTEN Command ADJSTA (ADJust a STAtion) combines one or up to a total of ten (10) horizontal abstracts (ABSHZT) into one unique list "LST" for the standpoint SPN. To enter the program type ADJSTA <cr>. The program will prompt the user for the standpoint SPN entry. After this entry has been completed, the program will then search out and collect all horizontal abstracts (ABSHZT) for the SPN requested.

The ADJSTA program has some system restrictions for the adjustment. The total number of abstracts cannot be greater than ten, and the total number of distinct points observed cannot exceed 57 for four (4) abstracts or 51 for ten (10) abstracts. If only one (1) abstract exists for the SPN, then the program will go directly to the output listing for the combined list "LST" see Figure (9.01). An additional restriction requires that the three programs ADJSTA, GETSTA, and LSTSTA be run one after the other when two or more abstracts exist.

The MTEN Command GETSTA (GET a STAtion adjustment) will compute a least squares station adjustment for the SPN. To enter the program type GETSTA <cr>. The GETSTA program will prompt the user for the default drive with the following statement:

```
CHANGE DEFAULT DRIVE=A    TYPE    "YES OR NO"
```

the user must then reply with either a YES <cr> or NO <cr> to the prompt. The program will next prompt the user for the Jobcode with the following:

```
ENTER YOUR CODE/JC/  TYPE  "JC=??" WHERE ?? IS THE JC
```

GETSTA will also print a summary of the abstracts, and the adjusted direction for each forepoint SPN (by abstract) and in the order they were combined. An example listing is given by Figure (9.02) for the Standpoint SPN=50.

The MTEN Command LSTSTA (LiST a STAtion adjustment) reformats the data. To enter the program type LSTSTA <cr>. The program will prompt the user the standpoint SPN entry and a printed listing is provided. A sample listing of a combined list "LST" for Standpoint SPN=50 is given by Figure (9.01).

SPN 50 LST

COMBINED LIST
OF
HORIZONTAL DIRECTIONS

STANDPOINT STATION NAME: PELLOW 1976
ODRER-AND-TYPE: 11
STATE/COUNTRY CODE: CT

ABSTRACT NUMBER	OCCUPATION DATE(S)	OBSERVER'S INITIALS	VOLUME NUMBER(S)	------INSTRUMENT------ JSI & SERIAL NUMBER(S)	
1	820630	DLM	VOL 2	15	1162333
2	820630	DLM	VOL 2	15	1162333
3	820630	MLB	VOL 2	15	1162333
4	820706	CEG	VOL 3	15	1162333
5	820706	CEG	VOL 3	15	1162333
6	830926	XXX	VOL 4	142	34567
7	830926	XXX	VOL 4	142	34567
8	831205	RWS	BK 40	142	34567
9	831207	DDW	VOL 3	15	1162333

--- FOREPOINT --- OBSERVED STATION NAMES	SPN	VG CODE	-DIRECTION- DEG	MN	SEC	NBR POS
RIDGE 1976	54	V	0	0	0.00	57
PELLOW 1976 AZ MK 1	64	Z	0	0	0.03	5
PELLOW 1976 AZ MK	57	Z	3	12	45.78	4
WINDFIELD MUN TANK	58	V	20	04	56.80	4
WINDFIELD LOT	59	V	41	34	05.49	4
MT CARMEL 2 CTGS 1940	55		57	07	14.37	56
WALLINGFORD SANITARIUM TANK	53	V	106	38	01.06	4
GAYLORD 1976	56	V	108	20	28.96	64
PELLOW 1976 RM 1	51	R	148	28	37.86	4
PELLOW 1976 RM 2	52	R	234	11	30.99	4
WINDFIELD LOT NO 2	61	V	239	03	34.99	4
WINDFIELD MUN TANK NO 3	62	V	282	28	44.40	4
WINDFIELD LOT NO 3	63	V	312	11	34.89	4

Figure (9.01) ---- Combined List Printed by LSTSTA

50 ********** COMPONENT 1

TATION BSERVED	OBSERVED DIRECTION	GROUP NUMBER	ADJUSTED DIRECTION	SIGMA (SEC)	WEIGHT (1/VAR)	RESID'L (SEC)	RESID'L/ SIGMA	RESID'L* WEIGHT	SIGMA V	RESID'L/ SIGMA V
54	00 00 00.00	1	00 00 00.000	0.6	2.778	0.037	0.062	0.103	0.642	0.058
55	57 07 14.46	1	57 07 14.374	0.6	2.778	-0.049	-0.082	-0.136	0.659	-0.074
56	108 20 28.99	1	108 20 28.962	0.6	2.778	0.009	0.015	0.025	0.659	0.014
56	00 00 00.00	2		1.2	0.694	0.000	0.000	0.000	0.000	0.000
51	40 08 08.90	2	148 28 37.862	1.2	0.694	0.000	0.000	0.000	0.000	0.000
52	125 51 02.03	2	234 11 30.992	1.8	0.305	0.000	0.000	0.000	0.000	0.000
56	00 00 00.00	3		1.2	0.694	0.000	0.000	0.000	0.000	0.000
53	358 17 32.10	3	106 38 01.062	1.2	0.694	0.000	0.000	0.000	0.000	0.000
56	00 00 00.00	4		0.6	2.778	0.584	0.973	1.622	0.659	0.886
54	251 39 31.19	4		0.6	2.778	0.432	0.720	1.200	0.642	0.672
55	308 46 47.01	4		0.6	2.778	-1.014	-1.690	-2.817	0.659	-1.538
54	00 00 00.00	5		0.6	2.778	-0.468	-0.780	-1.300	0.642	-0.728
55	57 07 12.44	5		0.6	2.778	1.466	2.443	4.072	0.659	2.223
56	108 20 29.49	5		0.6	2.778	-0.996	-1.660	-2.767	0.659	-1.510
56	00 00 00.00	6		0.9	1.384	0.809	0.952	1.120	0.894	0.905
55	308 46 47.03	6		0.9	1.384	-0.809	-0.952	-1.120	0.894	-0.905
54	00 00 00.00	7		1.2	0.694	0.000	0.000	0.000	0.000	0.000
57	03 12 45.78	7	03 12 45.780	4.1	0.059	0.000	0.000	0.000	0.000	0.000
58	20 04 56.80	7	20 04 56.800	1.2	0.694	0.000	0.000	0.000	0.000	0.000
59	41 34 05.49	7	41 34 05.490	1.2	0.694	0.000	0.000	0.000	0.000	0.000
61	239 03 34.99	7	239 03 34.990	1.2	0.694	0.000	0.000	0.000	0.000	0.000
62	282 28 44.40	7	282 28 44.400	1.2	0.694	0.000	0.000	0.000	0.000	0.000
63	312 11 34.89	7	312 11 34.890	1.2	0.694	0.000	0.000	0.000	0.000	0.000
64	00 00 00.00	8	00 00 00.026	1.2	0.694	0.008	0.007	0.006	0.609	0.013
54	359 59 59.99	8		1.2	0.694	-0.008	-0.007	-0.006	0.609	-0.013
64	00 00 00.00	9		2.4	0.174	-0.032	-0.013	-0.006	2.438	-0.013
54	359 59 59.91	9		2.4	0.174	0.032	0.013	0.006	2.438	0.013

EGREES OF FREEDOM = 6
ARIANCE OF UNIT WEIGHT = 2.5798
OTAL NUMBER NON-SPUR OBS = 15

Figure (9.02) ---- Sample Listing of the GETSTA Combined "LST"

9.2 ADJZEN

No program or reference material available due to the core limitations of the operating system of the Columbia computer.

9.3 ADJNET

No program or reference material available due to the core limitations of the operating system of the Columbia.

Report Generation and Listing Commands

10.1 LSTABS

The MTEN Command LSTABS (LiST an ABStract) will print any one of the seven types of abstracts used to enter observational data. To enter the program type LSTABS <cr>. The program will prompt for the standpoint SPN for which the abstract(s) are to be listed. After this information has been entered, the program then prompts the user to select one of the seven possible types of abstracts for each SPN and then prints the abstract before returning to the next selection.

The seven types of abstracts possible are formated and shown by the list of figures below:

Figure (10.01) --- Abstract of an Astronomic Azimuth
Figure (10.02) --- Abstract of Horizontal Measurements to Reference Objects
Figure (10.03) --- Abstract of Electronic Distance Measurement
Figure (10.04) --- Abstract of Difference of Elevation
Figure (10.05) --- Abstract of Horizontal Directions
Figure (10.06) --- Abstract of Short Traverse or Base Line
Figure (10.07) --- Abstract of Zenith Distances

10.2 LSTDST

The MTEN Command LSTDST (LiST DSTances) will print a summary listing of the one or all three types of distance abstracts (DST-EDM-LGH) for the project. In addition LSTDST has two other options, the program LSTDST will print the (EDM-LGH) abstract distances in either feet or meters as one user option; and the other option will print an extended listing with the following items: the (JSI) Job Specific Instrument number, the equipment serial number, the occupation date, the initials of the observer, and the type of source document. To enter the program type LSTDST <cr>. The program will prompt the user for the SPN range to be printed. After this entry has been completed, a printed listing will be generated. Figure (10.08) shows the form of the summary table.

10.3 LSTGPN

The MTEN Command LSTGPN (LiST a Geographic PositioN) will print a listing of the geodetic positions for the project. LSTGPN has two other options. The program LSTGPN will also print a listing of the project elevation and geoid heights; and a listing of SPN names with its year established, order-and-type, state, and plane coordinate zone. To enter the program type LSTGPN <cr>. The program will prompt the user for the SPN range to be printed. The listing printed will be in in numerical order by SPN or alphabetical order by station name. The three sample listings are given by Figures (10.09), (10.10), and (10.11).

10.4 LSTJSI

The MTEN Command LSTJSI (LiST Job Specific Instruments) will print a summary listing of equipment used for the project. The program LSTJSI will first print a table of instruments in numerical order of the assigned JSI. This is followed by a second instrument table listing sorted in the order of the equipment codes set forth in the "Input Formats and Specifications of the NGSDB", Annex F. To enter the program type LSTJSI <cr>. Figures (10.12) and (10.13) show the two equipment tables.

10.5 LSTNET

The MTEN Command LSTNET (LiST a NETwork) will print a listing showing the difference between the combined list of direction and the computed inverse for that forepoint. To enter the program type LSTNET <cr>. The program will prompt the user for the Standpoint SPN. A sample listing of a LSTNET command for standpoint SPN=71 is given on Figure (10.14).

The actual difference between the combined list direction and that from the inversed azimuth computed direction is 596.35 seconds. This large difference at SPN=79 between the two directions appears to be a blunder of about ten (10) minutes in the observed direction. The abstract on which this direction was entered should be checked and a new ADJSTA executed for this SPN once the correction has been found and made. The four "****" printed just to the right of the seconds is to bring to the attention of the user that the recorded distance and the computed distance differ by more than 2.5 meters and should be checked.

10.6 LSTTRI

The MTEN Command LSTTRI (LiST TRIangles) will format and print the whole set or any partial set of triangles for a given project. To enter the program type LSTTRI <cr>. The program will then prompt the user for how many triangles are to be entered. The printed listing will be in the form of three outputs:

Figure (10.15) --- Triangle List & Configuration
Figure (10.16) --- Triangle Statistics
Figure (10.17) --- Triangle Misclosure Histogram

```
                              ABSTRACT                                  SPN  30
                                 OF
                         ASTRONOMIC AZIMUTH                             AST   3
-------------------------------------------------------------------------------
   STANDPOINT STATION NAME:    WHITES
   ORDER-AND-TYPE CODE:        11
   STATE/CONTRY CODE:          CT
   OCCUPATION DATE (YMD):      791108
   RECORD VOLUME:              V 28
   OBSERVER'S INITIALS:        RLR
   JOB SPECIFIC INSTRUMENT:    121
   INSTRUMENT SERIAL NUMBER:   74708
   HEIGHT OF INSTRUMENT:              (M) METERS
   WEATHER:  CLOUD COVER  - PARTLY(20 TO 70%)
             WIND         - MODERATE(8-24KM/HR)
-------------------------------------------------------------------------------
ZONE       --- FOREPOINT ---          SPN VG --AZIMUTH-- POS LIMIT ---OBJECT--
 TIME    OBSERVED STATION NAME(S)                                (R)    HGT  CODE
                                             DEG MN  SEC      SEC    (M)
-------------------------------------------------------------------------------
      TAINTOR                         31     147 38 17.96  4  5.0   30.512  1

      ETA COMPONENT     0.000  EAST                  0.00  LAPLACE CORRECTION

      LAPLACE AZIMUTH                        147 38 17.96  (FROM NORTH)
```

Figure (10.01) ---- Abstract of Astronomic Azimuth

```
                              ABSTRACT                                  SPN  71
                                 OF
                 HORIZONTAL MEASUREMENTS TO REFERENCE OBJECTS           DST   1
-------------------------------------------------------------------------------
   STANDPOINT STATION NAME:    POUCH 1931
   ORDER-AND-TYPE CODE:        21
   STATE/CONTRY CODE:          NY
   OCCUPATION DATE (YMD):      800310
   RECORD VOLUME:              1
   OBSERVER'S INITIALS:        JGF
   JOB SPECIFIC INSTRUMENT:    55
   INSTRUMENT SERIAL NUMBER:   55
   HEIGHT OF INSTRUMENT:              (M) METERS
   WEATHER:  WIND         - CALM(UNDER 8KM/HR)
-------------------------------------------------------------------------------
ZONE       --- FOREPOINT ---          SPN VG  -MEASUREMENT-  LIMIT ---OBJECT--
 TIME    OBSERVED STATION NAME(S)              METERS   FEET   (R)   DISTANCE
                                                (M)     (FT)   (MM)    (KM)
-------------------------------------------------------------------------------
      POUCH 1931 RM 1                  72  R   2.639   8.658  3.0
      POUCH 1931 RM 2                  73  R  15.008  49.240  3.0
```

Figure (10.02) ---- Abstract of Horizontal Measurements to Reference Objects

```
                              ABSTRACT                                  SPN  85
                                 OF
                     ELECTRONIC DISTANCE MEASUREMENT                    EDM   1
-------------------------------------------------------------------------------
   STANDPOINT STATION NAME:    H 54 NY
   ORDER-AND-TYPE CODE:        31
   STATE/CONTRY CODE:          NY
   OCCUPATION DATE (YMD):      800313
   RECORD VOLUME:              14
   OBSERVER'S INITIALS:        JGF
   JOB SPECIFIC INSTRUMENT:    501
   INSTRUMENT SERIAL NUMBER:   97011
   HEIGHT OF INSTRUMENT:        1.615 (M) METERS
   WEATHER:  TEMPERATURE  - COLD(BELOW 0C)
             CLOUD COVER  - OVERCAST(OVER 70%)
             WIND         - MODERATE(8-24KM/HR)
-------------------------------------------------------------------------------
ZONE       --- FOREPOINT ---          SPN VG   -SLOPE-   NBR LIMIT ---OBJECT--
 TIME    OBSERVED STATION NAME(S)               DISTANCE   SHT  (R)    HGT  CODE
                                                  (M)           (MM)   (M)
-------------------------------------------------------------------------------
R1000 H 55 NY                          86      2327.1180   1          1.546   2
```

Figure (10.03) ---- Abstract of Electronic Distance Measurement

```
                              ABSTRACT                                  SPN   1
                                 OF
                        DIFFERENCE OF ELEVATION                         HGT   3
-------------------------------------------------------------------------------
   STANDPOINT STATION NAME:    STATION ONE
   ORDER-AND-TYPE CODE:        11
   STATE/CONTRY CODE:          WA
   OCCUPATION DATE (YMD):      830301
   RECORD VOLUME:              HGT  3
   OBSERVER'S INITIALS:        RWS
   JOB SPECIFIC INSTRUMENT:    401
   INSTRUMENT SERIAL NUMBER:   NGS-82-002
   WEATHER:  WIND         - STRONG(OVER 24KM/HR)
-------------------------------------------------------------------------------
ZONE       --- FOREPOINT ---          SPN VG -ELEVATION- REP LIMIT -SECTION---
 TIME    OBSERVED STATION NAME(S)               DIFFERENCE       (R)   LENGTH
                                                   (M)          (MM)   (KM)
-------------------------------------------------------------------------------
W1326 STATION TWO                       2        8.5900   1   2.0    0.225

      NUMBER OF SETUPS:                 5

      AGENCY:  NGS

      THIS ABSTRACT HAS LEVELING FOR A SHORT TRAVERSE MEASUREMENT
```

Figure (10.04) ---- Abstract of Difference of Elevation

```
                              ABSTRACT                                  SPN  83
                                 OF
                         HORIZONTAL DIRECTIONS                          HZT   1
-------------------------------------------------------------------------------
   STANDPOINT STATION NAME:    H 52 NY
   ORDER-AND-TYPE CODE:        31
   STATE/CONTRY CODE:          NY
   OCCUPATION DATE (YMD):      800312
   RECORD VOLUME:              1
   OBSERVER'S INITIALS:        JGF
   JOB SPECIFIC INSTRUMENT:    203
   INSTRUMENT SERIAL NUMBER:   226362
   HEIGHT OF INSTRUMENT:              (M) METERS
-------------------------------------------------------------------------------
ZONE       --- FOREPOINT ---          SPN VG -DIRECTION- POS LIMIT ---OBJECT--
 TIME    OBSERVED STATION NAME(S)                                (R)    HGT  CODE
                                              DEG MN  SEC       SEC    (M)
-------------------------------------------------------------------------------
      FT WADSWORTH LH                  75  V   0  0  0.00  4                 1
      POUCH 1931                       71  V  28  0 17.67  3                 1
      BORO HALL 1931                   70  V  76 25 39.38  4                 1
      H 53 NY                          84  V 137 40 35.12  4                 1
      STATUE OF LIBERTY                79  V 155 55 29.50  3                 3
      WORLD TRADE CENTER ANTENNA       81  V 176  4 34.62  4                 3
      H 54 NY                          85  V 181 35  8.38  4                 1
      FT WADSWORTH LH ECC              76  C   0  0  0.00  4                 1
                         ECCENTRICITY                                  -49.60(SEC)
```

Figure (10.05) ---- Abstract of Horizontal Directions

```
                              ABSTRACT                                  SPN   1
                                 OF
                     SHORT TRAVERSE OR PRECISE BASELINE                 LGH   3
-------------------------------------------------------------------------------
   STANDPOINT STATION NAME:    STATION ONE
   ORDER-AND-TYPE CODE:        11
   STATE/CONTRY CODE:          WA
   OCCUPATION DATE (YMD):      830301
   RECORD VOLUME:              LGH  3
   OBSERVER'S INITIALS:        RWS
   JOB SPECIFIC INSTRUMENT:    400
   INSTRUMENT SERIAL NUMBER:   NBS - 1307
   WEATHER:  WIND          - STRONG(OVER 24KM/HR)
-------------------------------------------------------------------------------
ZONE       --- FOREPOINT ---          SPN VG  --TAPED--  REP LIMIT
 TIME    OBSERVED STATION NAME(S)               DISTANCE      (R)
                                                   (M)       (MM)
-------------------------------------------------------------------------------
U1345  STATION TWO                      2      172.00682   1

       NUMBER OF BAYS:                  5
```

Figure (10.06) ---- Abstract of Short Traverse or Precise Baseline

ABSTRACT
OF
ZENITH DISTANCES

SPN 85
ZEN 1

STANDPOINT STATION NAME: H 54 NY
ORDER-AND-TYPE CODE: 31
STATE/CONTRY CODE: NY
OCCUPATION DATE (YMD): 800313
RECORD VOLUME: 1
OBSERVER'S INITIALS: JGF
JOB SPECIFIC INSTRUMENT: 203
INSTRUMENT SERIAL NUMBER: 226362
HEIGHT OF INSTRUMENT: 1.575 (M) METERS
WEATHER: TEMPERATURE - COLD(BELOW 0C)
CLOUD COVER - OVERCAST(OVER 70%)
WIND - MODERATE(8-24KM/HR)

ZONE TIME	--- FOREPOINT --- OBSERVED STATION NAME(S)	SPN	VG	--ZENITH-- DISTANCE DEG	MN	SEC	POS	LIMIT (R) SEC	---OBJECT-- HGT (M)	CODE	(T-O) (M)
R1200	H 52 NY	83		90	2	14.20	2		1.465	1	0.110
R1202	BORO HALL 1931	70		89	34	11.00	2		0.140	1	1.435
R1205	H 53 NY	84		90	2	21.00	2		1.637	1	-.062
1210	H 55 NY	86		90	0	27.20	2		1.386	1	0.189
1213	WORLD TRADE CENTER ANTENNA	81	V	81	44	57.50	2		0.000	3	1.575
1220	H 56 NY	87		90	3	52.80	2		1.428	1	0.147

Figure (10.07) ---- Abstract of Zenith Distances

SUMMARY OF MEASURED DISTANCES

FROM SPN NBR	STATION NAME	TO SPN NBR	--SET-- ABS	NBR	HORIZONTAL REFERENCE METERS	HORIZONTAL MEASUREMENTS FEET	HORIZONTAL MEASUREMENTS KM	GEODETIC DISTANCE METERS	(JSI)JOB SPECIFIC INSTR	EQUIPMENT SERIAL NUMBER	DATE YYMMDD	OBS	VOLUI SHEE LINE
1	STATION ONE												
	STATION TWO	2	LGH	3				172.0068	400	NBS - 1307	830301	RWS	LINE
2	STATION TWO												
	STATION ONE	1	LGH	3				172.0068	400	NBS - 1307	830301	XXX	LINE
71	POUCH 1931												
	POUCH 1931 RM 1	72	DST	1	2.639	8.66			55	55	800310	JGF	1
	POUCH 1931 RM 2	73		1	15.008	49.24							
	BORO HALL 1931	70	EDM	1			SLOPE <	2692.0000>	501	97011	800310	JGF	1
	H 52 NY	83	EDM	2			SLOPE <	3371.0000>	501	97011	800310	JGF	2
76	FT WADSWORTH LH ECC												
	FT WADSWORTH LH	75	DST	1	1.642	5.39			55	55	800310	JGF	1
	BORO HALL 1931	70	EDM	1				4472.3344	501	97011	800310	JGF	3
	H 52 NY	83	EDM	2				3976.7954	501	97011	800310	JGF	4
	H 5 NY 79	89	EDM	3				5403.5932	501	97011	800310	JGF	5
82	BOLT												
	H 53 NY	84	EDM	1				3014.6177	501	97011	800316	JGF	19
	H 55 NY	86	EDM	2				1515.3976	501	97011	800316	JGF	20
83	H 52 NY												
	BORO HALL 1931	70	EDM	1				3180.7722	501	97011	800312	JGF	7
	H 53 NY	84	EDM	2				4379.4894	501	97011	800312	JGF	8
	H 54 NY	85	EDM	3				4764.7835	501	97011	800312	JGF	9
84	H 53 NY												
	H 54 NY	85	EDM	1				3437.7597	501	97011	800313	JGF	10
	BOLT	82	EDM	2				3014.6406	501	97011	800313	JGF	11
	H 55 NY	86	EDM	3				1912.8598	501	97011	800313	JGF	12
	BORO HALL 1931	70	EDM	4				3986.9545	501	97011	800317	JGF	13

Figure (10.08) ---- Summary Table of Measured Distances by LSTDST

LIST OF SURVEY POINT NUMBERS

SPN	STATION NAME	YEAR	OT	ST	PCZ	PARENT	SUFFIX
82	BOLT	1980	31	NY	3104		
70	BORO HALL 1931	1931	21	NY	3104		
77	CONEY IS BKLYN GAS LG GAS TK	1930	47	NY	3104		
74	CONEY ISLAND LIGHTHOUSE 1903	1903	21	NY	3104		
80	EMPIRE STATE BUILDING	1932	47	NY	3101		
75	FT WADSWORTH LH	1903	47	NY	3104		
83	H 52 NY	1980	31	NY	3101		
84	H 53 NY	1980	31	NJ	2900		
85	H 54 NY	1980	31	NY	3104		
86	H 55 NY	1980	31	NY	3104		
87	H 56 NY	1980	31	NY	3104		
88	H 57 NY	1980	31	NY	3104		
71	POUCH 1931	1931	21	NY	3104		
72	POUCH 1931 RM 1		43	NY	3104	71	K
73	POUCH 1931 RM 2		43	NY	3104	71	L
78	ROBBINS REEF LIGHT USE	1930	47	NY	3104		
79	STATUE OF LIBERTY	1887	47	NY	3104		

Figure (10.09) ---- Station SPN and Name Listing

LIST OF GEOGRAPHIC POSITIONS

SPN	STATION NAME	GPN CODE K	LATITUDE DEG MN SEC	LONGITUDE DEG MN SEC	G-NBR
82	BOLT	4	40 41 10.19900	74 01 36.23553	
70	BORO HALL 1931	9	40 38 32.15600	74 04 35.58500	2477
77	CONEY IS BKLYN GAS LG GAS TK	9	40 34 53.59500	73 58 50.50300	2477
74	CONEY ISLAND LIGHTHOUSE 1903	9	40 34 35.37300	74 00 43.82700	2003
80	EMPIRE STATE BUILDING	9	40 44 53.98400	73 59 09.84200	4123
75	FT WADSWORTH LH	9	40 36 20.55000	74 03 15.71800	1228
83	H 52 NY	4	40 38 22.54453	74 02 20.81410	
84	H 53 NY	4	40 40 32.84694	74 03 34.84360	
85	H 54 NY	4	40 40 47.20434	74 01 09.69976	
86	H 55 NY	4	40 41 18.56258	74 02 39.82011	
87	H 56 NY	4	40 41 20.92844	74 00 45.97662	
88	H 57 NY	4	40 42 03.21999	74 00 52.99004	
71	POUCH 1931	9	40 37 07.89800	74 04 05.61200	2477
72	POUCH 1931 RM 1	0			
73	POUCH 1931 RM 2	0			
78	ROBBINS REEF LIGHT USE	9	40 39 26.14500	74 03 56.77700	2477
79	STATUE OF LIBERTY	9	40 41 20.65500	74 02 41.86300	2477

Figure (10.10) ---- Geographic Position Listing

LIST OF ELEVATIONS & GEOID HEIGHTS

SPN	STATION NAME	HGT CODE K	ELEVATION (M)	GEOID HGT (M)
82	BOLT	9	3.0610	
70	BORO HALL 1931	4	56.5150	
77	CONEY IS BKLYN GAS LG GAS TK	0		
74	CONEY ISLAND LIGHTHOUSE 1903	0		
80	EMPIRE STATE BUILDING	0		
75	FT WADSWORTH LH	2	20.5100	
83	H 52 NY	4	3.2500	
84	H 53 NY	5	3.3420	
85	H 54 NY	5	4.5460	
86	H 55 NY	5	4.8160	
87	H 56 NY	5	3.4850	
88	H 57 NY	5	15.1180	
71	POUCH 1931	4	29.8120	
72	POUCH 1931 RM 1	0		
73	POUCH 1931 RM 2	0		
78	ROBBINS REEF LIGHT USE	0		
79	STATUE OF LIBERTY	2	36.5734	

Figure (10.11) ---- Elevation & Geoid Height Listing

BLUEBK	-	BLUEBOOK CODE (ANNEX F)
C	-	CONSTANT FOR INSTRUMENT
CU	-	CONSTANT UNITS
FT	-	FEET
JSI	-	JOB SPECIFIC INSTRUMENT NUMBER
MA	-	MINUTES OF ARC
MF	-	MILLIFEET
MM	-	MILLIMETERS
MT	-	METERS
NBR	-	NUMBER
R	-	RESOLUTION
RU	-	RESOLUTION UNITS
SA	-	SECONDS OF ARC/TIME

PROJECT INSTRUMENT INVENTORY

BLUEBK NUMBER	SERIAL NUMBER	NODEL CLASS	MANUFACTURER TYPE OF EQUIPMENT	----INSTRUMENT---- R	RU	C	CU	JSI NBR
911		PEE WEE	LIGHT	0.000				1
912		TARGET	(WITH HEIGHT)	0.000				2
913		OBJECT	(NO HEIGHT)	0.000				3
914		TOP OF	A MARK (DISK)	0.000				4
915		TOP OF	A BENCHOVER	0.000				5
916		TOP OF	A STAND	0.000				6
917		TOP OF	A TRIPOD	0.000				7
918		TOP OF	A WELDED SECTION	0.000				8
919		TOP OF	THE LIGHT PLATE	0.000				9
123	1162333	T-3	WILD	0.200	SA	7.888	SA	15
461	55	30-MT	K+E	1.000	MM			55
251	345		K+E	1.000	SA			202
142	226362	T-2	WILD	1.000	SA			203
422	NBS - 1307	50-MT	K+E	0.200	MM			400
534	97011	LSE	K+E	2.000	MM	-0.322	MT	501
701	NGS - 234	3-PRISM		0.000		+0.315	MT	701
951	8413	CLOCK	CHRONOMETER	0.250	SA			951

Figure (10.12) ---- JSI Table (Numeric Order)

PROJECT INSTRUMENT INVENTORY

BLUEBK NUMBER	SERIAL NUMBER	NODEL CLASS	MANUFACTURER TYPE OF EQUIPMENT	----INSTRUMENT---- R	RU	C	CU	JSI NBR
000-099		SPECIAL INSTRUMENTATION						
100-199		THEODOLITES & TRANSITS						
123	1162333	T-3	WILD	0.200	SA	7.888	SA	15
142	226362	T-2	WILD	1.000	SA			203
200-299		LEVELING INSTRUMENTS						
251	345		K+E	1.000	SA			202
300-399		LEVELING RODS & STAVES						
400-499		STEEL & INVAR TAPES						
422	NBS - 1307	50-MT	K+E	0.200	MM			400
461	55	30-MT	K+E	1.000	MM			55
500-599		DISTANCE MEASURING-LIGHTWAVE						
534	97011	LSE	K+E	2.000	MM	-0.322	MT	501
600-699		DISTANCE MEASURING-INFRARED						
700-799		RETRO-REFLECTORS						
701	NGS - 234	3-PRISM		0.000		+0.315	MT	701
800-899		DISTANCE MEASURING-MICROWAVE						
900-999		SPECIAL TARGETS & MISCELLANEOUS EQUIPMENT						
911		PEE WEE	LIGHT	0.000				1
912		TARGET	(WITH HEIGHT)	0.000				2
913		OBJECT	(NO HEIGHT)	0.000				3
914		TOP OF	A MARK (DISK)	0.000				4
915		TOP OF	A BENCHOVER	0.000				5
916		TOP OF	A STAND	0.000				6
917		TOP OF	A TRIPOD	0.000				7
918		TOP OF	A WELDED SECTION	0.000				8
919		TOP OF	THE LIGHT PLATE	0.000				9
951	8413	CLOCK	CHRONOMETER	0.250	SA			951

Figure (10.13) ---- JSI Table (Bluebook Equipment Code Order)

SPN 71 LSTNET

COMPARISON OF COMBINED LIST DIRECTIONS
TO
DIRECTIONS COMPUTED FROM INVERSED AZIMUTHS

STANDPOINT STATION NAME: POUCH 1931
ORDER-AND-TYPE CODE: 21
STATE/COUNTRY CODE: NY

--- FOREPOINT --- OBSERVED STATION NAME(S)	SPN	VG	POS	COMBINED LIST RECORDED DISTANCE	COMBINED LIST DIRECTION (DEG MIN SEC)	INVERSE COMPUTATION DIRECTION (DEG MIN SEC)	INVERSE COMPUTATION INVERSE DISTANCE	COMPUTED DIFFERENCE (SEC)	
BORO HALL 1931	70	V	4	2692.819	00 00 00.00	00 00 00.00	2692.774	00.00	
STATUE OF LIBERTY	79	V	4	12552.908	29 29 00.52	29 19 04.17	8040.962	596.35	****
POUCH 1931 RM 2	73	R	1	15.008	53 44 29.52				
H 52 NY	83	V	4	3371.677	62 04 48.77	62 04 49.82	3371.620	-1.05	
POUCH 1931 RM 1	72	R	1	2.639	146 41 15.52				

Figure (10.14) ---- LSTNET Listing

LIST OF TRIANGLES IN STORAGE

TRIANGLE NUMBER	STATION NUMBERS (1)	(2)	(3)	MISCLOSURE (SEC)	EXCESS (SEC)
1	83	71	70	-3.16	0.020
2	76	70	83	-5.67	0.031
3	84	83	70	2.09	0.031
4	85	83	84	-2.90	0.037
5	85	83	70	5.84	0.037
6	84	85	70	-6.65	0.031
7	86	85	84	-3.15	0.011
8	NOT INCLUDED				
9	NOT INCLUDED				

Figure (10.15) ---- Triangle List & Configuration

--- STATISTICS ---

NUMBER OF TRIANGLES	7
NUMBER OF POSITIVE MISCLOSURES	2
NUMBER OF NEGATIVE MISCLOSURES	5
NUMBER OF ZERO CLOSURES	0
LARGEST (+) MISCLOSURE	5.84
LARGEST (-) MISCLOSURE	-6.65
ABSOLUTE AVERAGE TRIANGLE MISCLOSURE	4.21
MEDIAN TRIANGLE MISCLOSURE	-3.15
MEAN TRIANGLE MISCLOSURE	-1.94
TRIANGLE MISCLOSURE VARIANCE	19.46
S.E. OF A SINGLE TRIANGLE MISCLOSURE	4.41
S.E. OF THE MEAN TRIANGLE MISCLOSURE	1.67

Figure (10.16) ---- Triangle Statistics

```
   |- - - - - - - - - - - - - - - - - - -|
   |                                     |
   |                                     |
   |                                     |
   |                                     |
   |                                     |
   |                                     |
   |                                     |
   |                                     |
   |                                     |
   |                                     |
   |                                     |
  O|     O                               |
  O|     O O                   O         |O
 |-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|-|
 5   4   3   2   1   0   1   2   3   4   5
    --NEGATIVE--            --POSITIVE--

    ---TRIANGLE MISCLOSURE HISTOGRAM---
```

Figure (10.17) ---- Triangle Misclosure Histogram

Bluebook Data Set Generation Commands

11.1 BBKDES

The MTEN Command BBKDES (Blue BooK DEScription) will take text from any of the DES Files and print a single SPN description or the program will take all the descriptive text and create a Blue Book Dataset in the formats which are set forth in the "Input Formats and Specifications of the NGSDB", Chapter 3, Horizontal Descriptive (HZTL DESC) Data. To enter the program type BBKDES <cr>. The program will prompt the user for the default drive, and the two-letter project Jobecode. After the entry has been completed, the program prompts the user to select one of the four types of descriptive text.

```
HORIZONTAL   DESCRIPTION (Y/N)    Y      Program will use a
GPS/DOPPLER  DESCRIPTION (Y/N)           Horizontal Format
-------------------------------------------------------------------
BENCH MARK   DESCRIPTION (Y/N)           Program will use a
GRAVITY      DESCRIPTION (Y/N)           Vertical Format
-------------------------------------------------------------------
```

Once the type of descriptive text has been selected, the program will prompt the user to select one of two options.

```
CREATE A "BLUE BOOK" DESCRIPTION DATASET (Y/N)              N
```

If the response is "N" NO, the program will execute option one as shown by Figure (11.01) to print a single description. However, if the response is "Y" YES, the program will execute second option as shown by Figure (11.03) to create a "Blue Book" Dataset.

```
+-----------------------------------------------------------------------+
|                      DATA ENTRY ----  BBKDES                          |
|                  ------------------------------                       |
|      SURVEY POINT NUMBER/STANDPOINT/SPN (NNN) ?  50                   |
|                                                                       |
|                                                                       |
|                                                                       |
|                                                                       |
|                                                                       |
|       SPN  ---DESCRIPTION---  DISK    STATION                         |
|       NBR    TYPE      FILE   DRIVE     NAME                          |
|                                                                       |
|        50  ORIGINAL  FILEDESX   B   PELLOW 1976                       |
|                                                                       |
  .....
|                                                                       |
|      PRINT ANOTHER DESCRIPTION (Y/N)?  N                              |
|      REPEAT THIS ENTRY COMMAND (Y/N)   ?                              |
+-----------------------------------------------------------------------+
```

Figure (11.01) ---- BBKDES Description Listing Screen

When option one is in effect, the next prompt made by the program is to have the user select a Sandpoint SPN for which a description will be printed. As an example a partial horizontal description listing, Standpoint SPN=50 is shown by Figure (11.02).

```
OBSERVER  = DLM                                                    SPN  50  DES
VOL/SHEET = ___
        **********  S T A T I O N      D E S C R I P T I O N   **********

                                                  QUAD--      N41072341  QSN--
DESIGNATION--  PELLOW 1976                        ST/COUNTY-- CT/NEW HAVEN

                                        YEAR  COP
MONUMENT BY--  NGS                      1976  JLC  MARK TYPE-- HZTL DISK
                                        PACK TIME
REACHED BY--   4-WHEEL DRIVE           (     HHMM) INSTRUMENT HEIGHT-- 19.7 METERS
-----------------------------------------------------------------------------------
         CODE  MARK TYPE------  SETTING CODE----------------------- MAGNETIC CODE
SURFACE-- D08  SURVEY DISK      IN TOP OF A ROUND CONCRETE MONUMENT     N
UNDERGRD- D04  SURVEY DISK      IN AN IRREGULAR MASS OF CONCRETE        N
-----------------------------------------------------------------------------------
APPROXIMATE-- (LATITUDE = 412458N     LONGITUDE = 0724935W) --POSITION
-----------------------------------------------------------------------------------
MARK      REFERENCE            COMPASS  ------DISTANCES------   DIRECTION
CODE       OBJECTS             HEADING METERS  FEET   APPROX.   DDD MM SSS

D08NRIDGE 1976                   W   V             A12.09 KM   000 00 000
D08NPELLOW 1976 AZ MK            W                 A0.800 KM   003 12 458
L53 WINDFIELD MUN TANK           WNW               A5.600 KM   020 04 568
D08NPELLOW 1976 RM 1             NW  H 20.749 68.07            040 07 57
D08NPELLOW 1976 RM 2             NE  H 42.848140.57            125 50 47
    PELLOW 1976 RM 1
-TO-PELLOW 1976 RM 2                 H       151.55
```

THE STATION IS ABOUT 4.8 KM (3 MI) SOUTH OF WALLINGFORD, 4 KM (2.5 MI) NORTHEAST OF NORTH HAVEN. OWNERSHIP--STATE HIGHWAY RIGHT-OF-WAY.

TO REACH THE STATION FROM THE JUNCTION OF INTERSTATE 91 AND STATE HIGHWAY 5 IN NORTH HAVEN, GO NORTH FOR 2.8 KM (1.8 MI) ON STATE HIGHWAY 5 TO A SIDE ROAD ON THE RIGHT, TURN RIGHT AND GO EAST FOR 1.0 KM (0.6 MI) ON SCRUB OAK ROAD TO A CROSSROAD, CONTINUE STRAIGHT AHEAD EAST FOR 0.5 KM (0.3 MI) ON SCRUB OAK ROAD TO A SIDE ROAD ON THE RIGHT, TURN RIGHT AND GO SOUTH FOR 0.4 KM (0.25 MI) ON CLINTONVILLE ROAD TO A TRIANGULAR BLAZED TREE ON THE RIGHT, TURN RIGHT AND GO SOUTHWEST FOR 0.2 KM (0.1 MI) ON AND ACROSS AN OPEN FIELD, UPHILL, TO THE HIGHEST POINT OF THE HILL AND THE STATION AS DESCRIBED.

THE STATION IS A STANDARD NGS DISK STAMPED---PELLOW 1976---, SET INTO THE TOP OF A ROUND CONCRETE MONUMENT 30 CM IN DIAMETER FLUSH WITH THE GROUND. IT IS LOCATED 8.23 METERS (27.0 FT) NORTHEAST FROM A 25 CM TRIANGULAR BLAZED TREE, AND 2.1 METERS (7 FT) WEST FROM THE WEST EDGE OF OPEN FIELD.

REFERENCE MARK NO. 1 IS A STANDARD NGS DISK STAMPED---PELLOW NO 1 1976---, SET INTO THE TOP OF A ROUND CONCRETE MONUMENT 30 CM IN DIAMETER PROJECTING 2 CM ABOVE THE GROUND. IT IS LOCATED 9.8 METERS (32.0 FT) EAST FROM A 4-TRUNKED GUM TREE, AND 0.9 METER (3 FT) SOUTH-SOUTHWEST FROM A WITNESS POST. MARK IS 1.0 METER BELOW THE STATION.

...

Figure (11.02) ---- Partial Standpoint SPN=50 Description Listing

The second option, or a "Y" YES response, will create a "Blue Book" Dataset and the program will prompt the user if this new dataset is to be created on the default drive or not? If the answer is "Y" YES then the created dataset will be saved as a file on the default drive with BBKHZTLX as the filename and the filetype equal to the project Jobcode JC.

```
CREATE A "DISK FILE" ... (Y/N)?                                  Y
```

If the answer is "N" NO, only a paper listing is genterated.

Next the program prompts the user if this new dataset is a continuation of a previous BBKDES Dataset. If it is a continuation be sure the previous BBKDES Dataset has been renamed before this program is executed for the next dataset generation. Each time BBKDES is executed and a file is created the program will name it "BBKHZTLX.JC".

```
IS THIS A CONTINUED DESCRIPTION FILE ... (Y/N)?                  Y
```

If the answer is "N" NO, the user is prompted to enter the current date so the Data Set Identification Record can be generated,

```
TODAYS DATE/YYYY MM DD/ (NNNN NN NN)?
```

otherwise with an answer of "Y" YES the user is prompted to enter the re-start line number for the beginning record of this dataset.

```
ENTER THE RE-START LINE NUMBER (NNNNN)?                          1151
```

This allows the dataset to be numbered so that it is consecutive to a previous dataset created. However if, this is the first record of the Descriptive "Blue Book" Dataset, the program will prompt the user to enter the current date so that the "Data Set Identification Record", *JC*, can be created. Once the record has been completed the program prompts the user for a range of standpoint SPN's to use as limits for the generated dataset. Figure (11.03) shows the screen for a selected range from SPN=50 to SPN=70.

```
+-----------------------------------------------------------------------+
|                      DATA ENTRY ----  BBKDES                          |
|                   ------------------------------                      |
|      CREATE A "BLUE BOOK" DESCRIPTION DATASET (Y/N)?          Y       |
|                                                                       |
|                                  BEGINNING /SPN/ (NNN)?       50      |
|                                  END WITH  /SPN/ (NNN)?       70      |
|                                                                       |
|       SPN  ---DESCRIPTION---  DISK    STATION                         |
|       NBR    TYPE      FILE   DRIVE     NAME                          |
|                                                                       |
|        50  ORIGINAL  FILEDESX   B   PELLOW 1976                       |
|        70  RECOVERY  FILEDESX   B   BORO HALL 1931                    |
|  ....
|      THIS THE "VERY LAST" LINE OF DESCRIPTIVE TEXT (Y/N)?      Y       |
|      REPEAT THIS ENTRY COMMAND (Y/N)   ?                              |
+-----------------------------------------------------------------------+
```

Figure (11.03) ---- BBKDES "Blue Book" Dataset Screen

If Standpoint SPN=70 is the very last description to be created on the current Descriptive "Blue Book" Dataset and when it is completed, the program will flash the user is this is the "VERY LAST" line? If so, the Data Set Termination Record *JC* will be put at the end of the dataset. If the dataset is to be continued with additional files, answer "N" NO and the program will flash to the screen the following information to be used on the next dataset to be created.

```
      THE LAST "RECORD NUMBER" WAS =     1150
      EXIT & SAVE ... "BBKHZTLX.JC" ... DESCRIPTION FILE!!!!
  ?   TOUCH <SPACE BAR + CR> .... WHEN YOU ARE READY
```

Figure (11.04) shows the descriptive text records for Standpoint SPN=50 that will be contained in the "Blue Book" Dataset.

```
000010*JC*HZTLDESCNGS   NATIONAL GEODETIC SURVEY                          19840328
          <--- Data Set Identification Record
   ...

          <--- Continuation Dataset Listing

010330*10*050D                    *11*N41072341        *12*D08N        *13*D04N
010340*14*PELLOW 1976                                  *15*CT/NEW HAVEN
010350*20*1/NGS                   *21*1976JLC          *22*HX          *23*19.7
010360*30*D08NRIDGE 1976                        W  V             A12.09 KM  00000000
010370*30*D08NPELLOW 1976 AZ MK                 W                A0.800 KM  00312458
010380*30*L53 WINDFIELD MUN TANK                WNW              A5.600 KM  02004568
010390*30*D08NPELLOW 1976 RM 1                  NW H 20.749 68.07            0400757
010400*30*D08NPELLOW 1976 RM 2                  NE H 42.848140.57            1255047
010410*30*    PELLOW 1976 RM 1
010420*30*    PELLOW 1976 RM 2                     H       151.55
010430*30*$$
010440*40*THE STATION IS ABOUT 4.8 KM (3 MI) SOUTH OF WALLINGFORD, 4 KM (2.5 MI)
010450*40*NORTHEAST OF NORTH HAVEN.
010460*40*OWNERSHIP--STATE HIGHWAY RIGHT-OF-WAY.
010470*40*$
010480*40*TO REACH THE STATION FROM THE JUNCTION OF INTERSTATE 91 AND STATE
010490*40*HIGHWAY 5 IN NORTH HAVEN, GO NORTH FOR 2.8 KM (1.8 MI) ON STATE
010500*40*HIGHWAY 5 TO A SIDE ROAD ON THE RIGHT,
010510*40*TURN RIGHT AND GO EAST FOR 1.0 KM (0.6 MI) ON SCRUB OAK ROAD TO A
010520*40*CROSSROAD, CONTINUE STRAIGHT AHEAD EAST FOR 0.5 KM (0.3 MI) ON SCRUB
010530*40*OAK ROAD TO A SIDE ROAD ON THE RIGHT,
010540*40*TURN RIGHT AND GO SOUTH FOR 0.4 KM (0.25 MI) ON CLINTONVILLE ROAD TO
010550*40*A TRIANGULAR BLAZED TREE ON THE RIGHT,
010560*40*TURN RIGHT AND GO SOUTHWEST FOR 0.2 KM (0.1 MI) ON AND ACROSS AN
010570*40*OPEN FIELD, UPHILL, TO THE HIGHEST POINT OF THE HILL AND THE STATION
010580*40*AS DESCRIBED.
010590*40*$
010600*40*THE STATION IS A STANDARD NGS DISK
010610*40*STAMPED---PELLOW 1976---,
010620*40*SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
010630*40*30 CM IN DIAMETER FLUSH WITH THE GROUND.  IT IS LOCATED
010640*40*8.23 METERS (27.0 FT) NORTHEAST FROM A 25 CM TRIANGULAR BLAZED TREE
010640*40*AND,
010650*40*2.1 METERS (7 FT) WEST FROM THE WEST EDGE OF THE OPEN FIELD.
010660*40*$
010670*40*REFERENCE MARK NO. 1 IS A STANDARD NGS DISK
010680*40*STAMPED---PELLOW NO 1 1976---,
010690*40*SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
010700*40*30 CM IN DIAMETER PROJECTING 2 CM ABOVE THE GROUND.  IT IS LOCATED
010710*40*9.8 METERS (32.0 FT) EAST FROM A 4-TRUNKED GUM TREE, AND
010720*40*0.9 METER (3 FT) SOUTH-SOUTHWEST FROM A WITNESS POST.
010730*40*MARK IS 1.0 METER BELOW THE STATION.
010740*40*$
   ...

036570*JC*   <--- Date Set Termination Record
```

Figure (11.04) ---- A Sample Descriptive "Blue Book" Dataset Listing

11.2 BBKOBS

The MTEN Command BBKOBS (Blue BooK OBServations) will take data from all system files and create an Observation Blue Book Dataset in the formats set forth in the "Input Formats and Specifications of the NGSDB", Chapter 2, Horizontal Observation (HZTL OBS) Data. To enter the program type BBKOBS <cr>. After the entry has been completed, the program will prompt the user whether or not to save the created observation dataset.

```
CREATE A "DISK FILE" ... (Y/N)?                    Y
```

An answer of "Y" YES will cause the program to save a copy of the created dataset on the default drive with BBKOBSXX as the filename and the project jobcode JC as the filetype. If "N" NO, the observation dataset will be listed by the printer and not saved. The program will then prompt the user to enter the current date,

```
TODAYS DATE/YYYY MM DD/ (NNNN NN NN)?  1984 03 28
```

Once this entry has been completed the program will flash to the screen the overall range of SPN's. Where the beginning SPN will be one (1) and the ending SPN will be the last (MAX value or highest SPN used on the project).

The first pass made by the BBKOBS program is to remove all blank SPN's that are in the limits of the SPN range. The standpoint names and SPN's will flash to the screen one-by-one as each record is searched for data. When the limit has been reached, the program begins flashing each type of record found. The set of records will be:

```
*JC*  -- Data Set Identification Record
*10*  -- Project Title Record
*12*  -- Project Information Record
*13*  -- Geodetic Datum and Ellipsoid Record
...
...
...
```

and

```
*JC*  -- Data Set Termination Record
```

Utility Programs

12.1 LSTBBK

The MTEN Command LSTBBK (LiST A BlueBooK data set) will take either a BBKOBS or BBKDES Data Set in 80-character records as input and print a page formated listing. To enter the program type LSTBBK <cr>. After the entry has been completed the program will prompt the user first for the "/OLD/" input data set's primary filename (SAMPLE), filetype (AAA), and the drive assignment (B). The program will then prompt the user for the "/NEW/" output data set's primary filename (BBKHZTLX), filetype (DOC), and drive (A) so it can put the file on the disk drive with a line feed (LF) and a carriage return (CR) at the end of each record so it will be available for listing with the "TYPE" command. Sample screens are given by Figures (12.01) and (12.02).

```
+-----------------------------------------------------------------------+
|                        ENTRY      ----  LSTBBK                         |
|                     ------------------------------                    |
|                                                                       |
|      OLD DATA SET NAME--- SAMPLE  .AAA       DRIVE--- B               |
|                                                                       |
|      NEW DATA SET NAME--- BBKHZTLX.DOC       DRIVE--- A               |
|                                                                       |
|      ENTER YOUR FILE NAME (8A)? /NEW/        BBKHZTLX                 |
|                                                                       |
|      ENTER YOUR JOBCODE /JC/ (AAA)?          DOC                      |
|                                                                       |
|      CHANGE YOUR DEFAULT DRIVE=A (Y/N)?      N                        |
|                                                                       |
|      PROCESS THE FILE /NEW/ (Y/N)?           Y                        |
|                                                                       |
 ....
+-----------------------------------------------------------------------+
```

Figure (12.01) ---- LSTBBK Initial Screen

```
+-----------------------------------------------------------------------+
 ...
|                                                                       |
|      PRINT A LISTING OF THE DATA SET (Y/N)?                    Y      |
|                                                                       |
|      PRINT LISTING ON THE SCREEN (Y/N)?                        Y      |
|                                                                       |
|      START AT BEGINNING OF THE DATA SET (Y/N)?                 N      |
|                                                                       |
|      ENTER THE STARTING FILE RECORD NUMBER (NNNNNN)?           1200   |
|                                                                       |
|      STOP AT THE END OF THE DATA SET (Y/N)?                    Y      |
|                                                                       |
 ...
|                                                                       |
|      REPEAT THIS ENTRY COMMAND (Y/N)   ?                              |
+-----------------------------------------------------------------------+
```

Figure (12.02) ---- LSTBBK Second Screen

12.2 LSTDAT

The MTEN Command LSTDAT (LiST a DATa file) will print a listing in sequential order for a selected range of records from any of the five system files. To enter the program type LSTDAT <cr>. Next, the following screen appears, see Figure (12.03):

```
+------------------------------------------------------------------------+
|                      LIST ENTRY ----  LSTDAT                           |
|                   ------------------------------                       |
|                                                                        |
|                      --FILE--          NUMBER                          |
|                                                                        |
|                         GPN               6                            |
|                         NDX               7                            |
|                         INX               8                            |
|                         DAT               9                            |
|                         DES              10                            |
|                                                                        |
|      SELECT A "FILE NUMBER" (N)?                                  ?    |
|                                                                        |
|                                                                        |
|                                                                        |
|      BEGIN RECORD NUMBER (NNNN)?                                  ????  |
|      END   RECORD NUMBER (NNNN)?                                  ????  |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|      CONTINUE THIS FILE LISTING (Y/N)  ?                               |
|      REPEAT THIS ENTRY COMMAND (Y/N)   ?                               |
+------------------------------------------------------------------------+
```

Figure (12.03) ---- LSTDAT Initial Screen

If any file number other than ten (10) is selected the program will prompt for the beginning and ending record numbers to be listed. However, if file number ten (10) is selected, the user is prompted for the correct "DES" file, see sample screen Figure (12.04). All records listed by LSTDAT have the following heading

```
  LOCATION  ...                 FILE ( ??? )

RECORD ...
RECORD ...
RECORD ...
```

where (???) is the name of the data file from which the records will be listed and followed by a line-by-line (RECORD ...) listing of the requested record range.

```
+-----------------------------------------------------------------------------+
01|                        LIST ENTRY ----  LSTDAT                              |
02|                    ------------------------------                           |
03|                                                                             |
 ....
11|                                                                             |
12|       SELECT A "FILE NUMBER" (N)?                                  10       |
13|                                                                             |
14|       SELECT THIS "DES FILE" .... LABEL = X              (Y/N)  ?          |
15|                                                                             |
16|       BEGIN RECORD NUMBER (NNNN)?                                  ????     |
17|       END   RECORD NUMBER (NNNN)?                                  ????     |
18|                                                                             |
19|       EDIT ONE OF THE ABOVE RECORDS (Y/N)?                         ?        |
20|                                                                             |
21|       ENTER THE RECORD NUMBER (NNNN)?                              ????     |
21|       CHANGE THE DATA CODE (Y/N)?                                  ?        |
21|       CHANGE THE "DES" TEXT (Y/N)?                                 ?        |
21|       CHANGE THE NEXT RECORD PONTER (Y/N)?                         ?        |
22|                                                                             |
23|       CONTINUE THIS FILE LISTING (Y/N)  ?                                   |
24|       REPEAT THIS ENTRY COMMAND (Y/N)   ?                                   |
+-----------------------------------------------------------------------------+
```

Figure (12.04) ---- LSTDAT ... DES or DAT File Screen

12.3 LSTSUM

The MTEN Command LSTSUM (LiST SUM) will flash off-and-on to the screen for the user the totals for all files of the space created and used to date. To enter the program type LSTSUM <cr>. After the entry has been completed the program will flash the first screen showing the status of the GPN, INX, DAT, and NDX project files, see sample screen Figure (12.05). On first screen the file DAT shows that 552 records have been initialized but only 510 records have been used to date by the user. The second screen, Figure (12.06), shows the status of the twelve DES Files. To date the user has created only two (2) DES files of the possible twelve (12) allowed; and within the two 4000-record DES files created, only 973 and 207 records to date have been used in the two files respectively.

```
+-----------------------------------------------------------------------+
|                    ENTRY      ----  LSTSUM                            |
|                 ------------------------------                        |
|                                                                       |
|                                                                       |
|                                                                       |
|      RECORDS FOR FILE(S):          MAXIMUM      USED   DRIVE         |
|                                                                       |
|        FILE  GPN  X                    146       127     A           |
|        FILE  INX  X                     51        50     A           |
|        FILE  DAT  X                    552       510     A           |
|        FILE  NDX  X                    170       123     A           |
|                                                                       |
|  ....                                                                 |
|                                                                       |
|  ?    TOUCH <SPACE BAR + CR>  ....  WHEN YOU ARE READY                |
+-----------------------------------------------------------------------+
```

Figure (12.05) ---- LSTSUM First Screen

```
+-----------------------------------------------------------------------+
|  ...                                                                  |
|                                                                       |
|       -NAME-        -MAXIMUM-   -USED-    -DRIVE-                     |
|                                                                       |
|  FILE  DES  X          4000      973        B                        |
|  FILE  DES  1          8000      207        B                        |
|  FILE  DES  2                                                         |
|  FILE  DES  3                                                         |
|  FILE  DES  4                                                         |
|  FILE  DES  5                                                         |
|  FILE  DES  6                                                         |
|  FILE  DES  7                                                         |
|  FILE  DES  8                                                         |
|  FILE  DES  9                                                         |
|  FILE  DES  A                                                         |
|  FILE  DES  B                                                         |
|                                                                       |
|                                                                       |
|      REPEAT THIS ENTRY COMMAND (Y/N)   ?                              |
+-----------------------------------------------------------------------+
```

Figure (12.06) ---- LSTSUM Second Screen

12.4 LSTJOB

The MTEN Command LSTJOB (LiST a JOB) will print a listing in sequential order for a selected range of SPN's. The printed listing will give the status of the following types of data: SPN, Station Name, position and elevation code, LST, TRI, DES, and the seven possible abstract entries (AST, DST, EDM, HGT, HZT, LGH, and ZEN). To enter the program type LSTJOB <cr>.

Appendix A

MTEN BLUEBOOK PROGRAM SCHEMATIC

DATE: 841119

```
BBKDOC

ABSINX GETREC          ............................................  LSTSUM

               STRJSI          ......................................  LSTJSI

               STRNAM
               STRGPN
               STRHGT          ......................................  LSTGPN

                      GETABS ABSAST  GETAST ........ (ASTCHK)
                                                     (ASTTME)
                                                     (ASTRAD)..(WRKAST)
                             ABSDST
                             ABSEDM ........................ (WRKEDM)  LSTDST

                             ABSHGT (GETROD)

                             ABSHZT ......... (ADJSTA) ....... (GETSTA)  LSTSTA

                             ABSLGH (GETBAY)

                             ABSZEN

                                     Abstract(s)  ....................  LSTABS

                      GETTRI ................ (WRKTRI) ....... (WRKCHK)  LSTTRI
                                                              (WRKGPN)

                      GETDES GETTXT (GETBOX) ........................... BBKDES
                                                                         BBKOBS
                                                                         LSTBBK

                                             (ADJZEN) ...?
                                             (ADJNET) ...?
                                                                         LSTNET
                                                                         LSTJOB

                                                                         LSTNDX
                                                                         LSTDAT
```

(NAME) -- Computational Commands

MTEN 3 -- BLUEBOOK PROGRAM SCHEMATIC

DATE: 850901

```
                                                                    BBKDOC
ABSINX GETREC          ............................................ LSTSUM
   STRJSI          ............................................... LSTJSI
   STRSPN /STRNAM,STRGPN,STRHGT/       ............................ LSTGPN
      ABSAST /GETABS/ GETAST.(ASTCTR /ASTCHK,ASTTME,ASTRAD/)..(WRKAST)
      ABSDST /GETABS/
      ABSEDM /GETABS/                ......................... (WRKEDM) LSTDST
      ABSHGT /GETABS/ (GETROD)
      ABSHZT /GETABS/  ....  (ADJSTA /GETSTA,LSTSTA/)  ............... LSTNET
      ABSLGH /GETABS/ (GETBAY)
      ABSZEN /GETABS/
         Abstract Listing(s)    ..................................... LSTABS

         GETTRI     ....................... (WRKTRI) ....... (WRKCHK) LSTTRI
                                                            (WRKGPN)
         GETDES /GETTXT/  (GETBOX)  ................................. BBKDES
                                                                    BBKOBS
                                                                    LSTBBK
                                                                    LSTNDX
                                                                    LSTDAT
                                          (ADJZEN) ... (ADJNET) ... ADJUST
```

(NAME) -- Computational Commands
/ NAME / -- Subroutine Callable Programs

MTEN (Micro TENcol) ACRONYMS

Acronym	-	Statement or Meaning of the Acronym
ABS	-	an ABStract of
ADJ	-	an ADJustment of
ANS	-	an ANSwer
APS	-	the Apparent Place of fundemental Stars
AST	-	an ASTronomical azimuth observation
BAY	-	BAY (the distance between two taping supports)
BBK	-	BlueBooK or related output data sets for IFS
BOX	-	BOX score or the reference object records (*30* codes)
CHG	-	CHanGe or convert the entry
CHK	-	CHecK or recompute an entry
CON	-	CONvert an entry
CPM	-	Control Program for Microprocessors
DAT	-	DATa
DAY	-	DAY or local date (YYMMDD)
DB	-	Data Base
DEC	-	DECimal or floating point entry
DEL	-	DELete a pointer or record entry
DES	-	DEScription
DIR	-	DIRection or DIRect
DMS	-	Degrees, Minutes, and Seconds
DOC	-	DOCumentation or DOCument
DST	-	reference object DiSTance measurements/observations
DZD	-	Double Zenith Distance
EDM	-	Electronic Distance Measurements/observations
END	-	the END or last entry/record
FAC	-	FACtor, solve, and invert a upper triangular matrix
FLD	-	entry data type or FieLD
FMT	-	ForMaT
GET	-	GET or input an entry
GPN	-	a Geographic PositioN
HGT	-	a HeiGhT or an elevation difference observation
HRI	-	Helmert-Rainsford geodetic Inverse
HTR	-	HeaTeR (a connectivity-graph matrix of warm neighobors)
HZT	-	HoriZonTal directions
IFS	-	Input Formats and Specifications of the NGS DB
INS	-	INSert a address pointer
INV	-	INVerse geodetic computation
INX	-	survey project INdeX
JOB	-	JOB/project information
JSI	-	Job Specific Instrument record/table
KEY	-	a limit or KEY set that input data must fall within
LGH	-	LenGtH or short traverse measurements/observations
LNE	-	LiNE or default record
LOC	-	LOCation or LOCate
LOR	-	LOwer and modulo entry to given Range
LST	-	LiST or format a requested printed output
MPM	-	Multi-Programming Monitor for microprocessors
MTR	-	MeTeR or Metric Table Record

IFS/NGSDB(I) - Input Formats and Specifications of the National Geodetic Survey Data Base: Volume I--Horizontal Control Data, by Pfeifer, L., 1978. 205 pp.

---------ERROR MESSAGES----------

001 ---- FIELD OVER FLOW
To many characters entered in this field. The dashes after the prompt indicate the size of the field to be input. The input character is ignored.

002 ---- EXTRANEOUS CONTROL CHARACTER IGNORED
The only control characters allowed are carriage return (CNTL-M), backspace (CNTL-H), Rubout (Del), Escape (Esc), and CNTL-A. Any other input control character is ignored.

003 ---- INVALID INPUT CHARACTER
The character keyed is invalid in the context for which it was used. For example, a space was keyed within a number. The input is ignored.

004 ---- ONLY LETTERS ALLOWED
A number or a punctuation character has been entered in a field which allows only the letters (A-Z). The character is ignored.
GETABS - In this program a blank (space bar) is considered as a letter for entering observer's initials.

005 ---- FIRST CHARACTER MUST BE A LETTER
The first character must be a letter. The cursor is at the first position of the input field and something other than a letter was entered. A letter is required for the field. The input character is ignored.

006 ---- PLEASE ANSWER Y OR N
The only valid input for this field is Y (yes) or N (no). The input character is ignored.

007 ---- ONLY NUMBER ALLOWED
The field accepts only numbers as input. The input character is ignored.

008 ---- ENTRY OUT OF RANGE
The keyed entry is outside preset limits. Input is ignored.
STRJSI - The limit is ... -100.0 < INSTR CONST < 100.0 ...

009 ---- Blank

010 ---- CONVERSION ERROR
An illegal character found by program GETFLD was to be converted. The program default changed it to a zero (0) and continued plus it sent a message to the screen that the keyed character was illegal.

011 ---- MANDATORY FIELD REQUIRES INPUT
At least one character must be entered for this field.
GETABS The height of target for zenith and edm obsrvations is mandatory input to the system. Also the time of observation is mandatory for both zenith and edm observations as well.

012 ---- INVALID TIME OR ANGLE FORMAT
The input field is required to be in the format (D,M,I.F), where
D represents one to three numeric characters,
M represents one or two numeric characters,
I represents one or two numeric characters, and
F must be at least one or more numeric characters.
Both commas and the decimal point must be entered. To correct an entry error the entire field must be reentered.

013-019 Blank

020 ---- INVALID UNITS CHARACTER
The character keyed was an invalid response. The response character must be a letter and only one of those letters listed on the screen by the prompt. Example (C/F)? or (M/F)? the response must be a C, F, M, or F.

021 ---- INVALID TIME (HHMM)
The number of characters and format keyed was correct, however one of the following input items are wrong,

(Time)	Hours	(0<= HH <30)
	Minutes	(0<= MM <=59)

022 ---- FROM & TO STATION HAVE THE SAME NUMBER
The SPN for the standpoint was keyed and then the SPN for the forepoint was keyed as the same. Input is ignored. Reenter the correct SPN for the forepoint.

023 ---- INVALID NUMBER RANGE (1-999)
The number keyed for this Job Specific Instrument (JSI) must be within the range (1 to 999). The input is ignored. Check the JSI number and reenter the data.

024 ---- INVALID DDD-MM-SS.SS INPUT

The number of characters and format keyed was correct, however one of the following input items are wrong,

STRGPN (Latitude)	Degrees	(0<= DDD <90)
ABSZEN (Vertical)	Minutes	(0<= MM <60)
	Seconds	(0<= SS.SS <=60.0)
STRGPN (Longitude)	Degrees	(0<= DDD <180)
	Minutes	(0<= MM <60)
	Seconds	(0<= SS.SS <=60.0)
ABSAST (Azimuth)	Degrees	(0<= DDD <360)
GETAST (Direction)	Minutes	(0<= MM <60)
	Seconds	(0<= SS.SS <=60.0)

025 ---- INVALID NUMBER INPUT

The number keyed was outside preset limits for this prompt field. The input is ignored. Check the type of field and reenter number.

026 ---- INVALID HH-MM-SS.SS INPUT

The number of characters and format keyed was correct, however one of the following is wrong,

GETAST (Time)	Hours	(0<= HH <30)
	Minutes	(0<= MM <60)
	Seconds	(0<= SS.SS <=60.0)

027-028 Blank

029 ---- INX FILE IS FULL

The dataset named FILEINXX.JCode has used up all available records. Exit current program and then enlarge the INX file by excuting the program GETREC to create additional records.

030 ---- SPN OUT OF RANGE OF GPN FILE

The SPN keyed was larger than the total number of records available in the dataset named FILEGPNX.JCode. Exit the program and then enlarge the GPN file by excuting the program GETREC.

031 ---- GPN FILE IS BLANK

A request for a GPN record was made but at this time no information has ever been stored for this SPN. Exit the program and execute the program STRNAM. Reenter the current program to continue.

032 ---- NDX FILE IS FULL

The dataset named FILENDXX.JCode is full. Exit the current program and enlarge the NDX file by excuting the program GETREC to create new records. Reenter the current program and continue entering data.

033 ---- ENTRY ALREADY EXISTS
The system while executing program NDXINS was trying to put records into the NDX file and found that the current record was already stored. Exit program and check the data carefully.

034 ---- CHANGE THE PARENT STATION
The wrong parent station was selected. Exit the program and reenter.

035 ---- MORE THAN 5 MATCHES WERE FOUND
The system subroutine NDXSRC searches information in dataset named FILENDXX.JCode. If more than five (5) "Hits" or locations are found where only one should be, an error condition occures. Exit the porgram and check the observed data.

036 ---- NO INSTRUMENT RECORD FOUND
Exit the current program and create a new instrument record by excuting the program STRJSI, then reenter the current program to continue entering data.

037 ---- DAT FILE IS FULL
The dataset named FILEDATX.JCode is full. Exit the current program and enlarge the DAT file by excuting the program GETREC to create new records. Reenter the current program and continue entering data.

038 ---- NO ABSTRACT FOUND .... TYPE "GETABS"
Before any observational data can be entered an abstract must first be created. Exit the current program and create an abstract by excuting the program GETABS then reenter the currect program and continue to enter data.

039 ---- NO NDX FILE FOUND .... ENTER AN ABSTRACT
A program went to a SPN for observational data and found that the current SPN has no data available. Exit the current program and key the required observations into storage first, then reenter the current program to continue.

040 ---- NO DES FILE FOUND .... TYPE "GETREC"
A program executed went to a SPN to enter descriptive text and found that the dataset named FILEDES?.JCode has no file available. Exit the current program and key the required space into storage first, by executing program GETREC. Then reenter the current program to continue.

041 ---- DES FILE IS FULL
The current dataset named FILEDES?.JCode is full. Exit the current program an execute the program GETREC to create a new file. There are twelve (12) files possible and they are as folows:

X (the first), 1, 2, 3, 4, 5, 6, 7, 8, 9, A, and B (the last)

and should be created in that order.

042 ---- BUFFER FILE IS FULL
Each dataset named FILEDES?.JCode has 4000 records in it to store descriptive text. However, only the first 3899 records can be used as input. The remaining records from 3900 to 4000 are reserved as records to be used only for record inserts when the text is being modified. If the buffer is full no more record inserts are possible.

043 ---- NO NDX RECORD FOUND FOR THIS SPN
This SPN has on observational data in the DAT File.

044-050 Blank

051 ---- STATE CODE -NOT FOUND- IS IT OK (Y/N)?
The abbreviation keyed did not find a match in the State Code Table, if the abbreviation is correct and is for a foreign country or U.S. territories, to continue answer Y (yes). If the abbreviation is for a state within the United States, reenter the prompt with the correct state abbreviation.

052 ---- OT CODE INCORRECT
The order-and-type (OT) keyed is not one listed in IFS/NGSDB(I), Annex E, Station Order-and-Type (OT) Codes. The input is ignored. Reenter the correct (OT) code.

053 ---- MARK CODE INCORRECT
The mark character keyed is not one listed in IFS/NGSDB(I), Annex I, Summary of Codes Used in Station Descriptions, page I-1. The input is ignored reenter the correct mark code.
MARK CODE - See chapter 3 pages (15-16).

054 ---- SETTING CODE INCORRECT
The setting code keyed is not one listed in IFS/NGSDB(I), Annex I, Summary of Codes Used in Station Descriptions, pages I-1,2, and 3. The input is ignored reenter the correct setting code.
SETTING CODE - See chapter 3 pages (15-18)
LANDMARK CODE - See chapter 3 pages (16,18-19)

055 ---- MAGNETIC CODE INCORRECT
The magnetic code keyed is not one listed in IFS/NGSDB(I), Annex I, Summary of Codes Used in Station Descriptions, page I-4. The input is ignored reenter the correct magnetic code.
M-CODE - See chapter 3 page (19).

056 ---- PC ZONE INCORRECT
The first characters keyed do not match those listed in the IFS/NGSDB(I), Annex B, State Plane Coordinates (SPC) Zone Codes, pages B-1, 2 for the state abbreviation entered. The input is ignored. The system will flash on the screen the proper state code, however the user will need to enter both the state code and the proper zone within that state if one exists.

057-059 Blank

060 ---- ELEVATION OUTSIDE LIMITS
The elevation entered must be between the follwing limits, i.e.
... -300.0 <= ELEV <= 8500.0 meters ...
The input is ignored and the elevation must be reentered.

061 ---- GEOID HGT OUTSIDE LIMITS
The absolute geoid height entered must be less than
... |HGT| < 300.0 meters ...
The input height is ignored and the geoid height must be reentered.

062 ---- INVALID ENTRY ... USE "ABSHGT"
If an elevation difference exists between two SPN's that information can only be entered by creating an abstract to show this data. Then the system will set the proper codes to reflect this relationship.

063 ---- POSITION REQUIRED FOR A BM
To enter any information about Differences of Elevation between two SPN's, both must have at least a scaled position entered by STRGPN first before any entry can be made.

064 ---- NAME REQUIRED BEFORE ENTRY
Any attempt to store information for a given SPN the GPN file is searched first to make sure a name exists before any data can be entered for the given SPN. Exit this program and enter the SPN name with the program STRNAM. Reenter the current program and store the SPN information.

065 ---- ENTER A POSITION FOR STATION
A position is requird before this program can continue. Exit the current program and enter a position by excuting the program STRGPN. Then reenter the current program and continue entering data.

066 ---- GPN OF SPN ??? IS TOO POOR
In the execution of the program WRKGPN the SPN's for the standpoint and the back azimuth point are checked for a proper geographic position before an inverse azimuth is computed. If either or both SPN geographic positions are poor, exit the current program and execute STRGPN to fixup the position codes and/or the geographic positions. Reenter the current program and continue.

In the execution of the program WRKEDM the SPN's for the end points of the given distance are checked for proper geographic postion in order to determine the mean latitude and azimuth for the observation before the distance reduction is computed. If either is too poor the computation is not completed. Exit the current program and execute the program STRGPN to fixup the position code(s) and/or the georaphic position(s). Reenter the current program and continue.

067 ---- HGT OF SPN ??? IS TOO POOR
In executing the program WRKGPN, in the approximate position mode, an elevation for the standpoint is required in order to compute the XYZ coordinates of the station from its latitude, longitude, and height.

In the execution of the program WRKEDM the SPN's for the end points of the given distance are checked for proper elevations in order to to determine if the distance reduction can be computed. If either is too poor, the computation is not completed. Exit the current program and execute the program STRHGT to fixup the elevation and/or codes to a value of 4 or greater. Reenter the current program and continue.

068 ---- GEOGRAPHIC POSITION BLANK (TOO POOR) FOR SPN
In LSTNET, an inverse could not be computed because the position was too poor or blank. Change the position code if too poor or enter a geographic position for the given SPN.

069 ---- GEOIDAL SLOPE EXCEEDS 10 SECONDS
In WRKEDM, while computing an EDM slope reduction the program found that the difference between the geoid heights at the end points for the slope distance caused an angle of 10 seconds or more. Check the geoid heights of the end points, they should be the same or very close in value to each other.

070-150 Blank

151 ---- INVALID FOOT MEASUREMENT
The keyed entry for feet must be less than 550.0 feet. If the distance is greater than 550.0 feet, enter the distance as approximate kilometers/miles. Input is ignored. Reenter with the proper type of distance.

152 ---- INVALID METER MEASUREMENT
The keyed entry for meters must be less than 167.0 meters. If the distance is greater than 167.0 meters, enter the distance as an approximate kilometers/miles. The input is ignored. Reenter with the proper type of distance.

153 ---- FEET & METERS CHECK IS OFF
The absolute value of |(METERS)-(FEET/3.2808333333)| was found to be greater than the limit of 3.45 millimeters. The input was ignored. Check the two measurements (METERS/FEET) and reenter the distances.

154-200 Blank

201 ---- LEVEL SETUPS UNEQUAL TO NUMBER TAPE BAYS
The number of leveling setups observed doesnot agree with the number of tape bays keyed. The input is ignored. Check that the two numbers are the same and reenter the correct number of setup/taping bays.

202 ---- INVALID ROD READING
The rod reading keyed is greater than the preset limit set at 12.0 feet/meters.

203 ---- 99 TAPING SECTIONS MAX

204 ---- 99 MAX FOR A BAY NUMBER
The taping -section identification number- must be within the limits of (1 to 99).

205 ---- INVALID NUMBER OF BAY SUPPORTS
The number of supports keyed is not allowed. The input is ignored. Correct the number and reenter the data.

206 ---- INVALID DISTANCE MEASUREMENT
The major taped distance must be greater than 0.010 feet/metes, otherwise any shorter distance must be entered as a SETUP/SETBACK measurement.

207 ---- INVALID TAPE-CATENARY CORRECTION
The correction keyed has exceeded the absolute limit value of 0.100 meters/feet. The input is ignored. Correct the entry and reenter the correction.

208 ---- INVALID TEMPERATURE CORRECTION
The correction keyed has exceeded the absolute limit value of 0.100 meters/feet. The input is ignored. Correct the entry and reenter the correction.

209 ---- CHECK TEMPERATURE CORRECTION
The system computed the correction based on the tape length, tape metal and the given temperature(s) and found the keyed correction did not agree to within 1 millimeter. The input is ignored. Check the correction and reenter the data.

210 ---- INVALID SETUP INPUT
The keyed entry was outside preset limits. The limits for a SETUP measurement are the following: 0.0 <= SETUP <= 10.0 meters/feet

211 ---- INVALID SETBACK INPUT
The keyed entry was outside preset limits. The limits for a SETUP measurement are the following: 0.0 <= SETBACK <= 10.0 meters/feet

212 ---- 8 BAY LIMIT MAX
The total number of taping bays that leveling can be done over is eight (8). The input is ignored.

213 ---- NO ENTRY FOUND ... TYPE "ABSLGH"
The program GETBAY was excuted before the records were setup by the program ABSLGH. Exit the current program and then excute the program ABSLGH to create the proper records. Reenter the current program and continue to enter data.

214 ---- END STATIONS NOT THE SAME
While processing the taping data the system found that the beginning and ending SPN's are not the same. The input is ignored. Check the SPN's and reenter the numbers.

215 ---- SURVEY EQUIPMENT CODE & METAL ARE INCONSISTENT
The JSI number keyed, when check against the instrument codes shows that the JSI is not consistent for the type of metal for this tape used. Check the JSI and the type of tape/metal that should be in the JSI records.

216 ---- "ABSLGH" NOT CODED FOR A SHORT TRAVERSE
The program ABSLGH must have the number of replications set to one.

217-250 Blank

251 ---- INVALID NUMBER OF EDM SHEETS
The total number of sheets allowed for an EDM distance measurement is ten (10).

252 ---- INVALID DISTANCE GIVEN
The keyed entry is greater than 150 KM, the limit set for all EDM measurements. The input is ignored.

253-400 Blank

401 ---- INVALID NUMBER INPUT (1-8)
The total number of setups keyed for this short-traverse leveling can not exceed eight (8). The input is ignored.

402 ---- INVALID SECTION LENGTH
The maximum length limit of 100.0 (KM/MI) for a single leveling section has been exceeded. The input is ignored.

403 ---- INVALID ACCURACY INPUT
The upper limit of 0.500 meters has been exceeded. The input is ignored. Reenter the estimate for the accuracy less than this limit.

404 ---- ESTIMATED ERROR IS TOO LARGE
The estimate as comparied to that computed based on the number of setups and the distance between the end points by the system was found to be too large. The input is ignored. Recompute the estimate and the reenter.

405 ---- INVALID ELEVATION DIFFERENCE
The absoute value for the difference of elevation is greater than the preset limit. ...|DIFF OF ELEV| < 501.0 meters ...

406 ---- NO ENTRY FOUND ... TYPE "ABSHGT"
The program GETROD was excuted before the records were setup by the program ABSHGT. Exit the current program and then excute the program ABSHGT to create the proper records. Reenter the current program and continue to enter data.

The program GETBAY was excuted before the leveling was established, i.e., before any short-traverse taping observations can be entered the leveling across the taping supports must have been entered first.

407 ---- "ABSHGT" NOT CODED FOR A SHORT TRAVERSE
While in the program ABSHGT the flag was not set to show this leveling would be used for a short-traverse. Exit the current program and excute the program ABSHGT to set the proper flag. Then reenter the current program and continue to enter data.

408 ---- NO ENTRY FOUND ... TYPE "GETROD"
The elevations across the taping supports have not been established. Exit the current program and excute the program GETROD. Then reenter the current program and continue to enter data.

409 ---- MUST HAVE AT LEAST A SCALED ELEVATION
The program to execute must have a geographic position that is at somewhat close to the true position.

410-450 Blank

451 ---- TIME NOT BETWEEN (BEG/END TIME CHECKS)
The time keyed doesnot fall between the beginning and the ending time checks. Input is ignored. Reenter the time correctly.

452 ---- MAXIMUM 30 OBSERVATIONS
The total number of direct/reverse pairs must not exceed the preset limit of the program.

453 ---- NO ENTRY FOUND ... TYPE "ABSAST"
The program GETAST was excuted before the program ABSAST created the proper records to store the data. Exit the current program and then excute the program ABSAST. Reenter the current program and continue to enter data.

454-470 Blank

471 ---- STATIONS NOT FOUND AT END BASE
When the program WRKCHK (BASECK) is excuted, the last triangle given in the chain-of-computation to be computed must contain the proper SPN's for the required base measurement. Reenter the chain-of-computation to be computed.

472-500 Blank

501 ---- TRIANGLE ALREADY EXISTS
In executing of program GETTRI the new triangle number requested is already in storage. Check the triangle list for an unused number.

502 ---- ANGLE OVER 180 DEGREES
The system found from the combined list that at least one angle in the requested triangle has a value over 180 degrees. Check the triangle layout.

503 ---- DIRECTION NOT FOUND TO SPN (???) OR SPN (???)
In the proram WRKGPN the system found a combined list for the standpoint SPN, however it didnot find one or both SPN's on the combined list for the back azimuth station or the foreward direction azimuth station.

In the program GETTRI/WRKTRI a combined list was found for the triangle vertex in question, however, one or both directions to the other SPNs were not found on the list. Exit the current program and then execute the program ADJSTA. Reenter the current program to continue.

504 ---- POSITION (???) TOO POOR FOR AN INVERSE
In the executing of program GETTRI or WRKTRI an inverse must be computed, however the geographic position of the listed SPN is blank. Exit the current program and execute STRGPN then reenter the current program to continue.

505 ---- TRIANGLE CLOSURE IS WRONG
The absolute triangle closure for the current triangle is greater than five minutes (300 seconds). One or more directions on the combined lists are incorrect. Check observations for a 5-minute or greater recording error.

506 ---- UNIQUE GPN EXISTS BY TRIANGLE (???)
In the program GETTRI the "One" station was selected to create a unique geographic position, however, one already was selected as listed. The flag must either be remove from the listed unique triangle or this current triangle coded as NOT unique.

507 ---- NO TRIANGLE NUMBER (???)
The system was given a triangle chain-of-computation list, of which, one triangle number in the list does not have an existing triangle. Exit the current program and create a triangle for this missing number in the triangle chain-of-computation or correct the incorrect triangle number given.

508 ---- GPN POSITION OUTSIDE LIMITS
In the executing of program WRKTRI two geographic positions are computed for station "One", the first from station (2) to "One" and the second from station (3) to "One", the VALUE for the differences between the two computations execced the system's limit of 0.00001 degrees. The value is computed as follows:

```
DX    = (P21-P31)
DY    = (E21-E31)
VALUE = SQRT(DX*DX+DY*DY)
```

Where P21 and P31 are the latitudes and E21 and E31 are the longitudes computed for station "One" from station's (2) and (3) of the triangle.

509 ---- TRIANGLE (???) LAYOUT IS WRONG
The system found an inconsistence in the structure of this triangle or the wrong triangle was given in the chain-of-computation. Reenter the chain-of-computation or correct the incorrect triangle.

510 ---- VERTEX NOT FOUND IN TRIANGLE (???)
In the excution of program WRKCHK a requested triangle had to be rotated, however after two rotations the SPN for a given computation was not found to be at either vertex checked. Check the layout of triangle chain-of-computation for an incorrect triangle number.

511 ---- QUAD POINT IS NOT IN THE FIRST TRIANGLE
When the program WRKCHK (QUADCK) is excuted, the first triangle given in the quad to be computed must contain the proper SPN for the "Quad Point" to start the proper quad triangle layout. Reenter the quad to be conputed.

512 ---- THE SECOND "QUAD TRIANGLE" IS WRONG
The second triangle given for the quad trangle layout didnot find a side that was common to the side opposite the "Quad Point" given in the first triangle. Reenter the triangle chain-of-computation.

513-519 Blank

520 ---- NO COMPUTATION POSSIBLE
In the execution of the program WRKGPN the SPN's for the standpoint and the back azimuth point are checked for a proper geographic position before an inverse azimuth is computed. One or both of the geographic positions are poor, therefore the inverse between them cannot be computed. Exit the current program and execute the program STRGPN to fixup the position code(s) and/or the geographic position(s). Reenter the current program and continue.

521 ---- NO COMBINED LIST FOUND
The standpoint for this computation does not have a combined list. Therefore, there is no way to determine the foreward azimuth direction to compute the geographic position for the foreward SPN. Exit the current program and execute the program ADJSTA the reenter the current program to continue.

522 ---- NO DISTANCE(S) FOUND
In executing the program WRKGPN no distance was found to or from the standpoint SPN and the foreward azimuth direction station SPN. Therefore no computation is possible for the geographic position. Exit the current program and enter the required distance into the system then reenter the current program to continue.

523 ---- SLOPE DISTANCE NOT REDUCED
In executing the program WRKGPN a distance was found to the foreward azimuth direction station SPN, however, the distance is not yet properly reduced to a geodetic surface for use in computations. Exit the current program and execute the program WRKEDM in order to reduce the distance in question. Reenter the current program to continue.

524-550 Blank

551 ---- CANNOT DESCRIBE A "SUFFIX STATION"
This SPN has been coded as a suffix station, that is, it is a peripheral to some parent station.

552 ---- Blank

553 ---- HEIGHT TOO HIGH
The height of instrument keyed is outside of a preset limit.
... -10.0 < HEIGHT < 45.8 meters ...
Correct the keyed height.

554 ---- NO DES FOUND .... TYPE "GETDES"
The program GETBOX/GETTXT was excuted before the records were setup by the program GETDES. Exit the current program and then excute the program GETDES to create the proper records. Reenter the current program and continue to enter descriptive text or reference objects.

555 ---- INVALID TEXT (BLANKED OUT)
In executing the program GETTXT one or more illegal characters were keyed on a line of input. The illegal character(s) were changed to blank(s) and the line stored.

556 ---- NO LST FOUND .... TYPE "ADJSTA"
In the executing of the program GETBOX a combined list is required but none was found. Exit the current program and execute the program ADJSTA. Reenter the current program to continue to enter the box score information.

557 ---- "INITIAL" STATION MUST HAVE A POSITION
In the execution of program GETBOX an inverse is computed to order the determine the compass headings for the reference objects. Either store a geographic position for the initial by executing the program STRGPN or select a different initial which will have a position.