PREFACE

"Input Formats and Specifications of the National Geodetic Survey (NGS) Data Base," commonly called the "Blue Book," is a user's guide for preparing and submitting geodetic data for incorporation into NGS' data base. Survey data that are entered into NGS' data base become part of the National Spatial Reference System (NSRS), formerly the National Geodetic Reference System. The guide comprises three volumes. Volume I covers classical horizontal geodetic and Global Positioning System (GPS) data, volume II covers vertical geodetic data, and volume III covers gravity data. Beginning with this edition, the three formerly separate volumes are distributed as a set, since a great deal of information is common to each volume. Because some of the chapters and annexes are identical in all three volumes, the original numbering design has been retained.

The formats and specifications are consistent with the aims of the Executive Office of the President, Office of Management and Budget's (OMB) Circular A-16, as revised in 1990. A major goal of the circular, which is titled "Coordination of Surveying, Mapping, and Related Spatial Data Activities," is to develop a national spatial data infrastructure with the involvement of Federal, state, and local governments, and the private sector. This multilevel national information resource, united by standards and criteria established by the Federal Geodetic Control Subcommittee (FGCS) of the Federal Geographic Data Committee (FGDC), will enable the sharing and efficient transfer of geospatial data between producers and users.

Survey data that are submitted to NGS for incorporation into NSRS should be properly formatted and supply minimum accuracies of:

> First-order horizontal accuracy standards for GPS and conventional horizontal surveys;
>
> Second-order, class II vertical accuracy standards for conventional leveling;
>
> Third-order gravity standards for gravity surveys.

Effective September 1, 1995, survey project data must meet the above minimum accuracy standards to be accepted for inclusion into the NGS data base. Surveys that are of lower order than given above will be accepted only in exceptional cases approved by the Director, NGS.

In addition, these data standards and accuracies **must** be verified and the survey data contributed for inclusion into the NGS data base **must** be processed and adjusted by the provider, using currently available NGS software, before submitting the survey project to NGS.

At this time, NGS provides review, archiving, and distribution functions free of charge for survey data submitted in the proper format. These surveys must contain connections to NSRS in accordance with FGCS Standards and Specifications and they must contribute to the public good.

The production of the Blue Book entailed significant contributions from a number of NGS employees. Notable among these are D. Sherrill Snellgrove for his revision of Volume I, originally prepared by then-Commander Ludvik Pfeifer, NOAA (Ret.); Nancy L. Morrison and Commander Pfeifer, for their contributions to preparing Volume II; and then-Lieutenant Warren T. Dewhurst, NOAA, for his preparation of Volume III.

This publication and most of the documents referenced herein may be obtained from:

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Chapter 1

HORIZONTAL CONTROL (HZTL) DATA

INTRODUCTION

For coding and processing purposes, data associated with geodetic horizontal control (HZTL data) have been divided into two groups. These two groups are (1) field observations (OBS data) and (2) descriptions and recovery notes (DESC data). Detailed instructions and formats for coding and keying horizontal control OBS and DESC data sets are contained in Chapters 2 and 3. The treatment of all data normally generated in the conduct of a classical horizontal control survey (triangulation, trilateration, and/or traverse) is described.

Although both types of data are normally generated in a horizontal control survey, OBS and DESC data must be submitted to NGS in separate data sets. These will be inserted in the National Geodetic Survey Data Base.

The foregoing implies that every horizontal control survey project (or several small projects submitted as one "job" - see below) will be received at NGS as two distinct data sets HZTL OBS and GEOD DESC data sets. The two data sets created for each horizontal control job must be submitted at the same time.

JOB CODE AND SURVEY POINT NUMBERING

The basic unit or group of data is given the name "job." A horizontal control job can contain the data for a maximum of 9999 survey points - see the definition of "survey point" below. If the number of survey points in a horizontal control survey project exceeds this limit, the data must be divided and submitted in multiple jobs. A job will normally contain the data collected for one project (i.e., one unit of field work); however, several small projects can be included in one job, even though they may have no points in common. The preferred determining factor in selecting several small horizontal control survey projects for inclusion in any one job is geographic proximity.

A two-character alphanumeric job code must be assigned to each horizontal control job submitted by an organization. The job code, along with the data set type, the name of the submitting agency, and the data set creation date will serve to uniquely identify each data set received by NGS. The first character of the two-character job code must always be a letter; the second character may be either a letter or a number (1 through 9). The preferred method of assigning job codes is to begin with Al and end with ZZ, i.e., Al, A2, ..., A9, Bl, ..., Zl, ..., Z9, AA, AB, ..., ZZ. This allows for a total of 910 uniquely-identified horizontal control jobs to be submitted by any one organization. Should this sequence be exhausted, the job codes may then be assigned again from the beginning - Al, A2, etc.

A horizontal control point is defined as any survey point whose position has been previously determined and is in the NGS Data Base, whose position is to be determined in an adjustment of the submitted HZTL OBS data, or whose (adjusted) position is available from another source. A survey point is defined as any point which has one or more directions, angles (horizontal or vertical), distances or vectors measured to it or from it. A survey point may be a monumented (or otherwise permanently marked) control point, a reference mark or azimuth mark, a temporary point (not permanently marked and therefore non-recoverable) such as an auxiliary point, or an unmonumented recoverable landmark (usually an intersection station) such as a flagpole or church spire. An eccentric instrument setup and eccentric target (or reflector) also qualify as survey points under this definition.

Each survey point in a horizontal control job must be assigned a unique four-digit station serial number within the range 0001 through 9999. A unique station serial number not only identifies the various observations within the HZTL OBS data set but is the project specific link between data in the HZTL OBS data set and data in the GEOD DESC data set.

Normally there are many survey points in a horizontal control job which are not intended as control points. These points are, by their nature, peripheral to a control point. Examples of peripheral points are unoccupied reference and azimuth marks. Eccentric instrument setups and eccentric targets (or reflectors) are treated as peripheral points if the respective eccentric observations are to be reduced to center. This is usually the case when the eccentric point is not permanently marked. But, if an eccentric point is offset more than 10 meters from the control point to which it belongs (even though it may be unmarked), or if the eccentric point is permanently marked (e.g., a reference mark is occupied), then the respective eccentric observations should not be reduced to center, and the eccentric point should be treated as another control point.

When an eccentric instrument setup is utilized in a field project, whose offset distance from the respective control point does not exceed 10 meters, the respective eccentric observations should be reduced to center by the submitting organization and coded in the HZTL OBS deck as if the control station had been occupied. If, for any reason, this is not desired, the eccentric point in question must be carried as a control point and must be assigned a four-digit station serial number of its own.

An unoccupied reference or azimuth mark has one or more directions, angles, and/or distances measured to it but not from it. A reference mark or azimuth mark which is occupied as a part of the survey scheme (e.g., as an eccentric occupation of the respective control point) should always be treated as a distinct control point. However, a reference or azimuth mark with directions, angles, and/or distances measured from it (as well as to it) for the purpose of verifying and/or supplementing the observations which tie together the control point and its peripheral points may remain a peripheral point.

The observations (directions, angles, and/or distances) which link the peripheral points with the respective control points must appear in the appropriate subset of the HZTL OBS data set (see Chapter 2).

Figures 1-1 and 1-2 illustrate an assignment of station serial numbers to control points and to their peripheral points (reference marks, azimuth marks, and/or eccentric points). The numbering system provides unique identifiers for all the survey points. An AZ MK or RM which is being treated as a control point must not also be identified as a peripheral point in the OBS data set. The same station serial number must be consistently used throughout the OBS or DESC data set of a horizontal control job.

As stated in the INTRODUCTION, a horizontal control job consists of two separate data sets - the HZTL OBS data set and the GEOD DESC data set. The HZTL OBS data set may contain a greater number of points than the corresponding GEOD DESC data set. This might occur when there is no descriptive data for the peripheral points and for unmarked (auxiliary) points. Station descriptions or recovery notes are required only for recoverable survey points. Apart from the peripheral points, there may be a number of nonrecoverable control points (either originally unmarked or confirmed lost) which must be carried along in the OBS data set for network integrity purposes. There may also be recovery notes for stations not used or found destroyed in a survey. Observations for such stations would not be in the OBS data set. In isolated instances, there may be recoverable control points for which no descriptive data are available. In these instances the submitting organization should write a description for each recoverable control point and include it in the GEOD DESC data set.

When recording data on magnetic tape or floppy disks (see MEDIA FOR SUBMITTING DATA), the two data sets of a horizontal control job must be submitted in separate files. These files may be on the same disk/reel of tape or on different disks/reels. In any case, the first record of every data set (see Chapters 2 and 3) must contain information positively identifying the data and project: the job code, the data set type, the name of the submitting agency, and the data set creation date.

MEDIA FOR SUBMITTING DATA

Although, in principle, any computer-readable, general-purpose data-recording medium can be handled, the two media currently acceptable to NGS are the 5 1/4 inch and 3 1/2 inch floppy disk and the standard 1/2 inch magnetic tape. Magnetic tape should be used only as the medium for submitting large volumes of data. **Floppy disks are preferred** when submitting a single job or jobs which contain small to medium amounts of data.

When data are submitted on floppy disks, the files must be created using an MS DOS operating system and be in ASCII character format.

The following information must be provided for each floppy disk submitted:

1. Complete name and address of the submitting agency.

2. Number of files and the name of each file on the disk.

3. Method of keying data and machine used (e.g., MTEN on the IBM PC).

4. Disk format (360 k, 750 k, 1.2 m, or 1.4 m are acceptable).

5. Name and telephone number of the person to be contacted in case of difficulty with the data.

This information should be furnished in a letter of transmittal. A copy should be packed with the data set.

When the data are submitted as files of formatted records on magnetic tape, the following information is expected to be given for each reel of tape:

1. Name and address of the submitting agency.

2. Reel number or identification symbol assigned by the submitting agency.

3. Number of files and contents of each file by job code and data type (e.g. Al HZTL OBS, XX GEOD DESC, etc.).

4. Computer system on which the tape was created (e.g., IBM 360/XXX, CDC 6600, etc.)

5. Internal label information (e.g. non-labeled,

standard IBM label, etc.).

6. Number of tracks (7 or 9) and parity (even or odd).

7. Recording density (556, 800 or 1600 BPI).

8. Record length (LRECL) and block size (BLKSIZE).

9. Character representation code (BCD, EBCDIC, etc.) and keytape equipment designation, if applicable.

10. Name and phone number of person to be contacted in case of difficulty with the data.

This information should be furnished in a letter of transmittal. A copy should be packed with the data set.

A letter describing and itemizing the data transmitted should always be prepared for each data shipment. One copy should be enclosed with the data shipment, one sent by separate mail to NGS, and another copy retained by the sender. See ANNEX K for current mailing instructions. In every case, the submitting organization should retain a backup copy of all the data shipped until NGS acknowledges receipt of the data.

CODING, KEYING, AND DATA VERIFICATION

All data submitted to NGS for insertion into the National Geodetic Survey Data Base must be coded and keyed in strict conformity with the formats and specifications contained in this publication. In addition, the keying of all data must be verified.

Detailed formats and specifications for the coding and keying of horizontal control jobs are contained in Chapter 2 (HZTL OBS data) and in Chapter 3 (GEOD DESC data). The formats were designed to allow the keying and verification of the data to be accomplished on standard computer equipment, hence the 80-character record was adopted as the standard for all applications.

When coding and keying the data entries, carefully insure that alphabetic characters (letters) will be keyed using the alphabetic keys, and that numeric characters (numbers) will be keyed using the numeric keys. In particular, miscoding and miskeying the following characters must be avoided:

0 - number "zero"	1 - number "one"	2 - number "two"
O - letter "O"	L - letter "L"	Z - letter "Z"

SPECIAL CHARACTERS

In addition to the alphabetic characters (letters A through Z) and the numeric characters (numbers 0 through 9), only the following special characters are allowed:

(*) asterisk	(+) plus sign
( ) blank or space	(-) minus sign or hyphen
(,) comma	(=) equal sign
(.) period or decimal point	(/) slash or solidus
($) dollar sign	(() left parenthesis
	()) right parenthesis

SEQUENTIAL RECORD NUMBERING

The first six characters of every record are reserved for a record sequence number. The purpose of numbering records sequentially is to insure that the proper sequence of individual records in a data set can be verified and, if necessary, restored. The sequencing numbers must be assigned in ascending order, starting with the first record (the Data Set Identification Record) and ending with the last record (the Data Set Termination Record).

The preferred assignment of sequence numbers starts with 000010 on the first record in the data set (the Data Set Identification Record) and increments by 10 on each successive record. This numbering system allows up to nine records to be inserted between any two originally numbered records without the necessity of renumbering any records in the data set. Even when a large block of omitted records must be inserted, only a few of the existing records will have to be renumbered. To allow for the detection of missing records, all insertions and/or deletions which deviate from the basic 000010, 000020, 000030, etc. "increment-by-ten" record sequence must be accounted for in the letter of transmittal.

Discounting any after-the-fact insertions, the above-described sequential numbering system will permit a maximum of 99,999 uniquely-numbered records in any one data set. Should there ever be a need for a greater number of records in a data set, retain only the last six digits of the higher sequence numbers, i.e., ... 999980, 999990, 000000, 000010, etc.

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Chapter 2

HORIZONTAL OBSERVATION (HZTL OBS) DATA

INTRODUCTION

The purpose of this chapter is to provide detailed specifications and instructions for the coding and keying of an observation data set for a horizontal control job. As explained in Chapter 1, a horizontal control job consists of two distinct data sets which must be submitted together. The companion data set to the horizontal observation (HZTL OBS) data set discussed in this chapter is the data set which contains descriptions and/or recovery notes for the control points in the horizontal control job. The descriptive (GEOD DESC) data set is discussed in Chapter 3.

HZTL OBS DATA SET RECORDS

The data which constitute an HZTL OBS data set are organized into ten categories, which are as follows:

- Project Data
- Horizontal Direction Data
- Global Positioning System Data
- Horizontal Angle Data
- Vertical Angle/Zenith Distance/Level Data
- Distance Data
- Azimuth Data
- Survey Equipment Data
- Control Point Data
- Fixed Control Data

Within these categories, the data have been grouped into one or more logical units called "records." A record is a string of characters containing data coded according to a specific format. Every record in an HZTL OBS data set consists of 80 characters or "columns" (standard punched card image). Within each record, the 80 columns are divided into fixed-length "character fields," each field reserved for a specific data item. Accordingly, for every desired data item, a field of appropriate length exists into which the data item is entered. The set of rules by which the specific data items are converted into strings of alphanumeric characters is known as the "format" of that record.

The types of records which may appear in an HZTL OBS data set are listed in Table 2-1 on the following page. Each type of record has been given a name. A block diagram portraying the data fields and a brief description of each data field in that record can be found in the **FORMAT DIAGRAMS.**

TABLE 2-1

HORIZONTAL OBSERVATION DATA SET RECORDS

[FIRST RECORD]
aa - Data Set Identification Record
10 - Project Title Record
11 - Project Title Continuation Record
12 - Project Information Record
13 - Geodetic Datum and Ellipsoid Record
20 - Horizontal Direction Set Record
21 - Horizontal Direction Comment Record (Optional)
22 - Horizontal Direction Record
25 - GPS Occupation Header Record
26 - GPS Occupation Comment Record (optional)
27 - GPS Occupation Measurement Record
28 - GPS Clock Synchronization Record
29 - GPS Clock Synchronization Comment Record (optional)
30 - Horizontal Angle Set Record
31 - Horizontal Angle Comment Record (Optional)
32 - Horizontal Angle Record
40 - Vertical Angle Set Record
41 - Vertical Angle Comment Record (Optional)
42 - Vertical Angle Record
45 - Observed Difference of Elevation Record
46 - Observed Difference of Elevation Comment Record (optional)
47 - Observed Difference of Elevation Continuation Record
50 - Taped Distance Record
51 - Unreduced Distance Record
52 - Reduced Distance Record
53 - Unreduced Long Line Record
54 - Reduced Long Line Record
55 - Distance Comment Record (Optional)
60 - Laplace / Astronomic Azimuth Record
61 - Geodetic Azimuth Record
70 - Instrument Record
***71* - GPS Antenna Record**
80 - Control Point Record
81 - Control Point Record (UTM/SPC)
82 - Reference or Azimuth Mark Record
83 - Bench Mark Record [discontinued - Use *86* record instead]
84 - Geoid Height Record (Optional) [discontinued-Use *86*]
85 - Deflection Record (Optional)
86 - Orthometric Height, Geoid Height, Ellipsoid Height Record
90 - Fixed Control Record
[LAST RECORD]
aa - Data Set Termination Record

Note: The symbol "aa" denotes the two-character job code assigned by the submitting organization - see Chapter 1.

Except for the first and last records of the data set, the second character field of each record (columns 7-10) contains a two-digit numerical data code, preceded and followed by an asterisk, which specifies the format type for that record (*10*,*11*,...,*90* - see Table 2-1). In the first and last records of the data set (the Data Set Identification Record and the Data Set Termination Record) the second character field (columns 7-10) contains the two-character alphanumeric job code assigned by the submitting organization (*A1*,*A2*,....,*ZZ* - see Chapter 1). The first character field of every record (columns 1-6) is reserved for the respective record sequence number - see Chapter 1. The remaining portion of each record (columns 11-80) contains character fields which are unique to each type of record.

STRUCTURE OF THE HZTL OBS DATA SET

The first record of an HZTL OBS data set must be the Data Set Identification Record. It contains the required information to identify the data set and to correlate it with its companion GEOD DESC data set - job code, data type (HZTL OBS), name of submitting organization, and date the data set was created. The last record of the data set must be the Data Set Termination Record. It is the only other record in the data set containing the job code that appears in the same field (columns 7-10) on the Data Set Identification Record.

The HZTL OBS data set is bracketed by these two delimiting records. The data in between may pertain to one or more units of field work. The field observation data for several horizontal control survey projects may be submitted in one HZTL OBS data set under the same job code, provided that the total number of control points does not exceed 9999 (see Chapter 1). When two or more projects are included in one job, each project must be grouped to form a complete unit. Each project must begin with a *10* record, contain any number of the other types of records in proper sequence, and terminate with one or more *90* records.

TABLE 2-2 - HZTL OBS STRUCTURE

Data Set Identification Record	
10 record :::: *90* record	First Project
10 record :::: *90* record	Second Project
::::	::::
10 record :::: *90* record	Last Project
Data Set Termination Record	

A horizontal control survey project is defined as a unit of field work containing a number of survey points (control points and peripheral points - see Chapter 1) which are connected by observations - horizontal directions, horizontal angles, vertical angles, distance measurements, and/or Global Positioning System (GPS) phase measurements. When coded as a part of an HZTL OBS data set, a project is a block of records comprising record groups arranged in the following order:

<u>Project Data (*10*-Series) Records</u>:

```
*10*,*11*,*12*,*13* records
```

<u>Horizontal Direction Data (*20*-Series) Records</u>:

```
*20*,*21*,*22*,...,*22* for first set of horizontal directions
*20*,*21*,*22*,...,*22* for second set of horizontal directions
::::
*20*,*21*,*22*,...,*22* for last set of horizontal directions
```

<u>Global Positioning Systems Data (*20*-Series) Records</u>:

```
*25*,*26*,*27*,*27*     for first set of GPS data
*25*,*26*,*27*,*27*     for second set of GPS data
::::
*25*,*26*,*27*,*27*     for last set of GPS data
*28*,*29*               for each clock synchronization
```

(These records may be in any order within the GPS data series records)

<u>Horizontal Angle Data (*30*-Series) Records</u>:

```
*30*,*31*,*32*,...,*32* for first set of horizontal angles
*30*,*31*,*32*,...,*32* for second set of horizontal angles
::::
*30*,*31*,*32*,...,*32* for last set of horizontal angles
```

<u>Vertical Angle/Zenith Distance/Level Data (*40*-Series) Records</u>:

```
*40*,*41*,*42*,...,*42* for first set of vertical angles
*40*,*41*,*42*,...,*42* for second set of vertical angles
::::
*40*,*41*,*42*,...,*42* for last set of vertical angles

*45*,*46*,*47*          for first elevation difference
*45*,*46*,*47*          for second elevation difference
*45*,*46*,*47*          for last elevation difference
```

<u>Distance Data (*50*-Series) Records</u>:

```
*50*,*55* for each taped distance
*51*,*55* for each unreduced line-of-sight distance
*52*,*55* for each reduced line-of-sight distance
*53*,*55* for each unreduced long-line distance
*54*,*55* for each reduced long-line distance
```


<u>Azimuth Data (*60*-Series) Records</u>:

```
*60* for each observed astronomic/Laplace azimuth in the project
*61* for each geodetic azimuth used in the project
```

Survey Equipment Data (*70*-Series) Records:

70 for each item of survey equipment used in the project
***71* for each GPS antenna used in the project**

Survey Point Data (*80*-Series) Records:

80 or *81* for first control point
82 for each peripheral RM or AZ MK at first control point
85,*86*, as applicable, for first control point
80 or *81* (possibly *82*) for second control point
82 for each peripheral RM or AZ MK at second control point
85,*86*, as applicable, for second control point
::::
80 or *81* (possibly *82*) for last control point
82 for each peripheral RM or AZ MK at last control point
85,*86*, as applicable, for last control point

Fixed Control Data (*90*) Records:

90 for each control point published by the NGS.

PROJECT DATA RECORDS

10 - Project Title Record
11 - Project Title Continuation Record
12 - Project Information Record
13 - Geodetic Datum and Ellipsoid Record

The project data records, identified by *10*-series data codes, are listed above. The *10* record which contains the title of the project is always required; a *11* record is required only if the project title exceeds the 70-character field allowed on the *10* record. Do not divide words between the *10* and *11* records. The *12* record, which contains the date and general location of the survey, the survey method employed and the order classification of the survey, is always required. The *13* record defines the geodetic datum with respect to which geodetic positions, deflections of vertical, geoid heights, and/or ellipsoidal distances given in this project are specified. This record is required only if the geodetic datum is other than the North American Datum of 1983 (NAD 83). The entries on these records (see FORMAT DIAGRAMS) are self-explanatory; however, the following data items will be explained in greater detail:

Project Title: The elements of a good horizontal control survey project title should include (1) the order of accuracy of the survey, (2) the type of the survey, and (3) the geographic locality of the survey. Since the first two elements are coded elsewhere (*12* record), only the geographic locality of the survey needs to be spelled out in the title. The use of geographic locality alone for the title of a horizontal control survey project has traditionally been the practice of NGS and its predecessors.

In general, the title by which the project is known to the submitting agency should be used, supplemented to reflect geographic locality, as required. If the project is best described as covering an area network (triangulation or trilateration), give the geographic locality covered by the survey (e.g., KING COUNTY). If the project is generally linear such as an arc of triangulation or trilateration, or a traverse which is not confined within one locality, then give the geographic localities of its endpoints, in the order of the progress of the survey (e.g., CHARLESTON TO CAPE ROMAIN). Unless it is a part of the geographic locality name, omit the state or country designation if only one state or country is involved. This information will be coded on the *12* record.

Otherwise, use abbreviations listed in ANNEX A. Omit commas, periods, etc., and abbreviate in the interest of fitting the entire title on the *10* record, if possible.

Survey Method: A one-digit code is provided on the *12* record to specify the survey method used - triangulation (1), trilateration (2), traverse (3), or GPS (4). For horizontal control survey projects in which more than one survey method is prominent, enter the code for that survey method which best characterizes the project as a whole.

Order and Class of Survey: A two-digit code is provided on the *12* record to specify the order of accuracy of the survey. The first digit of this code reflects the order and the second digit the class of the survey in accordance with the Standards and Specifications for Geodetic Control Networks, prepared and published by the Federal Geodetic Control Committee (FGCC), Rockville, MD (September 1984). In addition to the five horizontal control survey categories defined in this publication, two other survey categories need to be considered - surveys of the Trans-Continental Traverse (TCT) type, and surveys of lower-than-third-order accuracy. The respective two-digit codes are as follows:

AA - AA Order Interferometric Positioning
A0 - A Order Interferometric Positioning
B0 - B Order Interferometric Positioning
00 - Trans-Continental Traverse
10 - First Order
21 - Second Order Class I
22 - Second Order Class II
31 - Third Order Class I
32 - Third Order Class II
40 - Lower Than Third Order

The order-and-class code assigned to a horizontal control survey project should reflect the procedures and specifications by which the main-scheme network was observed. It is understood that many times there are supplemental control points and intersected landmarks to which observations of a lesser order of accuracy are made.

When well-defined parts of a project fall into different order-and-class categories, consideration should be given to dividing the project accordingly and submitting the parts as individual projects. If this is not practical, assign an order-and-class code to the entire project which corresponds to the highest order of accuracy observed (i.e., if networks of both lst Order and 2nd Order Class I appear in a horizontal control survey project, assign order-and-class code 10 to the project as a whole). In this case, however, special care

must be taken to correctly identify the order and type of each horizontal control point on the corresponding *80* or *81* record, according to which order of accuracy main-scheme network the control point belongs - see section entitled SURVEY POINT DATA RECORDS and also see ANNEX E.

DATE AND TIME

The date the HZTL OBS data set was created must appear on the Data Set Identification Record, and the dates on which survey operations commenced and terminated must be entered on one of the project data records (*12* record). In addition, character fields for the date and time of observation are provided on all observation data records. Throughout the HZTL OBS data set, date and time are to be coded as follows:

Date: The full date is coded as an eight-digit integer number consisting of four two-digit groups denoting (from left to right) the last whole century, number of full years since the last turn of century, month of the year, and day of the month (CCYYMMDD). When the century is omitted, the date is coded as a six-digit integer number denoting the year, month, and day (YYMMDD). If the day is not known, leave the last two columns of the field blank; if the month is not known, leave the last four columns of the field blank. For example, 8 February 1970 would be coded as follows:

1. Full date is known:	19700208	or	700208
2. Day of the month is not known:	197002	or	7002
3. Month of the year is not known:	1970	or	70

NOTE: The full date for GPS data will be coded as a six-digit integer number containing three two-digit groups denoting (left to right) the number of full years since the last turn of the century, month of the year, and the day of the month (YYMMDD).

Time: A five-character field is reserved for the time of day on each observation data record. The time of day is coded as a four-digit integer number consisting of two two-digit groups denoting (from left to right) the hours and minutes of a 24-hour clock (HHMM), to be entered in the leftmost four columns of the field. The last column of the five-character time field is reserved for the appropriate one-letter time zone designation(see below). Except for GPS observations, the local zone time is to be used; in this manner ambiguities are avoided concerning the date, which is always assumed to be the "local" date (i.e., the date changes at local midnight).

NOTE: The time of GPS data must be in Universal Coordinated Time (UTC), otherwise known as Greenwich Mean Time (GMT) or ZULU time.

Time Zone: A time zone is a geographic region in which uniform time differing by an integer number of hours from the Greenwich Mean Time (GMT) is maintained by law. In theory, a time zone extends 7-1/2 degrees in longitude east and west of a "time meridian" whose longitude is a multiple of 15 degrees (since the Earth rotates 360 degrees in 24 hours, 15 degrees of longitude difference equals one hour of time difference). In practice, the lines which separate adjacent time zones follow political boundaries and are therefore rather irregular. Associated with every time zone is a "time zone description" - an integer number positive west of Greenwich and negative east of Greenwich -

which represents the number of hours which must be added (algebraically) to the local zone time in order to obtain the corresponding GMT. The time zone description is reduced by one hour when the standard zone time is changed to daylight-saving time.

Instead of the numerical time zone descriptions, it is more convenient to use the U.S. Navy one-letter codes which uniquely identify every time zone around the world. In this system, GMT is the "Z" (Zulu) Time Zone. Time zones east of Greenwich are identified by letters A,B,C, etc., through L, with the letter J omitted. Time zones west of Greenwich are identified by letters N,O,P, etc., through X. The letter Y is used to designate the western half of the time zone centered on the meridian of longitude 180 degrees (International Date Line), and the letter M is used to designate the eastern half of this zone.

The worldwide use of the time zone descriptions and of the U.S. Navy one-letter designations is illustrated in ANNEX H. In the continental United States (US), Alaska (AK), and Hawaii (HI) the time zones are as follows:

TABLE 2-3 - U.S. NAVY TIME ZONE DESIGNATIONS

STANDARD TIME	DAYLIGHT TIME	TIME MERIDIAN	TIME ZONE DESCRIPT'N	U.S. NAVY DESIGNATION
Atlantic AST	Eastern EDT	60W	+4	Q (Quebec)
Eastern EST	Central CDT	75W	+5	R (Romeo)
Central CST	Mountain MDT	90W	+6	S (Sierra)
Mountain MST	Pacific PDT	105W	+7	T (Tango)

Pacific PST	Yukon YDT	120W	+8	U (Uniform)
Yukon YST	AK/HI HDT	135W	+9	V (Victor)
AK/HI HST	Bering BDT	150W	+10	W (Whiskey)

If the time zone cannot be reliably ascertained, leave the last column of the time field blank. In this case, the time coded into the first four columns of the time field will be interpreted as the standard time in a zone determined on the basis of the longitude of the survey point from which the respective observation was taken.

OBSERVATION DATA RECORDS

In connection with classical survey operations, the term "observation" is used to denote one of many angular and linear measurements accomplished to quantify geometric relationships among survey points. In this context, the observations which occur in a horizontal control survey project can be classified as (1) horizontal directions, (2) horizontal angles, (3) vertical angles/zenith distances/leveling, and (4) distance measurements. Astronomic and geodetic azimuths used for orientation control may also be regarded as a type of observation. The HZTL OBS data set records which pertain to these observations are categorized as follows:

20-Series Records - Horizontal Direction/GPS Data
30-Series Records - Horizontal Angle Data
40-Series Records - Vertical Angle/Zenith Distance/Level Data
50-Series Records - Distance Data
60-Series Records - Azimuth Data

Although the GPS data records are not observations as defined here, they are used in conjunction with observational phase measurements to derive the Data Transfer Records (ANNEX N).

The basic element of an observation is a numerical value expressing the measured quantity in appropriate units of measurement. The units of measurement used consistently for all observations in the HZTL OBS data set are (1) sexagesimal degrees, minutes, seconds, and decimals of a second of arc for angular observations, and (2) meters and decimals of a meter for distance measurements. In addition to the respective measured quantity, other elements necessary to describe a horizontal control survey observation are (1) the type of observation, (2) the identity of the survey points from which and to which the observation is taken (standpoint and forepoint - see below), and (3) an estimate of the accuracy of the measured quantity. At times, auxiliary information such as the time of the observation and the height of the instrument and/or target are required in order to obtain proper spacial relationships.

The type of observation is specified by the data code of the record. The survey points associated with an observation are identified by unique, job-specific station serial numbers (see below). A reliable, specific estimate of the overall accuracy of a horizontal control survey observation is rarely at hand. However, a generalized accuracy estimate can be inferred from several data items which are normally available - the order and class of survey, the type of survey equipment used, the number of replications (independent measurements) taken, and the rejection limit enforced. With the exception of the Job-Specific Instrument Number (see below), the observation data items related to the estimate of accuracy of a horizontal control survey observation will be treated in the section entitled ACCURACY OF THE OBSERVATIONS.

Several data items which appear on the observation records are treated below. Detailed explanation of other observation data items is given elsewhere in this chapter.

Standpoint and Forepoint: In connection with a horizontal control survey observation, the point from which the observation is taken (e.g., the point which is occupied with a surveying instrument) will be referred to as the "standpoint" or "instrument station." The point to which the observation is taken (e.g., the point to which the foresight is directed) will be referred to as the "forepoint" or "target station."

Station Serial Number: For the purpose of identifying the standpoint and forepoint on the observation records in a concise manner, each survey point (control point or peripheral point) is assigned a job-specific station serial number in the range 0001 to 9999. See Chapter 1 for a detailed explanation of the survey point numbering system. See also the next section entitled ASSIGNMENT OF STATION SERIAL NUMBERS.

Weather Code: Where applicable, five adjacent integer fields have been reserved on the observation records for one-digit codes. These will be referred to collectively as the "weather code." The first of these codes is a general problem indicator, which should be the digit "0" under normal conditions or the digit "1" if a problem was encountered during an observation, in which case the problem must be explained on one or more comment records to immediately follow the observation record. The other four one-digit codes are indicators of visibility, temperature, cloud cover, and wind, in that order. These indicators may assume the values 0, 1, or 2 (see Table 2-4 below). Any one of these five indicators may be left blank if the condition it represents is either not known or not applicable.

TABLE 2-4 - WEATHER CODE

CODE ***	0	1	2
PROBLEM INDICATOR	No Problem Encountered	See Comment	Not Used
VISIBILITY INDICATOR	Good (Over 15MI)	Fair (7MI to 15MI)	Poor (Under 7MI)
TEMPERATURE INDICATOR	Normal Range (32~F to 80~F)	Hot (Over 80~F)	Cold (Below 32~F)
CLOUD COVER INDICATOR	Clear (Below 20%)	Partly Cloudy (20% to 70%)	Overcast (Over 70%)
WIND INDICATOR	Calm (Under 5MPH)	Moderate * (5MPH to 15MPH)	Strong ** (Over 15MPH)

*No effect on observations. **Possibly affecting observations.
***Blank if the condition is not known or not applicable.

Job-Specific Instrument Number: The instrument used to accomplish a horizontal control survey observation must be known; the type of survey equipment (i.e., its resolution and expected accuracy) will be used to compute a standard error for the observation. In order to identify the instrument on the respective observation record in a concise manner, a unique three-digit number in the range 001 to 999 is to be assigned to each item of survey equipment used in the job. In cases where this may be impractical, a three-digit instrument number may be assigned to a class of survey equipment (e.g., all 100-foot uncalibrated steel tapes could be treated as one "instrument"), it being understood that such a class label must correctly reflect the type, resolution, and expected accuracy of all instruments covered by it.

In a manner analogous to the assignment of station serial numbers, the instrument numbers are to be unique throughout a job, i.e., an item of survey equipment which appears in more than one project in the job must be consistently identified by the same number, while different items of survey equipment must be identified by different numbers throughout the HZTL OBS data set. A *70* record must be prepared for each item of survey equipment which has been assigned an instrument number - see SURVEY EQUIPMENT DATA RECORDS.

Job Specific GPS Antenna Number: In a manner analogous to the assignment of job specific instrument numbers, the job specific GPS antenna numbers are to be unique throughout a job, i.e., each GPS antenna which appears in more than one project in the job must be consistently identified by the same number, while different antennas must be identified by different numbers throughout the HZTL OBS data set. A *71* record must be prepared for each antenna which has been assigned an antenna number - see SURVEY EQUIPMENT DATA RECORDS.

Height of Instrument and Height of Target: Horizontal control survey measurements are seldom observed literally mark-to-mark between the survey points involved. Normally, they are measured from a surveying instrument mounted on a tripod, wooden stand, or survey tower erected over the standpoint to a "target" (e.g., a survey light, retro-reflector, or remote instrument) mounted on a similar structure over the forepoint.

The height of instrument (H.I.) is the vertical distance from the top of the occupied survey mark (standpoint) to the optical center of the surveying instrument, positive if the instrument is above the mark, and negative if it is below the mark. This distance is also known as the "height of telescope." Similarly, the height of target (H.T.) is the vertical distance from the top of the survey mark (forepoint) to the point above or below the mark which is used as the target for angular observations, or to the optical center of the retro-reflector (or of the antenna system of the remote instrument) in the case of electronic distance measurements. This distance is also known as the "height of object."

Together with the elevation (and geoid height) of the respective survey points, the height of instrument and the height of target are desired data items in some horizontal control survey observations and required in others. For horizontal directions and horizontal angles, the height of instrument and the height of target are desired for the computation of skew normal and deflection corrections. For vertical angles and distances, the height of instrument and the height of target are required for the reduction of instrument-to-target measurements to mark-to-mark values.

When the surveying instrument cannot be installed directly over the desired survey point and eccentric observations which are to be reduced to center are submitted, the height of instrument entered on the observation record **must be the vertical distance between the top of the survey point mark to which the eccentric observations are to be reduced and the horizontal plane passing through the optical center of the horizontally-offset surveying instrument.** The same considerations apply to an eccentric target, retro-reflector, or remote instrument.

Height of GPS Antenna: The desired antenna height is the vertical distance

from the top of the occupied survey point mark to the L1 phase center of the antenna used with the GPS receiver. See diagram on page 2-52a.

Visibility Code: Information concerning intervisibility between monumented control points is of great value to the local surveyor, who is not normally prepared to build survey towers over the control points to be occupied or sighted upon. To allow for recording this information, a provision was made for a one-letter visibility code on the observation records which pertains to line-of-sight observations. This code indicates whether or not the forepoint (i.e., a target which might be easily constructed over the forepoint) can be seen from ground level (height of eye) at the standpoint.

Since reference marks, azimuth marks, and the horizontal control point to which they belong are assumed to be intervisible at ground level, the visibility code is further used to indicate whether the forepoint is an RM or an AZ MK associated with the standpoint. The respective one-letter codes are listed below. If a conflict arises in the assignment of a visibility code, the hierarchy implied by this list should be followed. In each case, "forepoint" is meant to describe either a natural target or a simple target installed at height-of-eye level over the forepoint, and "ground" implies height-of-eye level at the respective standpoint.

1. N - Forepoint is not visible from ground.
2. R - Forepoint is an RM associated with standpoint.
3. Z - Forepoint is an AZ MK associated with standpoint.
4. V - Forepoint is visible from ground.

The codes R and Z are to be used only for reference and azimuth marks which are associated with the standpoint, that is, in connection with observations from the respective horizontal control point to its own reference or azimuth marks, or possibly in connection with observations taken among the reference or azimuth marks belonging to the same control point. When the forepoint is an RM or AZ MK which belongs to another control point, the codes N or V, as applicable, should be used. The visibility code field should be left blank if the intervisibility between the respective standpoint and forepoint is not known.

ASSIGNMENT OF STATION SERIAL NUMBERS

The station serial number (SSN) is a four-digit number in the range of 0001 to 9999, used to uniquely identify every survey point which appears in an HZTL OBS data set. The survey point numbering system was explained in detail in Chapter 1. To recapitulate, a survey point is defined as any point in a survey project which has one or more observations to it or from it. In a horizontal control network, a survey point is either a control point or a peripheral point.

Control Points: A control point is a survey point whose geodetic position is to be determined by the survey project, or whose position has been determined in a previous survey. Examples of a control point are (1) a monumented (or otherwise permanently marked) triangulation, trilateration, traverse, or GPS station; (2) a recoverable landmark (usually an intersection station) such as a flagpole or church spire; or (3) an unmarked (and hence nonrecoverable) survey point which must be carried as a control point for network integrity purposes. A survey point which cannot be positioned because of insufficient observations, whose geodetic position is not available from other sources, and which does not qualify as a peripheral point (see below) must also be treated as a control point, in that such a survey point must be identified by a unique, station serial number (see *82* record under **RECORD FORMATS**).

Each control point in a horizontal control job must be assigned a unique, four-digit station serial number. When more than one project appears in a job, care must be taken to insure that (1) the same station serial number is assigned to a control point which several of the projects may have in common, and that (2) different control points are assigned different station serial numbers throughout the horizontal control job. The station serial numbers assigned to control points in the OBS data set of a horizontal control job must be the same as those used to identify the same control points in the corresponding DESC data

set. In particular, any survey point for which a description and/or recovery note is to be submitted in the DESC data set must be identified by a unique, station serial number, i.e., it must be carried as a control point in the corresponding OBS data set.

Peripheral Points: Peripheral points are survey points in the vicinity of a control point which are not intended for positioning, such as reference marks and azimuth marks. These points are still identified by unique, four-digit station serial numbers. Unmonumented eccentric instrument setups and eccentric targets/reflectors are also peripheral points if the respective observations are reduced to center.

An eccentric point, RM, or AZ MK is not always treated as a peripheral point. If the eccentric instrument setup or target/reflector placement is made over a monumented (or otherwise permanently marked) point which can serve as a control point (e.g., when a reference mark is occupied), in many cases it will be desirable to treat the eccentric point as another control point. In any case, when an eccentric point is offset more than 10 meters from the respective control point, the eccentric observations should not be reduced to center (see next section), and the eccentric point should be treated as a control point, whether it is permanently marked or not.

A RM or an AZ MK which has not been occupied (i.e., one which has one or more directions, angles, and/or distances measured to it but not from it) is a peripheral point. But, if it is to be positioned, treat it as another control point. An RM or AZ MK that is occupied as a part of the survey scheme (i.e., as an eccentric occupation of the respective control point) should always be treated as a distinct control point. An RM or AZ MK that has directions, angles, and/or distances measured from it (as well as to it) for the purpose of verifying and/or supplementing the observations which tie together the control point and its peripheral points may remain a peripheral point even though the RM or AZ MK may appear as a standpoint on an observation record in this particular case.

The observations which establish the linkage between a peripheral point and its respective control point must appear among the observation data records. As a minimum, the following observations are required:

1. Eccentric Points: At least one angular observation (horizontal direction or horizontal angle) and one distance measurement, either from the eccentric point to the respective control point, or from the control point to the eccentric point.

2. Reference Marks: At least one angular observation (horizontal direction or horizontal angle) and one distance measurement from the respective control point to the RM in question.

3. Azimuth Marks: At least one angular observation (horizontal direction or horizontal angle) and one distance measurement from the respective control point to the AZ MK in question.

TREATMENT OF ECCENTRIC OBSERVATIONS

When the surveying instrument cannot be installed directly over the desired control point (i.e., when the control point cannot be "occupied"), observations must be made with the instrument offset a short distance from the intended standpoint. Similarly, when the target, retro-reflector, or remote instrument cannot be installed directly over the intended forepoint, observations are made to a target, retro-reflector, or remote instrument which is offset a short distance from the respective control point. When such a condition exists, the offset point from which and/or to which the observations are actually taken is said to be "eccentric" with respect to the control point in question, which is referred to as the "center."

Eccentric observations are normally "reduced to center" as a part of the field computation process. A correction is computed for each eccentric observation from the distance and direction of the offset. After such a correction is applied, the respective observation ceases to be "eccentric." For all practical purposes it is regarded as having been taken from the intended standpoint to the intended forepoint. <u>As a general rule, eccentric observations should be reduced to center by the submitting agency and included in the HZTL OBS data set as normal (i.e., non-eccentric) observations.</u>

When eccentric observations are submitted, care must be taken to select one of the two possible methods of handling eccentric observations which is applicable to the eccentric point in question, and to identify the respective eccentric point accordingly - either as a peripheral point if Method A is applicable, or as a control point if Method B is applicable (see preceding section for definitions of "control point" and "peripheral point").

<u>Method A</u>: <u>The eccentric observations are to be reduced to center</u>. In this case, the eccentric point is identified as a peripheral point. When such a peripheral point is encountered as either a standpoint or forepoint on an observation record, the respective observation will be reduced to center, and the original (eccentric) observation will not be retained. This method is applicable only to eccentric points which are offset no more than 10 meters from the respective control point. For offsets of greater than 10 meters Method B is mandatory.

<u>Method B</u>: <u>The eccentric point is to be treated as a control point</u> whether permanently marked or not. In this case, no reduction to center is involved, as the respective observations are not regarded as eccentric. The eccentric standpoint or forepoint is identified by a unique, four-digit station serial number just as any other control point (see preceding section). It is given a name (e.g., SMITH ECC, if the name of the respective control point is SMITH), and a *80* or *81* record containing its (approximate) geodetic position and elevation must appear among the *80*-series records. This method should be used for eccentric points which are permanently marked, regardless of the offset distance involved. Method B must always be used for eccentric points which are offset by more than 10 meters from the respective control point, whether the eccentric point is permanently marked or not.

<u>ACCURACY OF THE OBSERVATIONS</u>

For every horizontal control survey observation, an estimate of the absolute accuracy of the measured quantity must be available for the purpose of assigning appropriate weight to that observation when it participates in the adjustment of the respective horizontal control network. The absolute accuracy of a measurement is defined as the degree to which the result of that measurement approximates the true value of the measured quantity. Since the true value of a direction, angle, or distance is not known, it then follows that the accuracy of a horizontal control survey observation can only be estimated (1) by comparing the results of different measurements of the same quantity, and (2) by analyzing the misclosures by which the measured quantities fail to satisfy geometric conditions in the respective horizontal control network (e.g., triangle misclosures).

A horizontal control survey observation is rarely made as a single, isolated measurement. Once the required surveying equipment is set over the survey points in question, it is a common practice to measure the same quantity (direction, angle, or distance) several times within a short span of time, each complete measurement being carried out according to an observation scheme which has been carefully designed to eliminate instrumental errors (and possibly other constant and systematic errors as well). The advantage of "replication" is that large blunders can be detected and eliminated, and that the resulting group of measurements can be treated statistical as a random sample.

Each measurement is corrected for any known constant and/or systematic error. Then the resulting corrected sample elements are screened for outliers (larger-than expected random errors which are suspected to be blunders), usually by the application of a fixed, empirical rejection limit, and the mean of the remaining measurements is used as the best approximation of the true value.

Assuming that the blunders and/or outliers have been eliminated, and that constant and/or systematic errors from all known sources have been eliminated either by the observing procedure or by the application of computed corrections, other errors remain, as evidenced by a random disagreement (however small) which still normally exists among "corrected" sample elements. If another sample of measurements of the same quantity is taken with the same type of instrument but under different environmental conditions, the mean value of the second sample will normally differ from the first sample. If many such samples are taken, the mean values of the re-observed samples will be found to disagree in a random manner as well.

The errors which remain after the blunders and outliers are eliminated and after the sample elements are corrected for constant and systematic errors are seen as random errors of two different kinds. Random errors of the first kind are those errors which manifest themselves as discrepancies among the elements of a sample. Since the presence and general magnitude of these errors are readily apparent when the elements of the sample are compared, random errors of the first kind are known as "sample-internal" or "internal" errors. Random errors of the second kind are those errors which remain constant for all measurements within a sample but vary in a random manner for samples which are reobserved under different conditions. Since they introduce the same bias into every measurement in the sample, the presence and general magnitude of these errors become apparent only when the mean values of several reobserved samples are compared, or when misclosures of geometric conditions in the

respective horizontal control network are analyzed. Because of this fact, random errors of the second kind are known as "sample-external" or "external" errors.

The accuracy estimate needed to determine the proper weight for a horizontal control survey observation is the standard error (sigma) reflecting the combined effect of the internal and external errors which affect that observation. Such an estimate of the total uncertainty associated with the respective measured quantity is given by the vector sum (square root of the sum of squares) of the one-sigma estimates reflecting the contributions of the corresponding internal and external errors.

A direct estimate of the contribution of the respective internal errors (i.e., the Internal Consistency Sigma - see below) can be obtained as the standard deviation of the computed sample mean; a value based upon experience may be given when the sample size is one. If no value is specified on the respective observation record (i.e., the field is left blank), a one-sigma estimate can be obtained as a function of the rejection limit and number of replications, or from a default value based on the type of survey equipment used, number of replications taken, and on the order-and-class of the survey.

A direct estimate of the contribution of the respective external errors (i.e., the External Consistency Sigma - see below) is rarely at hand, as horizontal control survey observations are not normally re-accomplished by design under different environmental conditions for the purpose of evaluating the effect of the external errors. A value based on experience may be given; however, if no value is specified on the respective observation record (i.e., the field is left blank), a default value based on the survey equipment used, order-and-class of the survey, and on the type of the survey points involved will be assigned. In connection with triangulation projects, a collective estimate of the external error affecting horizontal directions (or horizontal angles) in that project will be recovered from the set of triangle misclosures when that project is first adjusted by NGS.

The data items which pertain to the accuracy estimate of the respective horizontal control survey observation not treated elsewhere in this chapter are defined below.

Number of Replications: Number of independent measurements of the same quantity, normally carried out within a short span of time (i.e., under the same environmental conditions) by the same personnel using the same equipment (i.e., sample size). In connection with horizontal control survey observations, it is the number of times a complete measurement procedure (observing scheme) is executed with the objective of obtaining a group of measurements the mean value of which is to be used as the observed quantity (e.g., number of positions in a set of horizontal directions).

Rejection Limit: Maximum variation allowed in a group of measurements. The individual measurements which exceed this limit are normally dropped from the sample and hence do not enter into the computation of sample mean. For horizontal directions and horizontal angles, the rejection limit is expressed as the maximum deviation of the individual measurements from the respective sample mean. For vertical angles and for distance measurements, the rejection limit is expressed as the maximum spread between the individual observations included in the sample (i.e., maximum range).

Internal Consistency Sigma: One-sigma estimate reflecting the contribution of the sample-internal random errors to the total uncertainty associated with a measured quantity. In connection with horizontal control survey observations, a direct estimate of the effect of the respective internal errors is usually available as the standard deviation of the computed sample mean. See discussion above concerning the treatment of the accuracy estimate of an observation for which this data item is missing.

External Consistency Sigma: One-sigma estimate reflecting the contribution of the sample-external random errors to the total uncertainty associated with a measured quantity. In connection with horizontal control survey observations, a direct estimate of the effect of the respective external errors is not normally available; however, a value based on experience may be given. See discussion above concerning the treatment of the accuracy estimate of an observation for which this data item is missing.

HORIZONTAL DIRECTION DATA RECORDS

20 - Horizontal Direction Set Record
21 - Horizontal Direction Comment Record (Optional)
22 - Horizontal Direction Record

The horizontal direction data records, identified by *20*-series data codes, are listed above; the block diagrams depicting the respective formats will be found under **FORMAT DIAGRAMS**.

Since one horizontal direction by itself is meaningless, horizontal directions must be observed in sets of two or more directions. The respective observations are normally recorded in a field record book and later abstracted onto a standard form which is usually referred to as the "abstract of horizontal directions." As recorded on the "abstract," each direction consists of a group of "pointings" observed clockwise from the "initial" (direction to the first object sighted in the observing sequence), which is normally assigned a value of zero. For each forepoint included in the set, the horizontal direction value desired is the mean value of the respective group of pointings (in sexagesimal degrees, minutes, seconds, and decimals of second), corrected for eccentricity of the instrument and/or target, if applicable (see TREATMENT OF ECCENTRIC OBSERVATIONS).

Each set of horizontal directions is to be submitted as a group of records which must begin with one *20* record. In addition to containing information which pertains to the set as a whole, the *20* record also contains the data items associated with the initial direction. Following the *20* record, there may be one or more *21* comment records. These comment records are optional, except when the problem indicator flag on the *20* record (first digit of the weather code) is "1", in which case at least one *21* record containing an explanation of the problem encountered is required.

After the *21* record(s), or immediately after the *20* record if no *21* record(s) are present, one or more *22* records must follow, one for each additional direction observed in the set. Each of these *22* records must have the same standpoint designation and set number (see below) as the *20* record of that horizontal direction set.

When two or more sets of horizontal directions are observed at the same station, each set must be submitted as a separate, complete group of *20*-series records (i.e., a *20* record, one or more *21* records if applicable, followed by one or more *22* records). All sets observed at the same station must be assigned different set numbers and must appear as consecutive sets in the order of increasing set numbers among the *20*-series records.

Set Number: The first set of observations associated with a survey control point is normally coded as 01. Subsequent sets are coded 02, 03, etc. Deviation from this procedure should be explained either in the comment records or in the transmitting letter to prevent someone unfamiliar with the original coding to think that the records were not coded or lost. Sets observed at peripheral eccentric points are considered to belong with the control point and must be numbered as if observed at the control station. Again, the set numbers of successive sets of horizontal directions observed at the same station (including peripheral stations) need not be consecutive, but they must be assembled in increasing order.

Number of Objects Sighted in This Set: The number of forepoints to which directions were observed in the set of horizontal directions, including the initial equals the number of objects sighted in the set. This number minus one is equal to the number of *22* records which must appear behind the *20* record in that set.

Date and Time: The date of observation is required (at least the year) and must appear on every *20* record. The time of observation, when available, is desired to indicate the approximate time of day; any time associated with the set of horizontal directions (e.g., time of first observation, mean time of the set, etc.) is acceptable. Both date and time become required items when one attempts to set parameters for an adjustment based upon date and time constraints.

GLOBAL POSITIONING SYSTEM DATA RECORDS

- *25* - GPS Occupation Header Record
- *26* - GPS Occupation Comment Record (Optional)
- *27* - GPS Occupation Measurement Record
- *28* - GPS Clock Synchronization Record
- *29* - GPS Clock Synchronization Comment Record (Optional)

The Global Positioning System records, identified by the *25* - *29* data codes, are listed above; the block diagrams illustrating the respective formats will be found under **FORMAT DIAGRAMS.**

Whereas observations of classical survey operations are recorded in ASCII format in this text, GPS observations containing code and phase data are recorded by the GPS receiver in a binary format that is unreadable without a translation (e.g., vector reduction) program. The information on the *25* to *29* records and the GPS code and phase measurements are required to derive the information in the GPS Data Transfer Format file (G-File) records: A,B,C,D,E,F,G,H (ANNEX N).

A set of one *25* and two *27* records must exist for each independent occupation of a control point by a GPS receiver. The first *27* record indicates the time data recording was initiated plus associated occupation information; the second *27* indicates the time data recording was completed plus associated occupation information. Record the time and date referenced to UTC (or Greenwich Mean Time).

A *28* record, used with older receivers which do not recover time from the broadcast GPS signal, is required whenever GPS receivers must be time synchronized to the external time source, e.g., another receiver or a master time source. When using these "codeless" receivers, synchronization must be established between all receivers taking simultaneous measurements. Two synchronizations, normally one before and one after collecting the GPS observations, are required to check receiver clock drift and to verify that no time synchronization errors ("jumps") occurred during the observing period. The *28* record is not required for modern P-code receivers which may be referred to as codeless when in anti-spoofing mode.

The station serial number, weather code, and job-specific instrument number fields are required on GPS records. These entries are fully explained in the section, OBSERVATION DATA RECORDS. Other entries in the GPS records are self explanatory.

Job-Specific Data Media Data Identifier: Since the GPS observables (code and phase data) can not be practically accommodated in the formats of this text, they must be submitted in manufacturer specific or RINEX (Receiver Independent Exchange) data file formats. Depending upon the receiver type, one or more files may be generated. However, it is still necessary to associate a specific set of data file(s) to a specific occupation. This is done by the user who assigns a 10 character identifier for each station occupation. These identifiers are unique to a specific project and reflect information on the physical or digital labels of the phase data files. The sole function of the data media identifier is to provide to NGS a one-to-one correspondence between a control point occupation and a GPS data file. The standard format for the data media identifier can be found in ANNEX N.

HORIZONTAL ANGLE DATA RECORDS

- *30* - Horizontal Angle Set Record

31 - Horizontal Angle Comment Record (Optional)
32 - Horizontal Angle Record

The horizontal angle data records, identified by *30*-series data codes, are listed above; the block diagrams illustrating the respective formats will be found under **FORMAT DIAGRAMS**.

Horizontal angles (clockwise), as opposed to horizontal directions, are normally observed in connection with surveys of low accuracy (e.g., third order or lower) using repeating theodolites and engineer’s transits. The characteristic feature of these instruments is the double concentric motion about the vertical axis by means of which the horizontal circle can be set precisely to zero when one of the forepoints is sighted upon, and the desired horizontal angle to another forepoint can be "repeated"; i.e., measured several times in succession, each time allowing the horizontal circle reading to be incremented by the magnitude of the measured angle. The desired angular measure, expressed to a greater precision than the resolution of the respective instrument, is obtained when the total angle accumulated on the horizontal circle is divided by the number of "repetitions."

The number of repetitions must not be confused with the number of replications, as one angle measurement by this method, involving any number of repetitions, constitutes but one determination of that angle (i.e., one replication).

Normally, several such determinations are made; the desired horizontal angle value is the mean value of the respective group of measurements (in sexagesimal degrees, minutes, seconds, and decimals of second), corrected for eccentricity of instrument and/or target, if applicable (see TREATMENT OF ECCENTRIC OBSERVATIONS). Two forepoints are involved with every horizontal angle observation; the value given must be the clockwise angle from the first (left) forepoint to the second (right) forepoint.

Since a horizontal angle is a complete observation in itself, every horizontal angle may be submitted as a "set of size one," i.e., as a *30* record followed by one or more *31* comment records. These comment records are optional, except when the problem indicator on the *30* record (first digit of the weather code) is 1, in which case at least one *31* record containing an explanation of the problem encountered is required. When more than one angle is measured as a part of the same observing scheme (e.g., angle observation by Schreiber’s method), the additional angles in the same set should be submitted as *32* records to follow after the *31* record or records, or immediately after the *30* record if no *31* records are present. In addition to the same standpoint designation, each of these *32* records must bear the same set number (see below) as the *30* record of that horizontal angle set.

When two or more sets of horizontal angles are observed at the same station, each set must be submitted as a separate, complete group of *30*-series records (i.e., a *30* record, one or more *31* records if applicable, followed by one or more *32* records). All sets observed at the same station must be assigned different set numbers and must appear as consecutive sets in the order of increasing set numbers among the *30*-series records. If horizontal angles are to be reduced to center, the sets observed at peripheral eccentric points of the same control point must appear as members of the same sequence together with any set or sets observed directly over the corresponding control point.

Set Number: Normally coded as 01, unless two or more sets of horizontal angles observed at the same standpoint (either between the same or between different forepoints), in which case these sets must appear adjacent among the horizontal angle data records. The first set in the sequence must be assigned a two-digit set number, e.g., 01, and each additional consecutive set bearing the same standpoint designation must be assigned a higher number, e.g., 02, 03, etc. For this purpose, sets observed at peripheral eccentric points are considered to belong with the respective control point and must be grouped accordingly. The set numbers of successive sets of horizontal angles observed at the same station need not be consecutive; however, they must be increasing.

Number of Angles Observed in This Set: Total number of horizontal angles observed as a part of the same observing scheme. This number minus one equals the number of *32* records which must appear behind the respective *30* record in that set.

Date and Time: Date of observation is required (at least the year) and must appear on every *30* record. Time of observation, where available, is desired to indicate the approximate time of day; any time associated with the horizontal angle observation (e.g., starting time, mean time, ending time, etc.) is acceptable. Both date and time become required items when one attempts to set parameters for an adjustment based upon date and time constraints.

VERTICAL ANGLE/ZENITH DISTANCE DATA RECORDS

40 - Vertical Angle Set Record
41 - Vertical Angle Comment Record (Optional)
42 - Vertical Angle Record

The vertical angle/zenith distance data records, identified by *40*-series data codes, are listed above; the block diagrams illustrating the respective formats will be found under **FORMAT DIAGRAMS**.

Vertical angles (or zenith distances) are observed in connection with classical horizontal control survey projects for the purpose of obtaining elevation differences between horizontal control points by trigonometric leveling. The elevation of one or more of the survey points involved must be reliably known from some other source.

In addition to vertical angles and distances between survey points, the determination of the elevation differences by trigonometric leveling requires a knowledge of the geoid height at every survey point involved and of the deflection of vertical in the direction of each vertical angle observed at every standpoint. Since geoid heights and deflections of the vertical are seldom known, it is a common practice to assume a zero value for these quantities, and therefore only approximate results can normally be obtained. For this reason, vertical control should not be extended by this method without frequent ties to existing bench marks in the project area. Aside from the difficulties mentioned in the preceding paragraph, trigonometric leveling suffers from a large uncertainty due to atmospheric refraction. This uncertainty is brought about by the unpredictable nature of the irregular, preponderantly vertical bending of an optical ray due to the variation of the refraction gradient along its path. This effect of atmospheric refraction is the dominant source of the external random error associated with vertical angle observations. To control the influence of this external error, the magnitude of which grows with the length of the observed line, reciprocal vertical angles are often observed simultaneously or nearly simultaneously from both ends of the respective line.

In a manner similar to other types of horizontal control survey observations, a vertical angle is usually measured several times in rapid succession following a standard observing scheme. The desired vertical angle value is the mean value of the respective group of measurements (in sexagesimal degrees, minutes, seconds, and decimals of second) accompanied by the appropriate angle code (see below) which identifies the value given as an elevation angle (E), depression angle (D), or a zenith distance (Z). Since the magnitude of the dominant external error affecting the vertical angle measurement is proportional to the length of the observed line (see above, the respective External Consistency Sigma is expressed as seconds of arc per kilometer.)

A vertical angle is a complete observation in itself; hence every vertical angle may be submitted as a "set of size one," i.e., as a *40* record followed by one or more *41* comment records. These comment records are optional, except when the problem indicator on the *40* record (first digit of the weather code) is 1, in which case at least one *41* record containing an explanation of the problem encountered is required. When two or more vertical angles to different forepoints are measured at a station as a part of the same observing scheme, the additional vertical angles in the same set should be

submitted as *42* records to follow after the *41* record or records, or immediately after the *40* record if no *41* records are present. In addition to the same standpoint designation, each of these *42* records must bear the same set number (see below) as the *40* record of that vertical angle set.

When two or more sets of vertical angles are observed at the same station, each set must be submitted as a separate, complete group of *40*-series records (i.e., a *40* record, one or more *41* records if applicable, followed by one or more *42* records). All sets observed at the same station must be assigned different set numbers and must appear as consecutive sets in the order of increasing set numbers among the *40*-series records. For this purpose, sets observed at peripheral eccentric points of the same control point must appear as members of the same sequence together with any set or sets observed directly over the corresponding control point.

<u>Set Number</u>: Normally coded as 01, unless there are two or more sets of vertical angles observed at the same standpoint (either to the same or to different forepoints), in which case these sets must appear adjacent among the vertical angle data records. The first set in the sequence must be assigned a two-digit set number, e.g., 01, and each additional consecutive set bearing the same standpoint designation must be assigned a higher number, e.g., 02, 03, etc. For this purpose, sets observed at peripheral eccentric points are considered to belong with the respective control point and must be grouped accordingly. The set numbers of successive sets of vertical angles observed at the same station need not be consecutive; however, they must be increasing.

<u>Number of VAs or ZDs Observed in This Set</u>: Number of forepoints to which vertical angles (or zenith distances) were observed as a part of the same observing scheme. This number minus one equals the number of *42* records which must appear behind the respective *40* record in that set of vertical angles.

<u>Date and Time</u>: Date of observation is required (at least the year) and must appear on every *40* record. The full date and the time of the vertical angle observation to each forepoint involved should be supplied whenever possible, so that any search based on date and time can be made for simultaneous or nearly simultaneous reciprocal vertical angle observations. For this purpose, a time field appears on the *42* record as well as on the *40* record.

<u>Angle Code</u>: Vertical angles are measured with respect to the direction of the gravity vector at the respective standpoint by theodolites or transits equipped with appropriate vertical circles. Depending on the instrument, the origin (zero graduation mark) of the vertical circle points either in a direction perpendicular to that of the gravity vector, in which case the origin of the vertical circle lies in the local astronomic horizon, or else it points in the direction opposite to that of the gravity vector, in which case the origin of the vertical circle indicates the local astronomic zenith.

When the zero of the vertical circle defines the astronomic horizon, the vertical angle measured is an "elevation angle" or a "depression angle" depending on whether the object sighted is above or below the astronomic horizon. When the zero of the vertical circle points in the direction of the astronomic zenith, the vertical angle measured is a "zenith distance." The zenith distance of an object above the astronomic horizon will be less than 90

degrees, while the zenith distance of an object below the astronomic horizon will be greater than 90 degrees.

The angle code is a one-letter indicator of the type of the vertical angle given. The three possible codes are as follows:

E - elevation angle
D - depression angle
Z - zenith distance

LEVEL DATA RECORDS

45 - Observed Difference of Elevation Records
46 - Observed Difference of Elevation Comment Record
47 - Observed Difference of Elevation Continuation Record

The difference of elevation data records, identified by *40*-series data codes, are listed above; the block diagrams illustrating the respective formats will be found under **FORMAT DIAGRAMS**. Differences of elevation are observed in connection with classical horizontal control survey projects in order to maintain an observed difference of elevation relationship between two horizontal control points for the purpose of data reduction. Both horizontal control points generally do not have established vertical elevations. However, either one of these two control points could already have an established and published elevation.

In a manner similar to other types of horizontal control survey observations, a difference of elevation is usually measured at least twice (once in the forward direction and once in the reverse or backward direction) as standard observing practice. The desired difference of elevation is then the mean value of the two respective differences of elevation. However, each level running (i.e., forward and backward) can be considered as an independent observation and can be coded as a separate observed difference of elevation data set.

Since a difference of elevation is a complete observation in itself, each observation is submitted as a *45* record, followed by one or more *46* comment records, followed by a *47* record. The comment records are optional, except when the problem indicator on the *45* record (first digit of the weather code) is 1, in which case at least one *46* record containing an explanation of the problem encountered is required. The *47* record must bear the same standpoint designation as the *45* record preceding it.

When two or more sets of differences of elevation are observed at the same station, each set must be submitted as a separate, complete group of *40*-series records (i.e., a *45* record, one or more *46* records if applicable, followed by a *47* record).

Number of Replications: The number of replications for a single difference of elevation observation is one. If the difference of elevation is the mean
value of two level runnings of the same section (i.e., forward and backwards) then the number of replications is coded as 2.

Date and Time: The date of observation is required (at least the year) and must appear on every *45* record. The full date and time for the leveling observation should be supplied whenever possible. The observation time coded should be the mid-time for the running of the section.

DISTANCE DATA RECORDS

50 - Taped Distance Record
51 - Unreduced Distance Record
52 - Reduced Distance Record
53 - Unreduced Long Line Record
54 - Reduced Long Line Record

55 - Distance Comment Record (Optional)

The distance data records, identified by *50*-series data codes, are listed above; the block diagrams illustrating the respective formats will be found under **FORMAT DIAGRAMS.**

Submit a *50*, *51*, *52*, *53*, or *54* record, followed by one or more *55* comment records, for every distance determination in the horizontal control survey project. The comment records are optional, except when the problem indicator (first digit of the weather code) is 1, in which case at least one *55* record containing an explanation of the problem encountered must follow the respective *50*, *51*, or *52* distance record. The weather code has been omitted on the *53* and *54* long-line records. In every case, the desired distance value is the mean value of the respective group of replicated measurements to which all corrections applicable to that type of distance measurement have been applied (in meters and decimals of meter), further corrected for eccentric setup at either end of the measured line, if applicable (see TREATMENT OF ECCENTRIC OBSERVATIONS). It must be accompanied by the appropriate distance code (see below) which identifies the distance value given as to its type.

The *50* record is intended for distances measured with either calibrated or uncalibrated (i.e., standardized or not standardized) steel or invar tapes. Included are distances consisting of any number of segments taped horizontally, taped distances consisting of any number of segments which have all been reduced individually to a common horizontal reference surface (other than the sea level or the ellipsoid), and one-segment unreduced taped distances (less than or equal to one tape length) measured along a slope. The limitation to only one segment in this last case is forced by the additional data items (the elevation difference between the respective marks and the heights of tape supports over the marks) required for each such taped distance segment. Excluded are taped distances which have been reduced to sea level (geoid), to the ellipsoid, or to mark-to-mark, for which the *52* record should be used. In every case, the respective standardization, catenary, and temperature corrections, as applicable to the method of measurement and/or to the equipment used, are assumed to have been applied.

The *51* record is intended for unreduced slant-range distances under 100 kilometers measured by electronic distance-measuring equipment (DME). Included are line-of-sight instrument-to-reflector distances measured by electro-optical DME and master-to-remote distances measured by microwave DME with a resolution (i.e., smallest directly readable measurement unit) of 1 centimeter or better.

Excluded are distances measured to a precision coarser than 1 centimeter (because the respective Rejection Limit, Internal Consistency Sigma, and External Consistency Sigma should be expressed in different units), which may be submitted as *53* records. In every case, the respective instrument and/or reflector calibration corrections and refraction correction, as applicable to the method of measurement and/or to the equipment used, are assumed to have been applied.

The *52* record is intended for taped distances, and for distances under 100 kilometers measured by electronic DME with a precision of 1 centimeter or better, which have been reduced (1) to sea level (i.e., to the geoid), (2) to the ellipsoid (either NAD 83 or as specified on the *13* record), or (3) to mark-to-mark. For the same reason given in the preceding paragraph, reduced distances measured to a coarser precision than 1 centimeter should be submitted as *54* records. In every case, the distance given is assumed to be the appropriately reduced value corresponding to the mean of the respective sample of distance measurements to which all applicable corrections have been applied. Among the required data items are elevations (and of the geoid heights, if applicable) which were used in the reduction process (possibly different than those provided on the corresponding *80*-series records).

The preponderant external random errors affecting precisely taped distances or line-of-sight distances measured by fine-resolution electronic DME arise out of the inadequacy of the mathematical models used to correct the respective distance measurements for distance-dependent systematic errors, such as the temperature and catenary corrections in case of taped distances, or the refraction correction in case of distances measured by precise electro-optical or electro-magnetic DME. The magnitude of the respective external random errors is therefore also proportional to the length of the measured line. For this reason, the External Consistency Sigma on the *50*, *51*, and *52* records is expressed as a parts-per-million (ppm) value.

The *53* and *54* records are counterparts of the *51* and *52* records intended, respectively, for unreduced and reduced long-line distances (100 kilometers and longer) measured with either fine or coarse resolution by an indirect method. Examples of such long-line distances are the antenna-to-antenna spatial chords and the corresponding reduced sea-level (geoidal), ellipsoidal, or mark-to-mark distances derived from line-crossing measurements made with a long-range, airborne electro-magnetic DME (e.g. HIRAN), or obtained by extraterrestrial techniques (e.g., VLBI). These records may also be used, respectively, for unreduced and reduced slant-range distances under 100 kilometers measured directly by a coarse-resolution DME. Since the preponderant external random errors associated with long-line and/or coarse-resolution distance measurements do not normally exhibit any relationship with the length of the respective line, the External Consistency Sigma on the *53* and *54* records is expressed in meters.

Date and Time: Date of observation is required (at least the year) and must appear on every distance observation record. Time of observation, where available, is desired to indicate the approximate time of day; any time associated with the distance observation (e.g., starting time, mean time, ending time, etc.) is acceptable.

Distance Code: A one-letter indicator of the type of distance involved. This indicator must appear immediately following the distance field on the distance observation records. The possible distance codes are as follows:

1. Unreduced Distances:

   T - distance taped horizontally
   H - taped distance reduced to horizontal
   S - slope distance or slant-range distance
   C - spatial chord distance

2. Reduced Distances:

   G - sea-level (geoidal) distances
   E - ellipsoidal distances
   X - mark-to-mark distances

AZIMUTH DATA RECORDS

60 - Laplace/Astronomic Azimuth Record
61 - Geodetic Azimuth Record

The azimuth data records, identified by *60*-series data codes, are listed above; the block diagrams illustrating the respective formats will be found under **FORMAT DIAGRAMS.**

A Laplace azimuth is an astronomic azimuth determination (e.g., by observation of the star Polaris) converted to a corresponding geodetic azimuth by the application of the Laplace correction. A data element necessary for the computation of the Laplace correction is the east-west (prime-vertical) component of the deflection of vertical at the respective standpoint. If the deflection component is not known from other sources, an astronomic longitude must also be observed. A horizontal control point at which the prime-vertical component of the deflection of vertical is known, and at which a determination of astronomic azimuth has been made, is called a "Laplace station."

Laplace azimuths are the primary means for orienting a survey project if the orientation cannot be obtained with respect to established horizontal control points (e.g., because of intervisibility problems). When a survey project is extended away from existing horizontal control, Laplace stations must be established at regular intervals to guard against the buildup of systematic errors which may cause a gradual swing in the orientation of the network.

Submit a *60* record for each astronomic or Laplace azimuth used in the project. If there are two or more sets of astronomic azimuth observations (e.g., sets observed on different nights), submit a separate *60* record for each set. The desired Laplace azimuth is the mean value of the respective set of astronomic azimuth observations to which all applicable corrections, including the Laplace correction, have been applied (in sexagesimal degrees, minutes, seconds, and decimals of second), further corrected for eccentricity of instrument and/or target, if applicable (see <u>TREATMENT OF ECCENTRIC OBSERVATIONS</u>).

A required data item on the *60* record is the <u>Prime-Vertical</u> <u>Component</u> <u>of</u>

<u>Deflection</u> (Eta), i.e., the difference between the astronomic and geodetic longitudes of the standpoint, as used in the computation of the expressed Laplace correction. In addition to its absolute numerical value in seconds, the direction of the prime-vertical component of the deflection of vertical, i.e., the <u>Direction</u> <u>of</u> <u>Eta</u> must be specified as "E" or "W" according to whether the astronomic longitude falls east or west of the corresponding geodetic longitude of the standpoint.

The results of astronomic observations in the form of an astronomic azimuth or a computed Laplace azimuth and the meridional and prime-vertical components of the deflection of vertical are called for on the *60* and *85* records of the HZTL OBS data set. In addition, the respective astronomic latitude, longitude, and/or azimuth observations should be submitted separately in full detail for rigorous processing and incorporation into the astronomic data file of the National Geodetic Survey Data Base.

Geodetic azimuths are used when orientation control for a survey project is obtained with respect to the existing horizontal control network by including an azimuth reference object (e.g., the azimuth mark) among the forepoints to which horizontal directions or horizontal angles are observed at one or more existing horizontal control points. Such control points, occupied for the purpose of establishing connection with the existing horizontal control network, must be identified as "fixed" by means of *90* Fixed Control Records (see <u>FIXED CONTROL DATA RECORDS</u>).

Submit a *61* record containing the respective geodetic azimuth value (in sexagesimal degrees, minutes, seconds, and decimals of second) for every azimuth reference object to which a horizontal direction or horizontal angle has been observed for the purpose of providing orientation control for the survey project. **But, do not submit a *61* record if the azimuth reference object in question is another control point in the HZTL OBS data set**, i.e., if a *80* or *81* record defining its geodetic position appears among the *80*-series records (see <u>SURVEY POINT DATA RECORDS</u>). Instead, if such a control point is used for azimuth reference, it must be identified as "fixed" by means of a *90* Fixed Control Record in the same manner as the respective standpoint (see above).

Date and Time: The date of the astronomic azimuth observation is required (at least the year) and must appear on the respective *60* Astronomic/Laplace Azimuth Record. The time of observation is desired to indicate the approximate time; any time associated with the astronomic azimuth observation (e.g., starting time, mean time, ending time, etc.) is acceptable. Date and time have been omitted on the *61* Geodetic Azimuth Record, since one does not observe a geodetic azimuth. It is a computed quantity.

Origin of Azimuth: A one-letter code indicating the branch of the meridian (north or south) with respect to which the azimuth given on a *60* or *61* record is specified. The azimuth of a line joining a standpoint and a forepoint is defined as the clockwise horizontal angle (0 to 360 degrees) measured from either the north or the south branch of the meridian at the standpoint to the forepoint in question. Since the azimuth may be defined as either "from the north" or "from the south," the origin of the azimuth must be specified as "N" or "S", whichever applies. In the NAD 27 system of coordinates, astronomic and geodetic azimuths are defined as originating from the south. In the NAD 83 system of coordinates, astronomic and geodetic azimuths are defined as originating from the north.

SURVEY EQUIPMENT DATA RECORDS

***70* - Instrument Record**
***71* - GPS Antenna Record**

The purpose of the *70* record is to provide descriptive information pertaining to an item of survey equipment which has been identified by a Job-Specific Instrument Number (see under OBSERVATION DATA RECORDS). Submit a *70* record for each item of survey equipment used in the project. Individual *70* records should appear in order of increasing Job-Specific Instrument Numbers (JSIN). More than one *70* record is required for any instrument used for more than one type of measurement. In other words, a theodolite used to measure both horizontal and vertical angles would require two *70* records: one to record the resolution of the horizontal measurements and the other to record the resolution of the vertical measurements. The resolution and units symbol (see below) of these two records would be different but, the JSIN and the NGS Survey Equipment Code would be identical.

If a "total station" type instrument is used in a survey, three *70* records may be required (horizontal directions, vertical angles and distance observations) for one JSIN. If this equipment is self-contained, the JSIN and the NGS Survey Equipment Code will be identical in each of the three records as stated above. Refer to the Total Station category (800-860) in ANNEX F. But, if modular type equipment (optional EDM instruments can be mounted on the same "total station" base unit) is used, the NGS Survey Equipment Code in the *70* record, which reflects the resolution of the distance measurements, must be that of the specific EDM instrument used for the observations. (Refer to Distance-Measuring Equipment categories (500-799) in ANNEX F). The equipment code for the other two *70* records would be listed in the Total Station category (861-899) in ANNEX F.

Most of the entries on the *70* record (see FORMAT DIAGRAMS) are self-explanatory; however, the following data items will be explained in greater detail:

NGS Survey Equipment Code: A three-digit numerical identification code is assigned to the different categories of survey equipment, and within each category to specific instruments or other items of survey equipment commonly used in the United States - see ANNEX F.

Resolution of the Instrument and Units: The size of the smallest directly-readable linear or angular measurement unit characteristic of the respective item of survey equipment, followed by a two-letter symbol for the units in which it is expressed:

MT - meters	HS - horizontal seconds of arc
MM - millimeters	HM - horizontal minutes of arc
FT - feet	VS - vertical seconds of arc
MF - millifeet	VM - vertical minutes of arc

The character fields reserved for <u>Resolution</u> <u>of</u> <u>the</u> <u>Instrument</u> and for <u>Units</u> on the *70* record may be left blank if the resolution of the surveying instrument in question cannot be expressed in these units (e.g., if the measurement is obtained in terms of arbitrary "dial" units which do not bear a fixed relationship to the measured quantity).

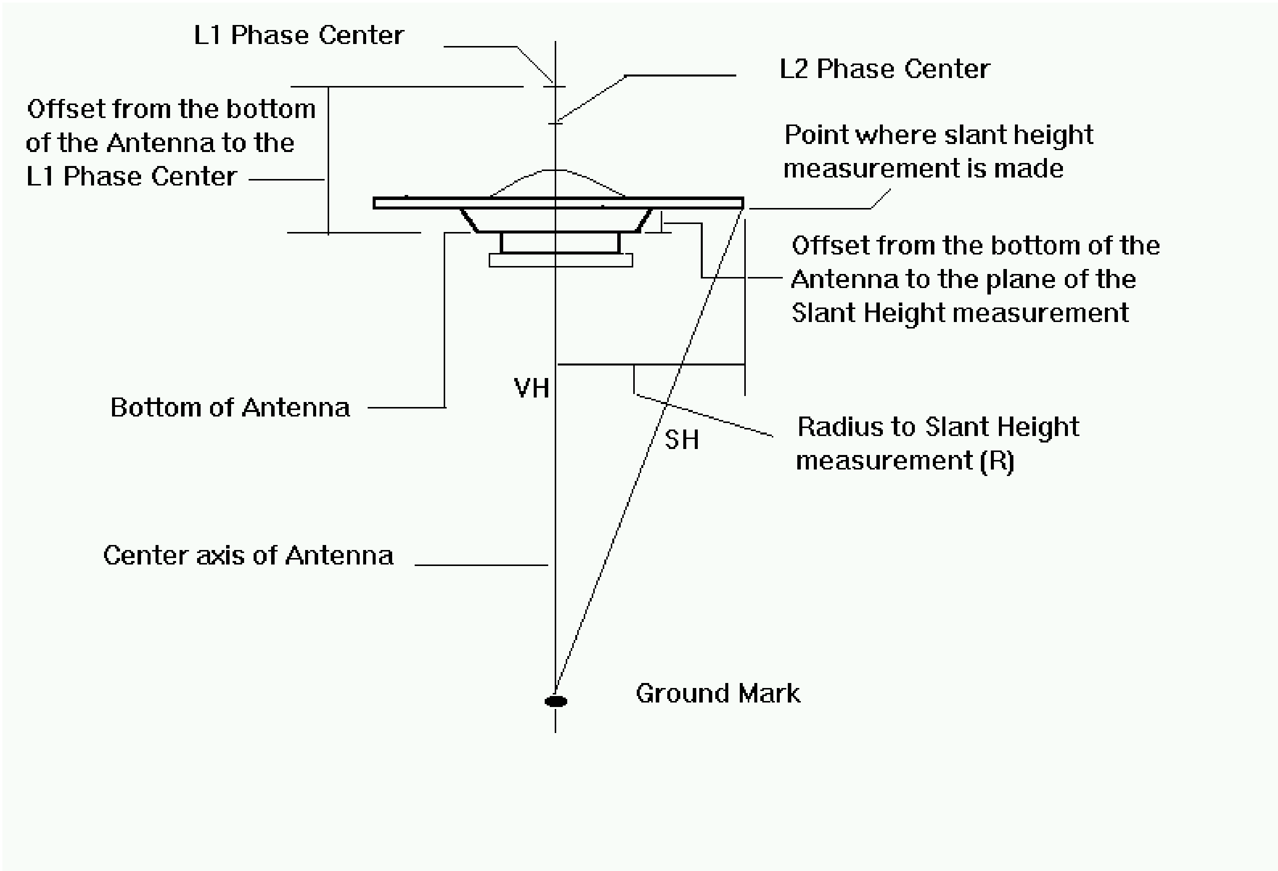
The purpose of the *71* record is to provide descriptive information pertaining to the GPS antenna which has been identified by a Job-Specific Antenna Number (see under <u>OBSERVATION DATA RECORDS</u>). Submit a *71* record for each antenna used in the project. Individual *71* records should appear in order of increasing Job-Specific Antenna Numbers (JSAN).

Most of the entries on the *71* record (see FORMAT DIAGRAMS) are self-explanatory: however, the following data items will be explained in greater detail:

<u>NGS Antenna Code</u>: An alpha-numeric identification code of up to 16 characters is assigned to each different type of GPS antenna commonly used with GPS receivers in the United States. See ANNEX J.

<u>Antenna Phase Pattern File</u>: This file contains phase patterns and offsets for several different types of antennas. As this file is updated, the patterns and/or offsets may be changed, so it is important to record which antenna file was used for the GPS processing. To date (March 1998), NGS has had two files available for use. These files were called ant_info.001 and ant_info.002. These “Antenna Phase Pattern” files will be modified as new antennas are added or as improved patterns are developed. For each antenna in the ant_info.002 file, there are patterns for L1 and L2, and the North, East, Up offsets for the L1 and L2 phase centers.

<u>Source Organization</u>: Use the six character symbol of the organization that maintains the antenna phase pattern files that were used to process the data. This field is required if the antenna phase patterns used are different from those provided by NGS.



Radius to Slant Height Measurement (R): This is the horizontal distance from the vertical center axis of the antenna to the point where the slant height measurement **(SH)** is made.

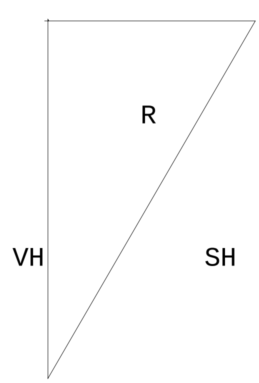
Vertical Height (VH): This value, reduced from the slant height measurement by the formula below, is used in computing the required vertical height of the phase center (L1/L2) above the ground mark in the *27* record.

$$VH = \sqrt{SH^2 - R^2}$$

VH = Vertical Height as reduced from the slant height measurement.

R = Radius to the Slant Height Measurement.

SH = Slant Height Measurement.



Note: The L1 Phase Center Offset used above is found in the Antenna Phase Pattern File.

SURVEY POINT DATA RECORDS

80 - Control Point Record
81 - Control Point Record (UTM/SPC)
82 - Reference or Azimuth Mark Record
85 - Deflection Record (Optional)
86 - Orthometric Height, Geoid Height, Ellipsoid Height Record

The survey point data records, identified by *80*-series data codes, are listed above; the block diagrams illustrating the respective formats will be found under **FORMAT DIAGRAMS**.

Submit a group of *80*-series records for every control point which appears in the horizontal control survey project. See ASSIGNMENT OF STATION SERIAL NUMBERS for definition of "control point" and "peripheral point" and for an explanation of the survey point numbering system. Start with the control point identified by the numerically lowest station serial number and continue with control points in the order of their increasing (not necessarily consecutive) station serial numbers.

The group of *80*-series records pertaining to a control point will usually consist of either a *80* record or a *81* record followed by as many *82* records as there are peripheral reference marks and/or azimuth marks associated with the horizontal control point in question. Use the *80* record if the geodetic position of the control point (see below) is given in geographic coordinates (latitude and longitude); use the *81* record if the position is given either in the Universal Transverse Mercator (UTM) coordinates or in State Plane Coordinates (SPC). Following the *80* or the *81* record, submit one *82* record for each peripheral RM or AZ MK of that control point. Do not submit a *82* record for an RM or AZ MK which is being treated as a control point for which a *80* or *81* record appears elsewhere among the survey point data records. After the *82* records, or after the *80* or *81* record if no *82* records are present, a *85* record may follow, followed by a *86* record. A *85* record should be submitted if either one or both the meridional and prime-vertical components of the deflection of vertical are known. Submit a *86* record to provide orthometric height values for all control points, except for unmonumented recoverable landmarks positioned by intersection. The geoid and ellipsoid height values in this record are optional, with one exception. If the submitted orthometric height value was determined by GPS observations, the associated geoid height value is required.

Two special cases are recognized, in which a *82* record must be submitted for a control point instead of the usual *80* or *81* record. The first case has to do with survey points which would normally be regarded as horizontal control points (i.e., they do not qualify as peripheral points), which cannot be positioned because of insufficient observations, and whose geodetic position cannot be obtained from other sources. Such a survey point must be identified just as a normal control point, however, since the respective geodetic position is not available; submit a *82* record in lieu of a *80* or *81* record, then proceed as for any other normal control point, i.e., submit additional *82* records, a *85* record, and a *86* record, as applicable.

The second case has to do with survey points which are used as vertical control points only, i.e., bench marks or other points to which and/or from which one or more vertical angles and distances have been observed, but no horizontal

directions or angles. Survey points of this kind must also be identified by four-digit station serial numbers. If such a survey point is positionable (e.g. by trilateration), then it should be treated as a normal control point. Otherwise, submit a *82* record for this point in lieu of a *80* or *81* record. A *85* record may follow, if applicable, but a *86* record is required.

Additional *82* records are not allowed in this set. Should such a point have any peripheral reference or azimuth marks, then it should be treated as in the first special case, described in the preceding paragraph.

For the purpose of easy identification, any *82* records, used in lieu of *80* or *81* records as described in the special cases above, should be grouped together and sequenced to follow all the control points with geodetic positions.

The entries on the *80*-series records (see **FORMAT DIAGRAMS**) are self-explanatory; however, the following data items will be explained in greater detail:

Station Name: In the United States, it has traditionally been the preferred practice at the National Geodetic Survey (NGS) and its predecessors to assign intelligible names as primary identifiers of horizontal control points. Such "station names" have the important advantage of being mnemonic - a quality which pure numbers or arbitrary alphanumeric symbols do not possess. In addition, a properly chosen station name may in itself be descriptive and/or indicative of the general location of the horizontal control point, which is a desirable property. For automatic data processing purposes, however, the use of station names as primary identifiers does pose some difficulty, in that their length must, of necessity, be limited to a specific number of characters, and that, contrary to common usage of intelligible names, exactly the same abbreviation and/or spelling of the respective station name must be used whenever a reference is made to a horizontal control point in computer-readable media.

The name of a monumented horizontal control point is usually concise, being limited in length by the space which is available on a standard disk marker for the die-stamping of the respective station name. The usual practice is to stamp the name above the survey point symbol (e.g., triangle) which appears in the center of a standard disk marker, and the year (e.g., 1935) in which the mark was set is usually stamped below the survey point symbol.

In addition to this "year mark set" which normally appears stamped on every monumented survey point, another date is associated with every horizontal control point, i.e., with every survey point which is positioned, whether it is a monumented control point or an unmonumented recoverable landmark (see below). Referred to as the "year established," it is the year in which observations were first performed for the purpose of determining the position of that horizontal control point; this is normally also the year in which the original description of that control point was prepared. The "year established" and "year-mark-set" of a monumented horizontal control point are often identical.

Another type of horizontal control point is an unmonumented recoverable landmark (usually an intersection station) such as a flagpole or church spire. The name of a horizontal control point of this type must be sufficiently descriptive in

order to identify the respective landmark (and frequently a specific feature of the landmark) adequately, and for this reason it is usually lengthy.

For data processing purposes in HZTL OBS data sets, the length of a station name (including all imbedded blanks) is limited to 30 characters, and the same limit applies to the name or designation of a reference mark (RM) or azimuth mark (AZ MK). Accordingly, the name of every horizontal control point to be entered on the *80* or *81* record (as well as the name or designation of an RM or AZ MK to be entered on the *82* record) must be abbreviated and/or edited if it exceeds 30 characters. Guidelines for survey point names and designations, including recommended abbreviations, are given in ANNEX D. **Note that the name or designation of a bench mark (BM) is limited to 25 characters (see Vertical Control Data, Chapters 5, 6, and 7).**

For some of the lengthier names given to horizontal control points (e.g., those of unmonumented recoverable landmarks) contraction to 30 characters will involve rather drastic abbreviation and editing, in which process much of the desired intelligibility and descriptiveness may be lost. To minimize this effect in connection with geodetic materials which are intended for use by the general public, up to 40 characters are allowed for the name of a horizontal control point in the GEOD DESC data set (see Chapter 3). This 40-character station name will be used in the automated publication of geodetic data sheets, station descriptions, and associated indexes. This implies that two versions for every station name which exceeds 30 characters in length can exist - a 30-character version used for data processing purposes, and a 40-character version used for publication purposes. The two versions should differ only as to the manner in which the station name is abbreviated and/or edited.

The name of a horizontal control point entered on the *80* or *81* record should be taken as it appears under "Station Name" in the heading of the respective station description and subsequent recovery notes. For monumented horizontal control points, this station name is normally identical to or closely resembles the name stamped above the survey point symbol on the respective disk marker. Note that neither the "year established" nor the "year mark set" normally appears as a part of the station name. While parts of a lengthy station name may be abbreviated or edited out in order to conform to the 30-character limit, nothing should be added, except as necessary to render the station name unique within the job (see below).

Parentheses are not permitted to appear in a station name. Other special characters such as periods, commas, etc. (see Chapter 1) - as well as any unnecessary spaces (blanks) - should also be edited out whenever possible.

In the same manner as the job-specific station serial number of a horizontal control point, that is unique within a job, it is highly desirable to have a station name that is unique within a job. If two or more control points in a job are found to have identical names, they should be rendered unique by appending to the respective station names, in order of preference:

1. The name of the county (parish, census division) in which the station is located, followed by the symbol CO (PA,CD) - Example: JONES CLALLAM CO and JONES KING CO (SMITH ORLEANS PA and SMITH DE SOTO PA, ROCK KENAI-COOK INLET CD and ROCK ANCHORAGE CD).

2. The name of a locality other than county, parish, or census division - Example: PIPE SAN ANTONIO and PIPE LACKLAND AFB.

The year the mark was set is considered extraneous information and is not to be carried as a part of a control point name. For marks whose names were not altered when they were reset, the word RESET must be appended to the original designations. This also holds true for control points which have been reset more than once. In such cases the year given in the "year monumented" field of the description / recovery note will be used to distinguish the marks. See ANNEX D for additional information and examples.

Whenever the name of a horizontal control point is modified in this manner in the HZTL OBS data set for the purpose of making it unique within the respective job, the appended information becomes part of the station name, and care must be taken that exactly the same information is appended to the station name in the heading of the description and of all subsequent recovery notes which are given for that horizontal control point in the companion GEOD DESC data set (see Chapter 3).

When the lengthy name of a horizontal control point must be contracted to 30 characters, the abbreviation and/or editing of the station name in question should be accomplished with due regard to the following: First, a 40-character version of the same station name is required in the GEOD DESC data set submitted concurrently with the HZTL OBS data set (see INTRODUCTION). This less drastically contracted version of the station name will be used for publication purposes. Second, the names of reference and azimuth marks are normally formed by appending the symbols RM 1, RM 2, ..., RM 13, etc., and AZ MK (possibly AZ MK 2, AZ MK 3, etc.) to the station name of the control point to which they belong. For this reason, the name of a horizontal control point which has peripheral reference marks and/or azimuth mark(s) may have to be further contracted to 24 characters (and possibly less) in order to allow for the respective reference and azimuth mark names to confirm to the 30-character limit.

Name or Designation of RM or AZ MK: Reference marks and azimuth marks are usually identified by standard disk markers which display an arrow as the survey point symbol at their center; the markers are set in such a way that the arrow points toward the associated horizontal control point. Two or more reference marks are normally established in the immediate vicinity of a monumented horizontal control point. The purpose of the reference mark is to act as a "pointer" to the related horizontal control point, thereby aiding in its recovery, and to provide a means of verifying whether or not the station monument has been disturbed. In addition to the reference marks, an azimuth mark may be established at some distance to provide an azimuth reference point which is visible from ground level. Less frequently, more than one azimuth mark is established for the same horizontal control point.

The originally established reference marks of a horizontal control point are normally assigned sequential numbers, e.g., NO 1, NO 2, etc. Any subsequently established reference mark should be assigned the next unused number in the sequence, even though one or more of the previously established reference marks may have been destroyed. The standard practice is to stamp the name of the horizontal control point to which a reference mark belongs above the arrow which appears in the center of the respective disk marker, the number of the reference mark (i.e., NO 1, NO 2, etc.) immediately below the arrow, and the year in which the reference mark was set farther below the arrow. The same procedure is

followed in the case of an azimuth mark, except that a number is normally assigned and stamped on the respective disk marker only if more than one azimuth mark is involved.

The name or designation of a reference mark (RM) or an azimuth mark (AZ MK) entered on the *82* record must not exceed 30 characters in length. It should normally consist of the name of the horizontal control point to which the RM or AZ MK belongs, with the symbol RM 1, RM 2, ..., RM 13, etc. appended for reference marks NO 1, NO 2, ..., NO 13, etc. For azimuth marks, the symbol AZ MK is appended if only one azimuth mark is involved, otherwise the symbol AZ MK 2, AZ MK 3, etc. for azimuth marks NO 2, NO 3, etc. In general, nothing else should be added to the name of an RM or AZ MK, except when the numbering system outlined in the preceding paragraph has not been followed, with the result that two or more reference or azimuth marks associated with a horizontal control point are referred to by the same name.

Considering that the total length of an RM or AZ MK name must not exceed 30 characters, the name of the horizontal control point to which the RM 1, RM 2, etc., and/or AZ MK symbols are appended must be limited to 24 characters, and may have to be further contracted if a numeral must follow the AZ MK symbol and/or the "year mark set" has to be added. The name of the respective horizontal control point must be taken as it appears on the corresponding *80* or *81* record (see Station Name), except for possible further abbreviation and/or editing which may be required.

The same general considerations apply to a reference or azimuth mark which is being treated as a control point (i.e., which is not regarded as a peripheral RM or AZ MK), whose 30-character name is to be entered on the respective *80* or *81* record. Occasionally, an existing monumented survey point of another agency is used for a reference mark or, more frequently, for an azimuth mark. Such a survey point must be treated as a control point, i.e., it must be identified by an four--digit station serial number. If it can be positioned (or if its geodetic position is available from other sources), submit a *80* or *81* record for a control point of this kind; otherwise submit a *82* record to give its name or designation.

Name or Designation of Bench Mark: A bench mark (BM) is a monumented (or otherwise permanently marked) vertical control point whose height above mean sea level (MSL) has been determined by differential leveling. Bench marks occur in a horizontal control survey project if (1) a horizontal control point is also a BM in a line of differential leveling connected to the national vertical control network, (2) a spur level line connection exists between a horizontal control point and a nearby BM, or (3) a BM is included as a control point in the project for the purpose of extending vertical control by trigonometric leveling (vertical angles). **All bench marks in a project should be positioned, if possible.**

The name or designation of a bench mark entered on the *80* or *82* record must not exceed 30 characters in length. It should be taken as it appears in the heading of the bench mark description, which normally is identical to or closely resembles the name or designation stamped on the disk. If the name or designation of a bench mark must be contracted in order to conform to the 30-character limit, the same general considerations apply as for the abbreviation and/or editing of the name of a horizontal control point (see Station Name above).

If a reference mark disk (RM) for one control station is subsequently used as an azimuth mark for another control station, the name or designation of the mark should reflect the stamping on the mark (original use and not subsequent use).

Likewise, if a bench mark disk (BM) is used as a reference mark for a control station, the name or designation of the mark should always be that of the bench mark.

Geodetic Position: The geodetic position of every horizontal control point for which a *80* or *81* record is submitted must be given to serve either as a fixed position or as a preliminary position in the adjustment of the respective horizontal control survey project. The geodetic position may be expressed either in terms of geographic coordinates (latitude and longitude) on the *80* record, or it may be expressed in one of two plane coordinate systems - the Universal Transverse Mercator (UTM) coordinates, or the State Plane Coordinates (SPC) - on the *81* record.

For previously established horizontal control points which are identified as "fixed" by means of a *90* record (see FIXED CONTROL DATA RECORDS), the geodetic position given on the *80* or *81* record should be either the published position, if the control point in question is an existing point of the national horizontal control network, or else a position obtained from a constrained adjustment.

The *80* record is intended for horizontal control points whose geodetic position is given in terms of geographic coordinates, i.e., as Latitude and Longitude. In addition to the numeric value (in sexagesimal degrees, minutes, seconds, and decimals of a second), the Direction of Latitude must be specified as "N" or "S", and the Direction of Longitude must be specified as "E" or "W", by a one-letter code adjacent to the latitude and longitude fields.

The *81* record is intended for horizontal control points whose geodetic position is given in terms of plane coordinates, i.e., as a Y-Coordinate (northing) and an X-Coordinate (easting), followed by a four-digit coordinate system zone designation. If Universal Transverse Mercator (UTM) coordinates are used, the northing and easting values are expected in meters and decimals of a meter. The zone designation must be the appropriate UTM Zone Number (0001-0060) as shown in ANNEX H. If State Plane Coordinates (SPC) are used, the northing and easting values are expected in meters and decimals of a meter. The zone designation must be the appropriate State Zone Code as given in ANNEX B.

Elevation and Elevation Code: Elevation is the vertical distance above the geoid - an equipotential surface. Along the sea coast the geoid closely follows mean sea level (MSL). Often referred to as "orthometric height," elevation is normally the dominant component of ellipsoidal height. Ellipsoidal height is the sum of elevation and geoid height. Geoid height is the name given to the vertical separation between the geoid and the reference ellipsoid of the geodetic datum used (NAD 83 or as specified on the *13* record). Ellipsoid heights of horizontal control points must be known or closely approximated for the purpose of reducing distance measurements to the reference ellipsoid and for computation of the skew normal and deflection corrections which are applied to horizontal directions and/or horizontal angles.

The elevation of every horizontal control point for which a *80* or *81* record is submitted must be given, **except for unaccessible, unmonumented, recoverable landmarks positioned by intersection**. When given, the elevation of such a landmark should be the ground level elevation (e.g., obtained from a topographic map, if a more accurate value is not available), and the height of the point actually sighted entered as the height of target on the respective observation record. **But, since no distances are involved, the elevation field of an unaccessible landmark is preferred left blank**.

The elevation of a survey point is determined most accurately by differential leveling. Other less accurate methods of determining the elevation of a survey point are (1) GPS observations, (2) trigonometric leveling using reciprocal vertical angles, (3) trigonometric leveling using non-reciprocal (i.e., one-sided) vertical angles, and (4) photogrammetric methods. In addition, an estimate of elevation based on the exponential decrease of atmospheric pressure with altitude can be obtained by a barometric leveling scheme (e.g., with the aid of an altimeter). As a last resort, if elevation from another source is not at hand, the approximate elevation can be obtained by interpolation between adjacent elevation contour lines on a map. In situations where ellipsoidal heights are known, the orthometric height can be computed by subtracting some estimate of the geoid height from the ellipsoidal height. Orthometric heights derived in this manner are coded using the "G" code. The geoid height value used in the computation must be submitted on a *86* record.

In every case, the source and general accuracy of the elevation value given on a *80*, *81*, or the **preferred new *86* record** must be indicated by a one-letter Orthometric Height (OHT) Code (See table on page 2-84 for explanations). The possible elevation codes are as follows:

A - The control point is a bench mark (BM) in the NGSIDB.
B - BM determined using FGCS/NGS procedures but **not** in the NGSIDB.
C - The control point is a 'posted' bench mark.
D - OHT determined by datum transformation.
H - OHT determined using FGCS procedures but tied to only one (1) BM.
L - OHT established using NGS leveling RESET procedures.
F - OHT established using fly-leveling.
T - OHT determined by leveling between control points which are not BMs.
R - OHT determined by reciprocal vertical angles.
V - OHT determined by non-reciprocal vertical angles.
P - OHT determined by a photogrammetric method.
M - OHT scaled from a topographic map.
G - **OHT derived from GPS-observed heights with decimeter accuracy.**
J - OHT derived from GPS-observed heights tied to meter accuracy control.
K - OHT derived from GPS-observed heights, according to the 2cm/5cm ellipsoid height standards, and a high resolution national geoid model.

Station Order and Type: A two-character field is reserved on the *80* and

81 records for the order-and-type code. The purpose of this code is to characterize the specific order of accuracy of the horizontal control point and to indicate whether the horizontal control point in question is monumented (or otherwise permanently marked), unmonumented but recoverable (e.g., a landmark), or unmonumented and non-recoverable (e.g., an auxiliary point). In addition, the purpose of this code is to characterize the type of the survey scheme of which the horizontal control point is a part and/or by means of which it is positioned (i.e., triangulation, trilateration, traverse, intersection, or resection). It also indicates whether the horizontal control point in question is considered to be a main-scheme station or a supplemental station in the respective survey scheme.

In every case, care must be taken to assign an order-and-type code which reflects how the horizontal control point was used in the project. For example, if a horizontal control point previously established as a first-order triangulation station is occupied in the course of a second-order traverse project, then it must be assigned an order-and-type code which classifies it as a second-order traverse station rather than as a first-order triangulation station. For control points which cannot be positioned within the project

because of insufficient observations (but for which an accurate geodetic position is available from other sources, and hence for which a *80* or *81* record is submitted), the order-and-type code is to be left blank.

The first character (order) of the order-and-type code indicates the order of accuracy used to survey the main-scheme network. It reflects the surveying method used, procedures followed, and specifications enforced by the project instructions. It is also intended to indicate whether the horizontal control point is a monumented (or otherwise permanently marked) control point, an unmonumented recoverable landmark, or a temporary point, not permanently marked and therefore nonrecoverable, which must be treated as a control point (e.g., an unmarked eccentric point which is offset more than 10 meters from the respective control point). The respective "order codes" are as follows:

1. Order Codes of Permanently Marked Stations:

   A - Order A Interferometric Positioning
   B - Order B Interferometric Positioning
   0 - Trans-Continental Traverse (TCT)
   1 - First-Order Survey Scheme
   2 - Second-Order (Class I and Class II) Survey Scheme
   3 - Third-Order (Class I and Class II) Survey Scheme
   4 - Lower-Than-Third-Order Survey Scheme and
       Supplemental Unmonumented Recoverable Landmarks (see below).

2. Order Codes of Nonrecoverable Points:

   5 - First-Order Survey Scheme
   6 - Second-Order (Class I and Class II) Survey Scheme
   7 - Third-Order (Class I and Class II) Survey Scheme
   8 - Lower-Than-Third-Order Survey Scheme

In general, the order-and-type codes of all monumented (or otherwise permanently marked) horizontal control points should be assigned the same order code (equal to the order code of the order-and-class code assigned to the project - see under PROJECT DATA RECORDS), except when survey work of more than one order-and-class category is included in the project. In this case, special care must be taken to assign the appropriate order code to every monumented control point according to the order-and-class category of the respective section of the project; control points which qualify for more than one order designation must be assigned the order code which corresponds to the higher order-and-class category. But, in a Trans-Continental Traverse (TCT) type project, only the stations of the high-precision traverse proper (i.e., stations connected by horizontal directions and by distances measured with electro-optical DME on two nights) should carry the order code "0"; other horizontal control points occupied and/or sighted upon should be treated as comparable stations in a first-order project.

As a matter of convention, the order code "4" is assigned to unmonumented recoverable landmarks positioned as supplemental stations, i.e., as intersections or spur traverse stations which are incidental to the primary survey scheme, regardless of the order-and-class category of the project or section of project of which they are a part. However, if such a landmark (e.g., a flagpole or church spire) occurs as an unoccupied main-scheme station in a triangulation network, then it must be assigned the same order code as any other

main-scheme station in its vicinity, i.e., a main-scheme intersection station which is an unmonumented recoverable landmark must be assigned the same order code as a monumented control point.

Considering the discussion in the preceding two paragraphs, the allowable order codes of the order-and-type codes assigned to horizontal control points within a project (or within a section of a project) are as follows:

TABLE 2-5 - ALLOWABLE ORDER CODES

SURVEY SCHEME ORDER-AND-CLASS CATEGORY	ALLOWABLE ORDER CODES
Interferometric Positioning	A,B
Trans-Continental Traverse (TCT)	0,1,4,5
First-Order	1,4,5
Second-Order (Class I and Class II)	2,4,6
Third-Order (Class I and Class II)	3,4,7
Lower-Than-Third-Order	4,8

The second character (type) of the order-and-type code indicates the type of survey used to position the horizontal control point. It is also intended to indicate whether the horizontal control point is a main scheme station (i.e., one which is <u>essential</u> to the primary survey scheme) or a supplemental station (i.e., one which is <u>incidental</u> to the primary survey scheme). The respective "type codes" are as follows:

1. <u>Type Codes of Main-Scheme Stations</u>:

    1 - Positioned Primarily by Triangulation
    2 - Positioned Primarily by Trilateration
    3 - Positioned Primarily by Traverse
    A - Positioned Primarily by Interferometric Satellite Relative Positioning

2. <u>Type Codes of Supplemental Stations</u>:

    4 - Positioned Primarily by Triangulation
    5 - Positioned Primarily by Trilateration
    6 - Positioned Primarily by Traverse
    7 - Positioned by Intersection (Note: 1 if Main-Scheme Station)
    8 - Positioned by Resection
    B - Positioned Primarily by Interferometric Satellite Relative Positioning

As mentioned before, an intersection station which occurs as a main-scheme station (essential to the primary survey scheme) in a triangulation network is assigned the type code "1".

If it is not clear whether a horizontal control point is a main-scheme or supplemental station in a lst-Order or 2nd-Order (Class I or Class II) network, it should be treated as a main-scheme station. In particular, if special effort

has been made to preserve the nominal accuracy of the respective main-scheme network in the positioning of a station which may not appear to be essential to the primary survey scheme (e.g., extra angular observations were taken and/or a distance was measured with electro-optical DME), such a supplemental station should be regarded as a main-scheme station and assigned a type code accordingly.

In a third-order and lower-than-third-order survey schemes, the distinction between main-scheme and supplemental stations is unimportant, hence type codes 4, 5, and 6 are not used with order codes 3 and 4; however, type codes 7 and 8 are still used to identify supplemental intersection and resection stations. In particular, the order-and-type code assigned to a recoverable landmark which is incidental to the survey scheme should be 47 if positioned by intersection (43 if positioned by a spur traverse) in a survey scheme of any order and class. Considering the discussion above, the allowable combinations of order and type codes that can be assigned to horizontal control points within a project (or within a section of a project) are as follows:

TABLE 2-6 - ALLOWABLE TYPE CODES

ORDER CODE	ALLOWABLE TYPE CODES
A	A
B	A,B
0	3,6
1,5	1,2,3,4,5,6,7,8,A,B
2,6	1,2,3,4,5,6,7,8,A,B
3,7	1,2,3,7,8,A
4,8	1,2,3,7,8,A

Whenever a horizontal control point qualifies for more than one type code (i.e., when a station can be considered to be positioned by two or more different survey methods), the type code which reflects the survey method resulting in the strongest position, when used alone, should be assigned. A hierarchy of order-and-type codes is given in ANNEX E.

<u>Geoid Height</u>: Geoid height is the name given to the vertical separation between the geoid and the reference ellipsoid of the geodetic datum used (NAD 83 or as specified on the *13* record). Along the sea coast the geoid, an equipotential surface, closely follows mean sea level (MSL). Elevation is the vertical distance above the geoid. Often referred to as "orthometric height," elevation is normally the dominant component of ellipsoidal height. Ellipsoidal height is the sum of elevation and geoid height. Ellipsoidal height must be known for every horizontal (and vertical) control point for the purpose of reducing horizontal control survey observations to the reference ellipsoid (and for the extension of vertical control by trigonometric leveling). Since the geoid height value associated with a horizontal (or vertical) control point is often unknown, it is a common practice to assume it to be zero, and hence to use the elevation as the best available approximation for the desired ellipsoidal height.

If a reliable value of geoid height is known, a *86* record should be submitted on which the respective geoid height is given in meters and decimals of meter. Note that the geoid height is positive when the geoid is above the ellipsoid and that it is negative when the geoid is below the ellipsoid. The geoid height value given should be accompanied by an estimate of its absolute accuracy in the form of a standard error (Sigma).

Deflection of Vertical: The deflection of vertical is the angle formed by the tangent to the direction of gravity (known as the "vertical") and the "normal" to the reference ellipsoid of the geodetic datum (NAD 83 or as specified on the *13* record). In addition to the magnitude of this angle, usually given in seconds and decimals of second of arc, the direction (e.g. the geodetic azimuth) of the deflection must also be specified. Alternatively, the direction of the deflection of vertical is implied when the deflection is given in terms of two rectangular components - e.g. the north-south or meridional component and the east-west or prime-vertical component.

The deflection of vertical comes into consideration in connection with horizontal directions, horizontal angles, and vertical angles observed with theodolites or transits which are leveled (i.e., oriented with respect to the direction of gravity). Accordingly, the deflection of vertical must be known at every point from which horizontal directions, horizontal angles, or vertical angles have been observed, so that appropriate corrections can be computed to convert these observed quantities from the gravity-oriented "astronomic" frame of reference to the ellipsoid-oriented geodetic system.

Because the deflection of vertical at a given horizontal control point is often unknown, it is a common practice to assume it to be zero. Since, in the continental United States, the maximum deflection of vertical, defined with respect to the North American 1983 datum (NAD 83), seldom exceeds 20 seconds of arc, and is normally much less (e.g., 3 to 5 seconds), the error introduced by this approximation in connection with the reduction of horizontal directions and horizontal angles is imperceptible except for long, inclined lines of sight in mountainous regions. However, in connection with the use of vertical angles for determining elevation differences, this approximation is one of the major sources of error which render the extension of vertical control by trigonometric leveling inaccurate.

If the deflection of vertical is reliably known (e.g., as a result of astronomic latitude and longitude observations), a *85* record should be submitted. The deflection is given in terms of the respective meridional (i.e., north-south) and prime-vertical (i.e., east-west) components, each expressed in seconds and decimals of second of arc.

The Meridional Component (Xi) of the deflection of vertical is the difference between the astronomic and geodetic latitudes of the horizontal control point. The direction of the meridional component, i.e., the Direction of Xi must be specified as "N" or "S" according to whether the astronomic latitude falls north or south of the corresponding geodetic latitude. The Prime-Vertical Component (Eta) of the deflection of vertical is the difference between the astronomic and geodetic longitudes of the horizontal control point, multiplied by the cosine of the approximate (astronomic or geodetic) latitude. The direction of the prime-vertical component, i.e., the Direction of Eta must be specified as "E" or "W" according to whether the astronomic longitude falls east or west of the corresponding geodetic longitude. Both the meridional and prime-vertical components

of the deflection of vertical should be accompanied by an estimate of their absolute accuracy in the form of a standard error (Sigma).

The results of astronomic azimuth observations and astronomic position observations (recorded as the meridional and prime-vertical components of the deflection of vertical) are entered on the *60* and *85* records of the HZTL OBS data set. In addition, all astronomic latitude, longitude, and/or azimuth observations should be submitted separately in full detail for rigorous processing and incorporation into the astronomic data file of the National Geodetic Survey Data Base.

FIXED CONTROL DATA RECORDS

90 - Fixed Control Record

The purpose of the *90* record is to allow identification of horizontal control points which are to be used as "fixed control" in the project, i.e., those control points whose coordinates are to be held fixed in the adjustment of the respective horizontal control network. Submit a *90* record for each horizontal control point to be held fixed; a *80* or *81* record must appear among the *80*-series records (see SURVEY POINT DATA RECORDS) for each horizontal control point identified as "fixed" by a *90* record. And, as stated previously, the geodetic position given on each of these *80* or *81* records should be either the published position, if the control point in question is an existing point of the national horizontal control network, or else a position obtained from a constrained adjustment.

Normally, at least two horizontal control points will be designated as fixed control in a horizontal control survey project. If only one horizontal control point is identified, the necessary scale and orientation of the horizontal control network must be provided by sufficient *50*-series and *60*-series records (see DISTANCE DATA RECORDS and AZIMUTH DATA RECORDS).

RECORD FORMATS

For each record which may appear in an HZTL OBS data set (see Table 2-1), a block diagram has been prepared to illustrate the respective format. These "format diagrams" have been designed to fulfill the following objectives:

1. Each record is 80 characters long.

2. Each record has a fixed format, i.e., every data field has a specific length and specific position within the record.

3. Each format diagram is a graphical image of the respective record.

4. Within the limits of available space, the data to be entered in each data field are identified on the format diagrams to render them self-explanatory. See pages 2-88 thru 2-109.

5. In addition, a brief information and instruction sheet accompanies each format diagram. See pages 2-41 thru 2-87.

Required Data - In general, only those records which represent actual field observations collected during the survey project should be included in an HZTL OBS data set (e.g., no *60* records should be submitted if no astronomic/Laplace azimuths were determined in the project). Records that are optional or those which may be omitted under certain circumstances are clearly designated on the instruction sheet for each format diagram. **The required data fields on the format diagrams have been highlighted (bold printed).**

Floating Point Field (XXXxx) - intended for a data item which is coded as a decimal number, i.e., as a string of numeric characters (prefixed with minus sign if the number is negative) which may contain one leading, imbedded, or trailing period (the decimal point), but may not contain any imbedded blanks. If the decimal point is present, the character string representing the integer digits, the decimal point, and the decimal fraction digits may be positioned anywhere within the respective field (generally left-justified), and the unused columns of the data field are blank-filled. When a negative number is entered, code the minus sign immediately preceding the leading digit.

When the decimal point is not coded, the "X" portion of the floating-point field is to contain the integer part of the decimal number, and the "x" portion the corresponding decimal fraction part, the decimal point being implied between the rightmost "X" column and the leftmost "x" column of the field. The coded decimal point overrides the implied decimal point position in every case.

Integer Field - intended for a data item which is coded as a string of numeric characters representing a positive or negative integer number, to be entered in the respective data field right-justified. In the case of a positive integer number, zero-fill any unused columns on the left. In the case of a negative integer number, code the minus sign immediately preceding the leftmost non-zero digit, and blank-fill any unused columns to the left of the minus sign.

DATA SET IDENTIFICATION RECORD (*aa*)

The first record in a Horizontal Observation Data set must be a Data Set Identification Record which identifies the data class and type (HTZL OBS), the name of the submitting organization, and date the data set was created. The job code is a two-character alphanumeric code assigned to each horizontal control job submitted by an organization. An asterisk (*) immediately precedes and follows the code and the first character of the code must be a letter. Assign the code A1 to the first job and continue in sequence to the last. (A1, A2..., A9, B1, B2,...etc.) The job code used in this record must be identical to the job code in the Data Set Termination Record, the last record in the Horizontal Observation Data Set (HZTL OBS), and identical to the job code used in both the Data Set Identification Record and the Data Set Termination Record of the Geodetic Control Point Descriptive Data Set (GEOD DESC). **This record is required**.

aa FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE 000010.
CC 07-10	JOB CODE. MUST BE *aa*. THE SYMBOL "aa" DENOTES THE TWO-CHARACTER CODE ASSIGNED BY THE SUBMITTING ORGANIZATION.
CC 11-14	DATA CLASSIFICATION. MUST BE HZTL.
CC 15-18	DATA TYPE. MUST BE OBS. LEFT JUSTIFIED.

CC 19-24 ABBREVIATION OF ORGANIZATION. SEE ANNEX C. IF NOT LISTED THERE, PROPOSED ABBREVIATION MUST BE ACCEPTED BY NGS PRIOR TO FIRST SUBMITTAL OF DATA. SEE ANNEX K.
CC 25-66 SUBMITTING ORGANIZATION. FULL NAME OR ORGANIZATION PERFORMING THE OBSERVATION. LEFT JUSTIFIED.
CC 67-72 ASSIGNED G/GPS NUMBER. (FOR NGS USE ONLY)
CC 73-80 DATE DATA SET CREATED. YEAR, MONTH, DAY (YYYYMMDD).

For a more detailed explanation of the contents of the record see Chapter 1, page 1-1, JOB CODE AND POINT NUMBERING and Chapter 2, pages 2-1 thru 2-3, HZTL OBS DATA SET RECORDS.

PROJECT TITLE RECORD (*10*)

This record identifies the project by name. The use of geographic locality alone as the title of a horizontal control survey project has traditionally been the practice of NGS and its predecessors. **This record is required.**

10 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE 000020.
CC 07-10 DATA CODE. MUST BE *10*.
CC 11-80 PROJECT TITLE. LEFT JUSTIFIED.

PROJECT TITLE CONTINUATION RECORD (*11*)

This record is required only if the project title in the *10* record exceeds the 70-character field allowed. Do not divide words between *10* and *11* records. **This record is optional.**

11 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *11*.
CC 11-80 PROJECT TITLE CONTINUED FROM *10* RECORD, IF NECESSARY. THIS RECORD IS OPTIONAL.

For a more detailed explanation of the contents of this record see Chapter 2, pages 2-5 and 2-6, PROJECT DATA RECORDS.

PROJECT INFORMATION RECORD (*12*)

This record identifies the person responsible for the survey (chief of party) by name, provides a record of the dates on which survey operations commenced and terminated, indicates type of survey, and order and class of survey. **This record is required.**

12 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *12*.
CC 11-16	DATE FIELD OPERATIONS BEGAN. YEAR, MONTH (YYYYMM).
CC 17-22	DATE FIELD OPERATIONS ENDED. YEAR, MONTH (YYYYMM).
CC 23-25	CHIEF OF PARTY INITIALS. (FIRST C.O.P.).
CC 26-43	SURNAME AND INITIALS OF CHIEF OF PARTY (FIRST C.O.P.) LEFT JUSTIFIED. SEPARATE SURNAME AND EACH INITIAL WITH A BLANK. DO NOT USE PERIODS OR OTHER SPECIAL CHARACTERS.
CC 44-46	CHIEF OF PARTY INITIALS. (SECOND C.O.P., IF ANY).
CC 47-64	SURNAME AND INITIALS OF SECOND CHIEF OF PARTY, IF ANY.
CC 65-75	BLANK
CC 76	SURVEY METHOD. IDENTIFY PRIMARY SURVEY METHOD USED. SEE TABLE BELOW.
CC 77-78	PRIMARY STATE OR COUNTRY CODE. SEE ANNEX A.
CC 79-80	ORDER AND CLASS OF SURVEY. SEE TABLE BELOW.

Survey Method Codes	Order and Class of Survey Codes
1 - Triangulation	AA - AA Order Interferometric Positioning
2 - Trilateration	A0 - A Order Interferometric Positioning
3 - Traverse	B0 - B Order Interferometric Positioning

4 - Global Positioning System	00 - Trans-Continental Traverse 10 - First Order 21 - Second Order Class I 22 - Second Order Class II 31 - Third Order Class I 32 - Third Order Class II 40 - Lower Than Third Order

For a more detailed explanation of the contents of this record see Chapter 2, pages 2-5 thru 2-7, PROJECT DATA RECORDS and DATE AND TIME.

GEODETIC DATUM AND ELLIPSOID RECORD (*13*)

This record defines the datum and reference ellipsoid for the geodetic positions, deflections of the vertical, geoid heights, and/or reduced ellipsoidal distances (Code E in *52* record) as they appear in this project. Do not enter the Inverse Flattening (1/f) if the ellipsoid is defined by the Semi-Major Axis (a) and the Semi-Minor Axis (b). Likewise, do not enter the Semi-Minor Axis (b) if the ellipsoid is defined by (a) and (1/f). **This record is required unless the datum is the North American 1983 (NAD 83).**

13 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *13*.
CC 11-34	DATUM NAME. DO NOT INCLUDE THE WORD 'DATUM' IN THE NAME. ABBREVIATE IF NECESSARY.
CC 35-50	NAME OF THE ELLIPSOID.
CC 51-60	SEMI-MAJOR AXIS (a) IN METERS (MMMMMMMmmm).
CC 61-70	INVERSE FLATTENING (1/f) (XXXxxxxxxx). THE FLATTENING (f) = (a - b) / a.
CC 71-80	SEMI-MINOR AXIS (b) IN METERS (MMMMMMMmmm).

HORIZONTAL DIRECTION SET RECORD (*20*)

This record identifies the initial direction for each set of direction observations. Use the Horizontal Direction Record (*22*) for all the remaining directions observed in the same set. The instrument station (standpoint) refers to the point from which the observation is taken (e.g., the point occupied by the observer). The target station (forepoint) refers to the point to which the observation is directed. Use the *21* Comment Record(s) immediately following the *20* record for any comments.

To anticipate the accuracy of an observation, the type of survey equipment used must be known. To identify the instrument used for each observation, assign a **unique** three-digit number (Job-Specific Instrument Number) in the range 001 to 999 to each item of survey equipment used in the job. Each number will cross reference a NGS survey equipment code in the *70* record. See Chapter 2, page 2-10, Job-Specific Instrument Number and page 2-28, Survey Equipment Data Records.

20 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *20*.
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT). FOR ADDITIONAL INFORMATION SEE CHAPTER 1, PAGES 1-1 THRU 1-3, JOB CODE AND SURVEY POINT NUMBERING; CHAPTER 2, PAGES 2-8 THRU 2-9, OBSERVATION DATA RECORDS; PAGES 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.
CC 15-16	SET NUMBER. ENTER 01 FOR THE FIRST SET OF THE DIRECTION OBSERVATIONS. USE 02, 03, ETC. FOR SUCCESSIVE SETS. SEE CHAPTER 2, PAGE 2-18, SET NUMBER.
CC 17-22	FIELD RECORD BOOK NUMBER. VOLUME NUMBER ASSIGNED TO THE FIELD BOOK IN WHICH THE DIRECTION OBSERVATIONS ARE RECORDED.
CC 23-24	NUMBER OF OBJECTS SIGHTED IN THIS SET. THIS VALUE EQUALS THE SUM OF THE *20* RECORD AND THE *22* RECORD(S) IN THIS SET. SEE CHAPTER 2, PAGE 2-18.
CC 25-29	WEATHER CODE. THE FIRST COLUMN OF THIS CODE (25) IS A PROBLEM INDICATOR FOLLOWED BY VISIBILITY, TEMPERATURE, CLOUD COVER AND WIND INDICATORS IN SUCCESSION. FOR INFORMATION CONCERNING THE WEATHER CODE TO BE USED IN CONNECTION WITH HORIZONTAL OBSERVATIONS, SEE CHAPTER 2, PAGES 2-10.
CC 30-32	INITIALS OF THE OBSERVER.
CC 33-35	JOB-SPECIFIC INSTRUMENT NUMBER (JSIN). THE UNIQUE THREE-DIGIT NUMBER IN THE RANGE 001 TO 999 ASSIGNED TO THE INSTRUMENT USED TO

OBTAIN THIS OBSERVATION. THIS NUMBER WILL CROSS REFERENCE THE NGS SURVEY EQUIPMENT CODE IN THE *70* RECORD.

CC 36-39 HEIGHT OF INSTRUMENT. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE OCCUPIED SURVEY MARK (POINT) TO THE OPTICAL CENTER OF THE SURVEYING INSTRUMENT. IN METERS (MMmm). FOR ADDITIONAL INFORMATION SEE CHAPTER 2, PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.

CC 40-45 DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD). SEE CHAPTER 2, PAGES 2-18, DATE AND TIME.

CC 46-49 LOCAL TIME. HOURS, MINUTES (HHMM). SEE CHAPTER 2, PAGE 2-7, TIME, AND PAGE 2-18, DATE AND TIME.

CC 50 TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED. SEE CHAPTER 2, PAGE 2-7, TIME ZONE.

CC 51-54 STATION SERIAL NUMBER. TARGET STATION. SEE CHAPTER 1, PAGES 1-1 THRU 1-3, JOB CODE AND SURVEY POINT NUMBERING; CHAPTER 2, PAGES 2-8 THRU 2-9, OBSERVATION DATA RECORDS; PAGES 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.

CC 55-58 HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE TARGET STATION SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK USED FOR THE DIRECTION OBSERVATIONS. IN METERS (MMmm). SEE CHAPTER 2, PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.

CC 59 VISIBILITY CODE. SEE CHAPTER 2, PAGE 2-11, VISIBILITY CODE.

CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF POINTINGS OR MEASUREMENTS USED TO DETERMINE A HORIZONTAL DIRECTION. SEE CHAPTER 2, PAGE 2-16, NUMBER OF REPLICATIONS AND PAGE 2-19, LAST PARAGRAPH.

CC 62-63 REJECTION LIMIT. THE MAXIMUM ALLOWED DEVIATION OF A SINGLE OBSERVATION FROM THE MEAN OF ALL THE OBSERVATIONS USED TO DETERMINE A DIRECTION IN A SET. IN SECONDS. SEE CHAPTER 2, PAGE 2-16, REJECTION LIMIT.

CC 64-72 INITIAL DIRECTION. MEAN OF POINTINGS OR MEASUREMENTS TO THE FIRST OBJECT SIGHTED IN THE OBSERVING SEQUENCE, NORMALLY ASSIGNED A VALUE ZERO DEGREES, ZERO MINUTES AND ZERO SECONDS (DDDMMSSss). SEE CHAPTER 2, PAGES 2-17 AND 2-18, HORIZONTAL DIRECTION DATA RECORDS.

CC 73-76 INTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE CHAPTER 2, PAGE 2-17, INTERNAL CONSISTENCY SIGMA.

CC 77-80 EXTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE CHAPTER 2, PAGE 2-17, EXTERNAL CONSISTENCY SIGMA.

For a more detailed discussion on accuracy, internal and external errors, see Chapter 2, pages 2-15 thru 2-17, ACCURACY OF THE OBSERVATIONS.

HORIZONTAL DIRECTION COMMENT RECORD (*21*)

Use this record for comments pertinent to the set of directions. This record is required to explain the problem encountered, if the problem indicator (Column 25) on the respective Horizontal Direction Set Record (*20*) is 1. Otherwise, this record is optional.

21 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *21*.
CC 11-80	COMMENT. IF THE COMMENT(S) EXCEED 70 CHARACTERS, USE ANOTHER *21* RECORD FOR CONTINUATION. ANY NUMBER OF *21* RECORDS IS ALLOWED. BUT, DO NOT DIVIDE WORDS BETWEEN CONSECUTIVE *21* RECORDS. SEE CHAPTER 2, PAGES 2-17 AND 2-18, HORIZONTAL DIRECTION DATA RECORDS.

HORIZONTAL DIRECTION RECORD (*22*)

Use this record for the second and subsequent directions observed in the same horizontal direction set. Use the Horizontal Direction Set Record (*20*) for the first direction (initial) observed in the set.

22 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *22*.
CC 11-14	STATION SERIAL NUMBER. INSTRUMENT STATION (STANDPOINT). MUST BE IDENTICAL TO THE STATION SERIAL NUMBER (SSN) IN CC 11-14 ON THE RESPECTIVE *20* RECORD.
CC 15-16	SET NUMBER. MUST BE IDENTICAL TO THE SET NUMBER IN THE PRECEDING *20* RECORD.
CC 17-45	BLANK
CC 46-49	LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGE 2-7 THRU 2-8, <u>TIME</u>.
CC 50	TIME ZONE. ENTER LETTER CODE FROM ANNEX H. SEE PAGE 2-7, <u>TIME ZONE</u>.
CC 51-54	STATION SERIAL NUMBER (SSN). TARGET STATION (FOREPOINT). FOR ADDITIONAL INFORMATION SEE CHAPTER 1, PAGES 1-1 THRU 1-3, <u>JOB CODE AND SURVEY POINT NUMBERING</u>; CHAPTER 2, PAGES 2-8 THRU 2-9, <u>OBSERVATION DATA RECORDS</u>; PAGES 2-12 THRU 2-13, <u>ASSIGNMENT OF STATION SERIAL NUMBERS;</u> AND PAGE 2-14, <u>TREATMENT OF ECCENTRIC OBSERVATIONS</u>.
CC 55-58	HEIGHT OF TARGET. ENTER VERTICAL DISTANCE FROM THE TOP OF THE TARGET STATION SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK, USED FOR THE DIRECTION OBSERVATIONS. IN METERS (MMmm). SEE CHAPTER 2, PAGE 2-11, <u>HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET</u>.
CC 59	VISIBILITY CODE. SEE PAGE 2-11, <u>VISIBILITY CODE</u>.
CC 60-61	NUMBER OF REPLICATIONS. NUMBER OF POINTINGS OR MEASUREMENTS TO DETERMINE THIS OBSERVED DIRECTION. SEE CHAPTER 2, PAGE 2-16, <u>NUMBER OF REPLICATIONS</u> AND PAGE 2-19, LAST PARAGRAPH.
CC 62-63	REJECTION LIMIT. MAXIMUM ALLOWED DEVIATION FROM THE MEAN. IN SECONDS. SEE PAGE 2-16, <u>REJECTION LIMIT</u>.
CC 64-72	CLOCKWISE DIRECTION. MEAN OF POINTINGS OR MEASUREMENTS TO EACH OBJECT OBSERVED IN A SET. IN DEGREES, MINUTES, SECONDS (DDDMMSSss).
CC 73-76	INTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss) SEE PAGE 2-17, <u>INTERNAL CONSISTENCY SIGMA</u>.
CC 77-80	EXTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss) SEE PAGE 2-17, <u>EXTERNAL CONSISTENCY SIGMA</u>.

GPS OCCUPATION HEADER RECORD (*25*)

This record is used to define session information and the raw data file name at a station. There must be an occupation header record for each receiver in each session. Use the Comment Record (*26*) immediately following the *25* record for any comments.

To anticipate the accuracy of an observation, the type of survey equipment used must be known. To identify the instrument employed on each particular observation record in a concise manner, assign a unique three-digit number (Job-Specific Instrument Number) in the range 001 to 999 to each item of survey equipment used in the job. Each unique number will cross reference a NGS survey equipment code in the *70* record. See Chapter 2, page 2-10, Job-Specific Instrument Number and page 2-28, Survey Equipment Data Records. **This record is required.**

25 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *25*.
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION. FOR ADDITIONAL INFORMATION SEE CHAPTER 1, PAGES 1-2 THRU 1-6, JOB CODE AND SURVEY POINT NUMBERING; CHAPTER 2, PAGES 2-8 THRU 2-9, OBSERVATION DATA RECORDS; PAGES 2-12 THRU 2-14, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.
CC 15-24	DATA MEDIA IDENTIFIER. A CODE WHICH SPECIFICALLY DEFINES THE RECEIVER TYPE, DAY, YEAR, SESSION, AND STATION OBSERVED. FOR USE IN THE B-FILE AND G-FILE. SEE ANNEX L, PAGES L-1 AND L-2. THE FORMAT OF A DATA MEDIA IDENTIFIER IS: ADDDYSNNNN, WHERE: A IS THE CHARACTER WHICH INDICATES THE RECEIVER MANUFACTURER: A = ASHTECH, INC; C = TOPCON CORP; D = DEL NORTE TECHNOLOGY, INC; G = ALLEN OSBORNE ASSOCIATES, INC; I = ISTAC, INC; L = MINI-MAC™; M = Macrometer®; N = NORSTAR INSTRUMENTS, LTD; O = MOTOROLA, INC; R = TRIMBLE NAVIGATION, LTD; S = SERCEL, INC; T = TEXAS INSTRUMENTS,INC; W = LEICA HEERBRUGG AG-WILD HEERBRUGG-MAGNAVOX, INC; V = NOVATEL COMMUNICATIONS, LTD; X = OTHER DDD IS THE DAY OF YEAR OF THE FIRST DATA EPOCH (UTC) Y IS THE LAST DIGIT OF THE YEAR OF THE FIRST DATA EPOCH S IS THE LETTER OR NUMBER OF THE SESSION OBSERVED NNNN IS THE PROJECT UNIQUE, FOUR (4)-CHARACTER ABBREVIATION OF A STATION NAME.
CC 25-27	INITIALS OF THE OBSERVER
CC 28-30	JOB-SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE-DIGIT NUMBER IN THE RANGE 001 TO 999 ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. THIS NUMBER WILL CROSS REFERENCE THE NGS SURVEY EQUIPMENT CODE IN THE *70* RECORD.
CC 31-32	LENGTH OF THE CABLE USED TO CONNECT RECEIVER AND ANTENNA. (XX) METERS
CC 33-35	**JOB-SPECIFIC ANTENNA NUMBER (JSAN)**
CC 36-80	BLANK

GPS OCCUPATION COMMENT RECORD (*26*)

Use this record for comments pertinent to the GPS occupation session. This record is optional.

26 FORMAT

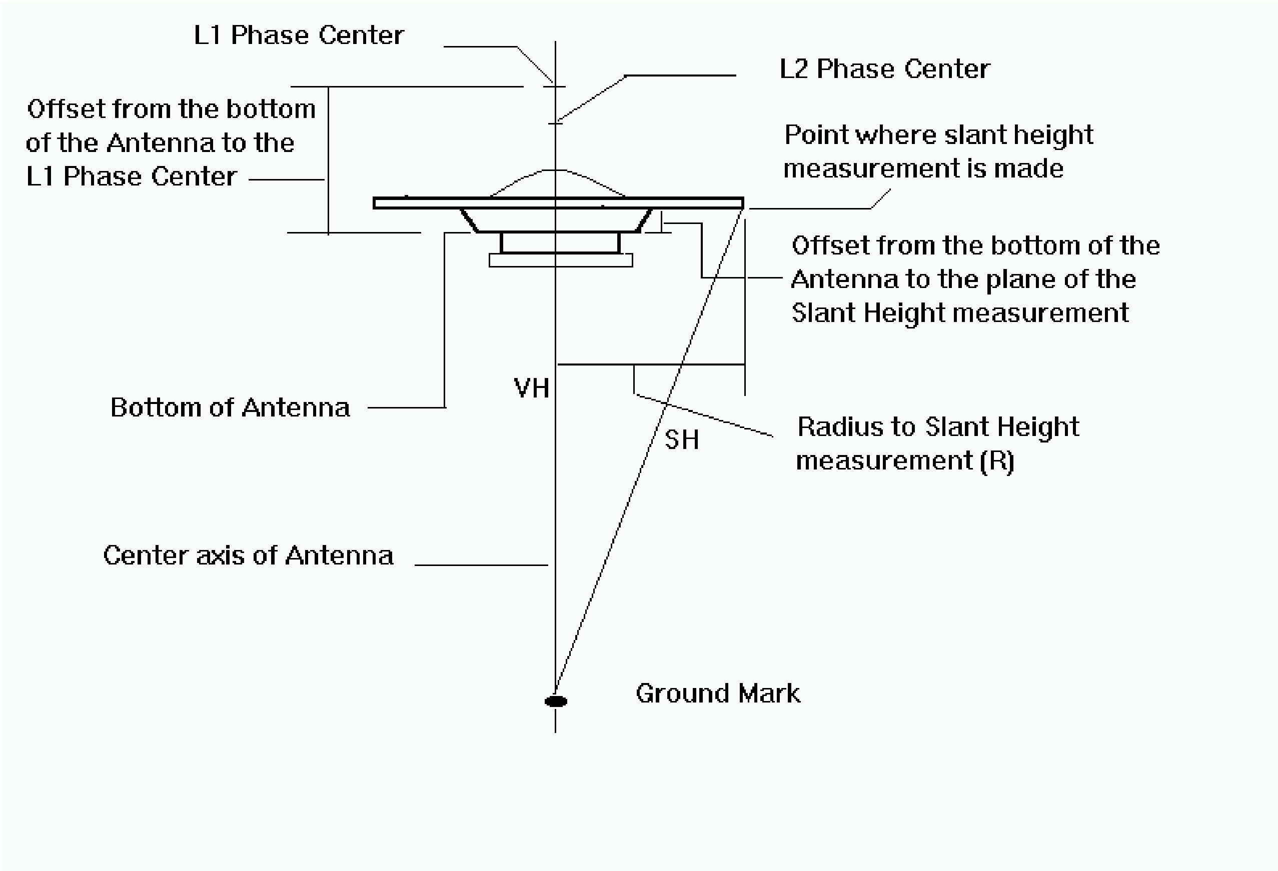
CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *26*.
CC 11-80	COMMENT. IF THE COMMENT(S) EXCEED 70 CHARACTERS, USE ANOTHER *26* RECORD FOR CONTINUATION. ANY NUMBER OF *26* RECORDS IS ALLOWED, BUT, DO NOT DIVIDE WORDS BETWEEN CONSECUTIVE *26* RECORDS.

GPS OCCUPATION MEASUREMENT RECORD (*27*)

To identify the station occupied on each particular observation record in a concise manner, assign a unique four-digit number (Station Serial Number) in the range 0001 to 9999 to each station occupied in the job. Each unique number will cross reference a survey station in an *80* record. See Chapter 1, page 1-1, Job Code and Survey Point Numbering and Chapter 2, page 2-12, Assignment of Station Serial Numbers. At least two Occupation Measurement Records must be completed for each station in each session, i.e. one pre-session and one post-session record. **More than two records can be accommodated. These records are required.**

27 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *27*.
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION. FOR ADDITIONAL INFORMATION SEE CHAPTER 1, PAGES 1-2 THRU 1-6, JOB CODE AND SURVEY POINT NUMBERING; CHAPTER 2, PAGES 2-8 THRU 2-9, OBSERVATION DATA RECORDS; PAGES 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.
CC 15-20	DATE OF OBSERVATION.(UTC) YEAR, MONTH, DAY (YYMMDD). SEE CHAPTER 2, PAGES 2-18, DATE AND TIME.
CC 21-24	TIME. HOURS, MINUTES (HHMM)(UTC). SEE CHAPTER 2, PAGE 2-7, TIME, AND PAGE 2-18, DATE AND TIME.
CC 25-29	HEIGHT OF THE ANTENNA L1 PHASE CENTER ABOVE THE MONUMENT (XX.xxx) IN METERS. **SEE THE DIAGRAM ON PAGE 2-52a.**
CC 30-33	DRY BULB TEMPERATURE (XXX.x). ALL REQUIRED WEATHER INFORMATION CAN BE FOUND ON THE METEOROLOGICAL DATA PORTION OF THE OBSERVER’S FIELD LOG. IT IS IMPORTANT TO MAKE SURE YOU ARE ENTERING DATA FOR THE CORRECT SESSION (BEGINNING AND ENDING READINGS).
CC 34	DRY BULB TEMPERATURE CODE (C/F). THE TEMPERATURE GIVEN MUST BE RECORDED IN CELSIUS OR FAHRENHEIT. **NGS PREFERS CELSIUS.**
CC 35-38	WET BULB TEMPERATURE (XXX.x). SEE DRY BULB TEMPERATURE.
CC 39	WET BULB TEMPERATURE CODE (C/F). SEE DRY BULB TEMPERATURE CODE.
CC 40-42	RELATIVE HUMIDITY (XX.x). ENTER THE PERCENTAGE OF RELATIVE HUMIDITY AT THE BEGINNING AND END OF THE SESSION.
CC 43-48	BAROMETRIC PRESSURE (XXXX.xx). (AT INITIATION AND COMPLETION) (ALLOWABLE UNITS MM, MB OR IN) THE BAROMETRIC PRESSURE CAN ALSO BE FOUND IN THE OBSERVER’S FIELD LOG.
CC 49-50	BAROMETRIC PRESSURE CODE. (MM, MB, IN) **NGS PREFERS MB.** MM - MILLIMETERS OF MERCURY MB - MILLIBARS IN - INCHES OF MERCURY
CC 51-55	WEATHER CODE. THE FIRST COLUMN OF THIS CODE (51) IS A PROBLEM INDICATOR FOLLOWED BY VISIBILITY, TEMPERATURE, CLOUD COVER AND WIND INDICATORS IN SUCCESSION. FOR INFORMATION CONCERNING THE WEATHER CODE TO BE USED IN CONNECTION WITH GEOMETRIC OBSERVATIONS, SEE CHAPTER 2, PAGES 2-10.
CC 56-80	BLANK



Radius to Slant Height Measurement (R): This is the horizontal distance from the vertical center axis of the antenna to the point where the slant height measurement **(SH)** is made.

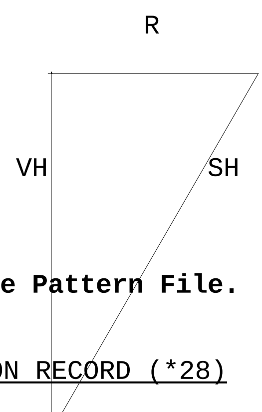
Vertical Height (VH): This value, reduced from the slant height measurement by the formula below, is used in computing the required vertical height of the phase center (L1/L2) above the ground mark in the *27* record.

$$VH=\sqrt{SH^2-R^2}$$

VH = Vertical Height as reduced from the slant height measurement.

R = Radius to the Slant Height Measurement.

SH = Slant Height Measurement.



Note: The L1 Phase Center Offset used above is found in the Antenna Phase Pattern File.

GPS CLOCK SYNCHRONIZATION RECORD (*28)

The Clock Synchronization Record is used to record codeless type receiver clock synchronization information. Two records are normally created for each receiver per day, i.e., one pre-session and one post-session. Use the Comment Record (*29*) immediately following the *28* record for any comments. **This record is required for codeless receivers.**

28 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *28*.
CC 11-16	SYNCHRONIZATION DATE (YYMMDD) UTC. CODELESS TYPE GPS RECEIVERS MUST BE TIME SYNCHRONIZED WITH OTHER RECEIVERS IN THE SESSION.
CC 17-20	SYNCHRONIZATION TIME (HHMM) UTC. SEE SYNCHRONIZATION DATE.
CC 21-23	JOB-SPECIFIC INSTRUMENT NUMBER A. THE UNIQUE THREE-DIGIT NUMBER IN THE RANGE 001 TO 999 ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. THIS NUMBER WILL CROSS REFERENCE THE NGS SURVEY EQUIPMENT CODE IN THE *70* RECORD.
CC 24-26	JOB-SPECIFIC INSTRUMENT NUMBER B. SEE CC 21-23.
CC 27-31	BLANK
CC 32-36	TIMING DIFFERENCE (XXX.xx)(MICROSECONDS).
CC 37	INTEGER TIME SECOND SYNCH (Y OR N).
CC 38-40	INITIALS OF THE OBSERVER.
CC 41-80	BLANK

GPS CLOCK SYNCHRONIZATION RECORD (*29*)

Use this record for comments pertinent to the time synchronization of two or more GPS receivers. This record is optional.

29 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *26*.
CC 11-80	COMMENT. IF THE COMMENT(S) EXCEED 70 CHARACTERS, USE ANOTHER *29* RECORD FOR CONTINUATION. ANY NUMBER OF *29* RECORDS IS ALLOWED, BUT DO NOT DIVIDE WORDS BETWEEN CONSECUTIVE *29* RECORDS. SEE CHAPTER 2, PAGES 2-17 AND 2-18, HORIZONTAL DIRECTION DATA RECORDS.

HORIZONTAL ANGLE SET RECORD (*30*)

Use this record for the first angle of every set of angles observed at a station. Use the Horizontal Angle Record (*32*) for the remaining angles observed in the same set. Use a Comment Record (*31*) immediately following the *30* record for any comments pertaining to the set of observations.

To anticipate the accuracy of an observation, the type of survey equipment used must be known. To identify the instrument used for each observation, assign a unique three-digit number (Job-Specific Instrument Number) in the range 001 to 999 to each item of survey equipment used in the job. Each number will cross reference a NGS SURVEY EQUIPMENT CODE in the *70* record. See Chapter 2, Page 2-10, Job-Specific Instrument Number and Page 2-28, Survey Equipment Data Records.

30 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *30*.
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT). FOR ADDITIONAL INFORMATION SEE CHAPTER 1, PAGES 1-1 THRU 1-3, JOB CODE AND SURVEY POINT NUMBERING; CHAPTER 2, PAGES 2-8 THRU 2-9, OBSERVATION DATA RECORDS; PAGES 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.
CC 15-16	SET NUMBER. ENTER 01 FOR THE FIRST SET OF ANGLE OBSERVATIONS. EACH ADDITIONAL SET OF OBSERVED ANGLES WITH THE SAME INSTRUMENT SSN MUST BE ASSIGNED A HIGHER NUMBER; 02, 03, ETC. SEE CHAPTER 2, PAGE 2-20, SET NUMBER.
CC 17-22	FIELD RECORD BOOK NUMBER. VOLUME NUMBER OF THE FIELD BOOK IN WHICH THE ANGLES OBSERVATIONS ARE RECORDED.
CC 23-24	NUMBER OF ANGLES OBSERVED IN THIS SET. THIS NUMBER IS THE SUM OF THE *30* RECORD AND THE *32* RECORD (S) IN THIS SET. SEE CHAPTER 2, PAGE 2-20.
CC 25-29	WEATHER CODE. THE FIRST COLUMN OF THIS CODE (25) IS A PROBLEM INDICATOR FOLLOWED BY VISIBILITY, TEMPERATURE, CLOUD COVER AND WIND INDICATORS IN SUCCESSION. IF THE PROBLEM INDICATOR IS 1, A *31* RECORD IS REQUIRED. SEE CHAPTER 2, PAGE 2-10.
CC 30-32	INITIALS OF THE OBSERVER.
CC 33-35	JOB-SPECIFIC INSTRUMENT NUMBER (JSIN). THE UNIQUE THREE-DIGIT NUMBER IN THE RANGE 001 TO 999 ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. THIS NUMBER WILL CROSS REFERENCE THE NGS SURVEY EQUIPMENT CODE IN THE *70* RECORD.
CC 36-39	HEIGHT OF INSTRUMENT. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE OCCUPIED SURVEY MARK (POINT) TO THE OPTICAL CENTER OF THE SURVEYING INSTRUMENT. IN METERS (MMmm). SEE PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.

CC 40-45	DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD). SEE CHAPTER 2, PAGE 2-20, DATE AND TIME.
CC 46-49	LOCAL TIME. HOURS, MINUTES (HHMM) SEE CHAPTER 2, PAGE 2-7, TIME; AND PAGE 2-20, DATE AND TIME.
CC 50	TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED. SEE CHAPTER 2, PAGE 2-7.
CC 51-54	STATION SERIAL NUMBER. FIRST TARGET STATION (LEFT FOREPOINT). SEE CHAPTER 1, PAGES 1-1 THRU 1-3, JOB CODE AND SURVEY POINT NUMBERING; CHAPTER 2, PAGES 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.
CC 55-58	HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE FIRST TARGET STATION (LEFT FOREPOINT) SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK USED FOR THE ANGLE OBSERVATIONS. IN METERS (MMmm). SEE CHAPTER 2, PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.
CC 59	VISIBILITY CODE. SEE CHAPTER 2, PAGE 2-11, VISIBILITY CODE.

CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF DETERMINATIONS OF A SINGLE ANGLE MEASUREMENT WHICH ARE MEANED TO OBTAIN THE DESIRED ANGLE VALUE. EACH DETERMINATION OF A SINGLE ANGLE WILL USUALLY INVOLVE SEVERAL REPEATED MEASUREMENTS (REPETITIONS). SEE CHAPTER 2, PAGES 2-19 AND 2-20, HORIZONTAL ANGLE DATA RECORDS.

CC 62-63 REJECTION LIMIT. THE MAXIMUM ALLOWED DEVIATION OF A SINGLE ANGLE MEASUREMENT FROM THE MEAN OF ALL THE MEASUREMENTS USED TO DETERMINE THE DESIRED ANGLE IN A SET. SEE CHAPTER 2, PAGES 2-16.

CC 64-71 CLOCKWISE ANGLE. MEAN OF FIRST ANGLE OBSERVED AT A STATION. IN DEGREES, MINUTES, SECONDS (DDDMMSSs). SEE PAGES 2-19 AND 2-20, HORIZONTAL ANGLE DATA RECORDS.

CC 72-75 STATION SERIAL NUMBER. SECOND TARGET STATION (RIGHT FOREPOINT). SEE PAGES 1-1 THRU 1-3, JOB CODE AND SURVEY POINT NUMBERING; PAGES 2-8 THRU 2-9, OBSERVATION DATA RECORDS; PAGES 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.

CC 76-79 HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE SECOND TARGET STATION (RIGHT FOREPOINT) SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK USED FOR THE ANGLE OBSERVATIONS. IN METERS (MMmm). SEE PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.

CC 80 VISIBILITY CODE. SEE PAGE 2-11, VISIBILITY CODE.

HORIZONTAL ANGLE COMMENT RECORD (*31*)

Use this record for comments pertaining to the set of angles. This record is required to explain the problem encountered if the problem indicator (column 25) on the respective Horizontal Angle Set Record (*30*) is "1". Otherwise, this record is optional.

31 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM THE PREVIOUS RECORD.

CC 07-10 DATA CODE. MUST BE *31*.

CC 11-80 COMMENT. IF THE COMMENT(S) EXCEED 70 CHARACTERS, USE ANOTHER *31* RECORD FOR CONTINUATION. ANY NUMBER OF *31* RECORDS IS ALLOWED. BUT, DO NOT DIVIDE WORDS BETWEEN CONSECUTIVE *31* RECORDS. SEE CHAPTER 2, PAGES 2-19 AND 2-20, HORIZONTAL ANGLE DATA RECORDS.

HORIZONTAL ANGLE RECORD (*32*)

Use this record for the second and subsequent angles observed in the same set. Use a Horizontal Angle Set Record (*30*) for the first angle observed in the set.

32 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *32*.
CC 11-14	STATION SERIAL NUMBER. INSTRUMENT STATION (STANDPOINT). FOR ADDITIONAL INFORMATION REFER TO PAGES 1-1 THRU 1-3, 2-9 AND 2-12 THRU 2-13.
CC 15-16	SET NUMBER. MUST BE THE SAME NUMBER AS ON THE PRECEDING *30* RECORD.
CC 17-45	BLANK.
CC 46-49	LOCAL TIME. HOURS, MINUTES (HHMM). SEE CHAPTER 2, PAGE 2-7, <u>TIME</u>; AND PAGE 2-20, <u>DATE AND TIME</u>.
CC 50	TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H THAT REPRESENTS THE TIME ZONE OCCUPIED. SEE CHAPTER 2, PAGE 2-7.
CC 51-54	STATION SERIAL NUMBER. FIRST TARGET STATION (LEFT FOREPOINT). SEE CHAPTER 1, PAGES 1-1 THRU 1-3, <u>JOB CODE AND SURVEY POINT NUMBERING</u>; CHAPTER 2, PAGES 2-12 THRU 2-13, <u>ASSIGNMENT OF STATION SERIAL NUMBERS</u>; AND PAGE 2-14, <u>TREATMENT OF ECCENTRIC OBSERVATIONS</u>.
CC 55-58	HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE FIRST TARGET STATION (LEFT FOREPOINT) SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK USED FOR THE ANGLE OBSERVATIONS. IN METERS (MMmm). SEE CHAPTER 2, PAGE 2-11, <u>HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET</u>.
CC 59	VISIBILITY CODE. SEE CHAPTER 2, PAGE 2-11, VISIBILITY CODE.
CC 60-61	NUMBER OF REPLICATIONS. NUMBER OF DETERMINATIONS OF A SINGLE ANGLE MEASUREMENT WHICH ARE MEANED TO OBTAIN THE DESIRED ANGLE

VALUE. EACH DETERMINATION OF A SINGLE ANGLE WILL USUALLY INVOLVE SEVERAL REPEATED MEASUREMENTS (REPETITIONS). SEE CHAPTER 2, PAGES 2-19 AND 2-20, HORIZONTAL ANGLE DATA RECORDS.

CC 62-63 REJECTION LIMIT. THE MAXIMUM ALLOWED DEVIATION OF A SINGLE ANGLE MEASUREMENT FROM THE MEAN OF ALL THE MEASUREMENTS USED TO DETERMINE THE DESIRED ANGLE IN A SET. SEE CHAPTER 2, PAGE 2-16.

CC 64-71 CLOCKWISE ANGLE. MEAN OF FIRST ANGLE OBSERVED AT A STATION. IN DEGREES, MINUTES, SECONDS (DDDMMSSs). SEE PAGES 2-19 AND 2-20, HORIZONTAL ANGLE DATA RECORDS.

CC 72-75 STATION SERIAL NUMBER. SECOND TARGET STATION (RIGHT FOREPOINT). SEE PAGES 1-1 THRU 1-3, JOB CODE AND SURVEY POINT NUMBERING; PAGES 2-8 THRU 2-9, OBSERVATION DATA RECORDS; PAGES 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS; AND PAGE 2-14, TREATMENT OF ECCENTRIC OBSERVATIONS.

CC 76-79 HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE SECOND TARGET STATION (RIGHT FOREPOINT) SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK USED FOR THE ANGLE OBSERVATIONS. IN METERS (MMmm). SEE PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.

CC 80 VISIBILITY CODE. SEE PAGE 2-11, VISIBILITY CODE.

VERTICAL ANGLE SET RECORD (*40*)

Use this record for the first vertical angle (VA) or zenith distance (ZD) observed in a set. Use the Vertical Angle Record (*42*) for the remaining vertical angles or zenith distances observed in the same set. Use a Comment Record (*41*) immediately following the *40* record for any comments. For additional information, refer to pages 2-21 thru 2-23, VA/ZD Data Records.

To anticipate the accuracy of an observation, the type of survey equipment must be known. To identify the instrument used for each observation, assign a unique three-digit number (Job-Specific Instrument Number) in the range 001 to 999 to each item of survey equipment used in the job. Each unique number will cross reference a NGS Survey Equipment Code in the *70* record. See Page 2-10, Job-Specific Instrument Number and Page 2-28, Survey Equipment Data Records.

40 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *40*
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-16	SET NUMBER. ENTER 01 FOR THE FIRST SET OF VA/ZD OBSERVATIONS. USE 02, 03, ETC. FOR SUCCESSIVE SETS. SEE PAGE 2-22, SET NUMBER.
CC 17-22	FIELD RECORD BOOK NUMBER. VOLUME NUMBER OF THE FIELD BOOK IN WHICH THE VA/ZD OBSERVATIONS ARE RECORDED.
CC 23-24	NUMBER OF VA OR ZD OBSERVATIONS IN THIS SET. THIS VALUE IS EQUAL TO THE SUM OF THE *40* RECORD AND THE *42* RECORD(S) IN THIS SET. SEE PAGE 2-22.
CC 25-29	WEATHER CODE. THE FIRST COLUMN OF THIS CODE (25) IS A PROBLEM INDICATOR FOLLOWED BY VISIBILITY, TEMPERATURE, CLOUD COVER AND WIND INDICATORS IN SUCCESSION. IF THE PROBLEM INDICATOR IS "1", A *41* RECORD IS REQUIRED. SEE PAGE 2-10, WEATHER CODE.
CC 30-32	INITIALS OF THE OBSERVER.
CC 33-35	JOB-SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE-DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. SEE ABOVE.
CC 36-39	HEIGHT OF INSTRUMENT. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE OCCUPIED SURVEY MARK (POINT) TO THE OPTICAL CENTER OF THE SURVEYING INSTRUMENT. IN METERS (MMmm). SEE PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.
CC 40-45	DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD). SEE PAGE 2-24, DATE AND TIME.
CC 46-49	LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGES 2-7, TIME AND 2-24, DATE AND TIME.
CC 50	TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED. SEE PAGE 2-7, TIME ZONE.
CC 51-54	STATION SERIAL NUMBER. TARGET STATION (FOREPOINT).

CC 55-58 HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE TARGET STATION SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK USED FOR THE VA/ZD OBSERVATION. IN METERS (MMmm). REFER TO PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.

CC 59 VISIBILITY CODE. SEE PAGE 2-11.

CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF POINTINGS OR MEASUREMENTS USED TO DETERMINE A VA OR ZD OBSERVATION. SEE PAGES 2-21 AND 2-22, VERTICAL ANGLE/ZENITH DISTANCE DATA RECORDS.

CC 62-63 REJECTION LIMIT. MAXIMUM ALLOWED SPREAD BETWEEN THE OBSERVATIONS. IN SECONDS (XXxx).

CC 64-71 VERTICAL ANGLE OR ZENITH DISTANCE. MEAN OF POINTINGS OR MEASUREMENTS TO THE FIRST OBJECT SIGHTED IN THE OBSERVING SEQUENCE. IN DEGREES, MINUTES, SECONDS (DDDMMSSs). LEAVE CC 71 BLANK IF VA OR ZD IS GIVEN TO THE NEAREST SECOND; LEAVE CC 69-71 BLANK IF IT IS GIVEN TO THE NEAREST MINUTE.

CC 72 ANGLE CODE. INDICATE TYPE OF VERTICAL ANGLE MEASURED. E= ELEVATION, D= DEPRESSION, Z= ZENITH DISTANCE. SEE PAGE 2-22, ANGLE CODE.

CC 73-76 INTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

CC 77-80 EXTERNAL CONSISTENCY. SIGMA IN SECONDS PER KILOMETER (SSss). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

VERTICAL ANGLE COMMENT RECORD (*41*)

Use this record for comments pertaining to the set of vertical angles or zenith distances. This record is required to explain the problem encountered when the problem indicator (column 25) on the preceding Vertical Angle Set Record (*40*) is "1". Otherwise, this record is optional.

41 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.

CC 07-10 DATA CODE. MUST BE *41*.

CC 11-80 COMMENT. IF THE COMMENT(s) EXCEED 70 CHARACTERS, USE ANOTHER *41* RECORD FOR CONTINUATION. ANY NUMBER OF *41* RECORDS IS ALLOWED. BUT, DO NOT DIVIDE WORDS BETWEEN CONSECUTIVE *41* RECORDS.

VERTICAL ANGLE RECORD (*42*)

Use this record for the second and subsequent vertical angles (VAs) or zenith distances (ZDs) observed in the same set; use Vertical Angle Set Record (*40*) for the first vertical angle or zenith distance observed in the set. Refer to pages 2-22 thru 2-24 for additional information.

42 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *42*
CC 11-14 STATION SERIAL NUMBER. INSTRUMENT STATION (STANDPOINT). MUST BE IDENTICAL TO THE STATION SERIAL NUMBER (SSN) USED IN CC 11-14 ON THE RESPECTIVE *40* RECORD.
CC 15-16 SET NUMBER. MUST BE THE SAME NUMBER AS ON THE PRECEDING *40* RECORD.
CC 17-45 BLANK.
CC 46-49 LOCAL TIME. HOURS, MINUTES (HHMM).
CC 50 TIME ZONE. ENTER THE LETTER CODE FORM ANNEX H.
CC 51-54 STATION SERIAL NUMBER (SSN). TARGET STATION (FOREPOINT).
CC 55-58 HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE TARGET STATION SURVEY MARK (POINT) TO THE TARGET (POINT) ABOVE THE MARK USED FOR THE VA/ZD OBSERVATION. REFER TO PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.
CC 59 VISIBILITY CODE. SEE PAGE 2-11.
CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF POINTINGS OR MEASUREMENTS USED TO DETERMINE A VA OR ZD OBSERVATION. SEE PAGES 2-21 AND 2-22, VERTICAL ANGLE/ZENITH DISTANCE DATA RECORDS.
CC 62-63 REJECTION LIMIT. MAXIMUM ALLOWED SPREAD BETWEEN THE OBSERVATIONS. IN SECONDS (XXxx).
CC 64-71 VERTICAL ANGLE OR ZENITH DISTANCE. MEAN OF POINTINGS OR MEASUREMENTS TO THE FIRST OBJECT SIGHTED IN THE OBSERVING SEQUENCE. IN DEGREES, MINUTES, SECONDS (DDDMMSSs). LEAVE CC 71 BLANK IF VA OR ZD IS GIVEN TO THE NEAREST SECOND; LEAVE CC 69-71 BLANK IF IT IS GIVEN TO THE NEAREST MINUTE.
CC 72 ANGLE CODE. INDICATE TYPE OF VERTICAL ANGLE MEASURED. E= ELEVATION, D= DEPRESSION, Z= ZENITH DISTANCE. SEE PAGE 2-22, ANGLE CODE.
CC 73-76 INTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.
CC 77-80 EXTERNAL CONSISTENCY. SIGMA IN SECONDS PER KILOMETER (SSss). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

DIFFERENCE OF ELEVATION RECORD (*45*)

Use this record for each observed difference of elevation obtained by spirit leveling or by other than the trigonometric method coded in the *40* thru *42* records. Use the Difference of Elevation Continuation Record (*47*) to code additional data pertinent to the observation in the preceding *45* record. For any comments use the Difference of Elevation Comment Record (*46*). Refer to page 2-23, LEVEL DATA RECORDS, for additional information.

45 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *45*.
CC 11-14 STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).

CC 15-16 BLANK.
CC 17-22 FIELD RECORD BOOK NUMBER. VOLUME NUMBER OF THE FIELD BOOK IN WHICH THE ELEVATION OBSERVATIONS ARE RECORDED.
CC 23-24 BLANK.
CC 25-29 WEATHER CODE. THE FIRST COLUMN OF THIS CODE (25) IS A PROBLEM INDICATOR FOLLOWED BY VISIBILITY, TEMPERATURE, CLOUD COVER AND WIND INDICATORS IN SUCCESSION. IF THE PROBLEM INDICATOR IS "1", A *46* RECORD IS REQUIRED. SEE PAGE 2-10, WEATHER CODE.
CC 30-32 INITIALS OF THE OBSERVER.
CC 33-35 JOB-SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE-DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. REFER TO PAGES 2-10 AND 2-28.
CC 36-38 NUMBER OF LEVELING SETUPS. NUMBER OF TURNING POINTS USED TO OBTAIN THE ELEVATION DIFFERENCE OF THE SECTION OBSERVED.
CC 39 BLANK.
CC 40-45 DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD).
CC 46-49 LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGE 2-7, TIME AND 2-24, DATE AND TIME.
CC 50 TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H TO INDICATE WHICH TIME ZONE WAS OCCUPIED. SEE PAGE 2-7.
CC 51-54 STATION SERIAL NUMBER. TARGET STATION (FOREPOINT).
CC 55-58 BLANK.
CC 59 VISIBILITY CODE. SEE PAGE 2-11.
CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF MEASUREMENTS (LEVEL RUNNINGS) OF THE SAME SECTION. IF THE MEAN VALUE OF A FORWARD AND A BACKWARD LEVEL RUN OF THE SAME SECTION IS CODED AS A SINGLE OBSERVATION, THEN THE NUMBER OF REPLICATIONS SHOULD BE CODED AS 2.
CC 62-63 BLANK.
CC 64-72 DIFFERENCE OF ELEVATION. DIFFERENCE OF ELEVATION OBSERVED BETWEEN TWO MARKS (A SECTION). IN METERS (MMMMMmmmm). IF THE DIFFERENCE IS NEGATIVE, CODE THE MINUS SIGN (-) IMMEDIATELY PRECEDING THE LEFTMOST DIGIT AND BLANK FILL COLUMNS LEFT OF THE MINUS SIGN.
CC 73-76 ACCURACY OF LEVELING. SIGMA IN MILLIMETERS (XXxx). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE.
CC 77-80 LENGTH OF SECTION. DISTANCE BETWEEN THE TWO MARKS FOR WHICH THE ELEVATION DIFFERENCE WAS DETERMINED. IN KILOMETERS (XXxx).

DIFFERENCE OF ELEVATION COMMENT RECORD (*46*)

Use this record for comments pertaining to the difference of elevation observations. If the problem indicator (column 25) on the preceding Difference of Elevation Record (*45*) is "1", this record is required to explain the problem encountered. Otherwise, this record is optional.

46 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *46*

CC 11-80 COMMENT. IF THE COMMENT(S) EXCEED 70 CHARACTERS, USE ANOTHER *46* RECORD FOR CONTINUATION. ANY NUMBER OF *46* RECORDS IS ALLOWED. BUT, DO NOT DIVIDE WORDS BETWEEN CONSECUTIVE *46* RECORDS.

DIFFERENCE OF ELEVATION CONTINUATION RECORD (*47*)

Use this record to indicate the Job-Specific Instrument (JSI) Number of the leveling rod and the initials of the observing agency.

47 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *47*.
CC 11-14 STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT). MUST BE THE SAME SSN AS ON THE PRECEDING *45* RECORD.
CC 15-16 BLANK.
CC 17-54 BLANK.
CC 55-57 JOB-SPECIFIC INSTRUMENT (JSIN) NUMBER. THE UNIQUE THREE-DIGIT NUMBER ASSIGNED TO THE LEVEL ROD USED TO OBTAIN THIS OBSERVATION. REFER TO PAGES 2-10 AND 2-28.
CC 58-63 OBSERVING ORGANIZATION. USE THE ABBREVIATION FOUND IN ANNEX C WHICH IDENTIFIES THE ORGANIZATION THAT OBSERVED THE DIFFERENCE OF ELEVATION BETWEEN THE TWO MARKS. ANY ABBREVIATION NOT FOUND IN ANNEX C MUST BE APPROVED BY NGS PRIOR TO SUBMITTING THE DATA.
CC 64-80 BLANK.

TAPED DISTANCE RECORD (*50*)

Use this record for distances measured with either calibrated (standardized) or uncalibrated steel or invar tapes. Included are distances consisting of any number of segments taped horizontally, taped distances consisting of any number of segments which have all been individually reduced to a common horizontal reference surface (other than the sea level or the ellipsoid) and one-segment unreduced tape distances (less than or equal to one tape length) measured along a slope. Use the *52* record for taped distances reduced to sea level or geoid, to the ellipsoid, or to mark-to-mark. See pages 2-24 thru 2-26, DISTANCE DATA RECORDS.

50 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *50*.
CC 11-14 STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-19 WEATHER CODE. THE FIRST COLUMN OF THIS CODE (15) IS A PROBLEM INDICATOR FOLLOWED BY VISIBILITY, TEMPERATURE, CLOUD COVER AND WIND INDICATORS IN SUCCESSION. IF THE PROBLEM INDICATOR IS "1", A *55* RECORD IS REQUIRED. SEE PAGE 2-10, WEATHER CODE.
CC 20-22 INITIALS OF THE OBSERVER.
CC 23-25 JOB-SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE-DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. REFER TO PAGES 2-10 AND 2-28.
CC 26-29 TAPE SUPPORT HEIGHT. IN METERS (MMmm). USED ONLY FOR A CODE "S" DISTANCE. ENTER THE VERTICAL HEIGHT OF THE TAPE SUPPORT (IF ANY) ABOVE THE INSTRUMENT STATION (STANDPOINT) MARK TO THE NEAREST CENTIMETER (cm).

CC 30-34 ELEVATION OF INSTRUMENT STATION (STANDPOINT). IN METERS (MMMMm). FOR A CODE "H" DISTANCE ENTER THE ELEVATION TO WHICH THE TAPED DISTANCE WAS REDUCED.

CC 35-40 DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD).

CC 41-44 LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGES 2-7, TIME AND 2-25, DATE AND TIME.

CC 45 TIME ZONE. ENTER THE LETTER FROM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED. REFER TO PAGE 2-7, TIME ZONE.

CC 46-49 STATION SERIAL NUMBER. TARGET STATION (FOREPOINT).

CC 50-53 TAPE SUPPORT HEIGHT. IN METERS (MMmm). USED ONLY FOR A CODE "S" DISTANCE. ENTER THE VERTICAL HEIGHT OF THE TAPE SUPPORT (IF ANY) ABOVE THE TARGET STATION (STANDPOINT) MARK TO THE NEAREST CENTIMETER (cm).

CC 54-58 DIFFERENCE OF ELEVATION. IN METERS (MMmm). USED ONLY FOR A CODE "S" DISTANCE. ENTER THE DIFFERENCE OF ELEVATION FROM MARK TO MARK WITH RESPECT TO THE INSTRUMENT STATION (STANDPOINT).

CC 59 VISIBILITY CODE. SEE BELOW OR PAGE 2-11.

CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF COMPLETE MEASUREMENTS OR DETERMINATIONS USED TO CALCULATE THE MEAN TAPED DISTANCE CODED IN THIS RECORD.

CC 62-63 REJECTION LIMIT. IN MILLIMETERS (XX). MAXIMUM ALLOWED DEVIATION OF OBSERVATIONS FROM THE MEAN .

CC 64-72 CORRECTED TAPED DISTANCE. IN METERS (MMMMMmmmm). TAPED HORIZONTAL (CODE T), REDUCED TO HORIZONTAL (CODE H) OR SLOPE (CODE S) DISTANCE WITH STANDARDIZATION, CATENARY AND TEMPERATURE CORRECTIONS APPLIED AS APPLICABLE TO THE METHOD OF MEASUREMENT AND/OR EQUIPMENT USED.

CC 73 DISTANCE CODE. SEE BELOW OR PAGE 2-26.

CC 74-76 INTERNAL CONSISTENCY. SIGMA IN MILLIMETERS (XXx). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. REFER TO PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

CC 77-80 EXTERNAL CONSISTENCY. SIGMA IN PARTS PER MILLION (XXXx). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGE 2-25.

VISIBILITY CODES

Code	Description
R	TARGET STATION (FOREPOINT) IS A REFERENCE MARK
Z	TARGET STATION IS AN AZIMUTH MARK
V	TARGET STATION IS VISIBLE FROM THE GROUND
N	TARGET STATION IS NOT VISIBLE FROM THE GROUND

DISTANCE CODES

Code	Description
T	TAPED HORIZONTAL DISTANCE
H	TAPED SLOPE DISTANCE REDUCED TO HORIZONTAL

S	TAPED SLOPE DISTANCE (ONE TAPE LENGTH OR LESS)

UNREDUCED DISTANCE RECORD (*51*)

Use this record for slant-range distances less than 100 kilometers in length, measured with electronic distance-measuring equipment (DME). Included are line-of-sight instrument-to-reflector distances measured with electro-optical DME and master-to-remote distances measured with microwave DME. Precision or resolution of the measured distance must be 1 centimeter or better. Use *53* record for coarser resolution DME. Instrument and/or reflector calibration corrections and refraction correction are assumed to have been applied. See pages 2-24 thru 2-26, DISTANCE DATA RECORDS.

51 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *51*.
CC 11-14 STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-19 WEATHER CODE. SAME FORMAT AS THE *50* RECORD. SEE PAGE 2-10, WEATHER CODE.
CC 20-22 INITIALS OF THE OBSERVER.
CC 23-25 JOB SPECIFIC INSTRUMENT NUMBER (JSIN). THE UNIQUE THREE DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. REFER TO PAGES 2-10 AND 2-28 FOR DETAILED EXPLANATION.
CC 26-29 HEIGHT OF INSTRUMENT. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE OCCUPIED SURVEY MARK (POINT) TO THE OPTICAL CENTER OF THE SURVEYING INSTRUMENT. IN METERS (MMmm). SEE PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.
CC 30-34 BLANK
CC 35-40 DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD).
CC 41-44 LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGES 2-7, TIME AND 2-25, DATE AND TIME.
CC 45 TIME ZONE. ENTER THE LETTER CODE FORM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED. REFER TO PAGE 2-7, TIME ZONE.
CC 46-49 STATION SERIAL NUMBER (SSN). TARGET STATION (FOREPOINT).
CC 50-53 HEIGHT OF REFLECTOR. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE TARGET STATION SURVEY MARK TO THE REFLECTOR ABOVE THE MARK USED FOR THE DISTANCE OBSERVATION IN METERS (MMmm). REFER TO PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.
CC 54-58 BLANK
CC 59 VISIBILITY CODE. SEE PAGE 2-11 OR SEE TEXT FOR THE *50* RECORD FORMAT.
CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF COMPLETE MEASUREMENTS OR DETERMINATIONS USED TO CALCULATE THE MEAN CORRECTED SLANT-RANGE DISTANCE CODED IN THIS RECORD.
CC 62-63 REJECTION LIMIT. MAXIMUM ALLOWED DEVIATION OF OBSERVATIONS FROM THE MEAN VALUE. IN MILLIMETERS.

CC 64-72 CORRECTED SLANT-RANGE DISTANCE. IN METERS (MMMMMmmmm). CORRECTIONS FOR THE INSTRUMENT, REFLECTOR AND REFRACTION ARE ASSUMED APPLIED AS APPLICABLE TO THE METHOD OF MEASUREMENT AND/OR THE EQUIPMENT USED

CC 73 DISTANCE CODE. MUST BE "S".

2-66

CC 74-76 INTERNAL CONSISTENCY. SIGMA IN MILLIMETERS (XXx). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. REFER TO PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

CC 77-80 EXTERNAL CONSISTENCY. SIGMA IN PARTS PER MILLION (XXXx). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGE 2-25.

REDUCED DISTANCE RECORD (*52*)

Use this record for distances of less than 100 kilometers in length, measured to a precision of 1 centimeter or better that have been reduced to sea level or the geoid (code G), to the ellipsoid (code E), or to mark-to-mark (code X). Use *54* record for coarser-precision distances. This record is intended for taped distances and distances measured with electronic DME. In every case, the distance given is assumed to be the appropriately reduced value corresponding to the mean of the respective sample of distance measurements to which all applicable corrections have been applied. Among the required data items on this record are the values of the elevations (and of the geoid heights, if applicable) which were used in the respective reduction process. These values may be different than those given on the corresponding *80*-series records.

52 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *52*.
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-19	WEATHER CODE. SAME FORMAT AS *50* AND *51* RECORDS.
CC 20-22	INITIALS OF THE OBSERVER.
CC 23-25	JOB SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS MEASUREMENT. SEE PAGES 2-10 AND 2-28.
CC 26-29	GEOID HEIGHT. IN METERS (MMMm). VALUE USED IN THE REDUCTION PROCESS. LEAVE BLANK FOR CODE "G" DISTANCE. IF THE GEOID HEIGHT IS NEGATIVE, CODE THE MINUS SIGN (-) IMMEDIATELY PRECEDING THE LEFTMOST DIGIT AND BLANK FILL COLUMNS LEFT OF THE MINUS SIGN.
CC 30-34	ELEVATION OF THE INSTRUMENT STATION (STANDPOINT) MARK. RECORD THE VALUE USED IN THE REDUCTION PROCESS. IN METERS (MMMMm).
CC 35-40	DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD).
CC 41-44	LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGE 2-7, <u>TIME</u>.
CC 45	TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H WHICH APPLIES.
CC 46-49	STATION SERIAL NUMBER (SSN). TARGET STATION (FOREPOINT).
CC 50-53	GEOID HEIGHT. IN METERS (MMMm). VALUE USED IN THE REDUCTION PROCESS. LEAVE BLANK FOR CODE "G" DISTANCE. IF THE GEOID HEIGHT IS NEGATIVE, CODE THE MINUS SIGN (-) IMMEDIATELY PRECEDING THE LEFTMOST DIGIT AND BLANK FILL COLUMNS LEFT OF THE MINUS SIGN.
CC 54-58	ELEVATION OF THE TARGET STATION (FOREPOINT) MARK. RECORD THE VALUE USED IN THE REDUCTION PROCESS. IN METERS (MMMMm).
CC 59	VISIBILITY CODE. SEE PAGE 2-12 OR THE TABLE BELOW.
CC 60-61	NUMBER OF REPLICATIONS. NUMBER OF MEASUREMENTS USED TO CALCULATE THE MEAN REDUCED DISTANCE CODED IN THIS RECORD.
CC 62-63	REJECTION LIMIT. MAXIMUM ALLOWED DEVIATION OF MEASUREMENTS FROM THE MEAN VALUE. IN MILLIMETERS (XX).

CC 64-72	REDUCED DISTANCE. IN METERS (MMMMMmmmm). ENTER DISTANCE REDUCED TO SEA LEVEL OR THE GEOID (CODE G), TO THE ELLIPSOID (CODE E), OR TO MARK-TO-MARK (CODE X). DO NOT ENTER TO MORE DECIMAL PLACES THAN IS WARRANTED BY THE PRECISION OF THE OBSERVATION.
CC 73	DISTANCE CODE. SEE PAGE 2-26 OR THE TABLE BELOW.
CC 74-76	INTERNAL CONSISTENCY. SIGMA IN MILLIMETERS (XXx). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. REFER TO PAGES 2-15 THRU 2-17, <u>ACCURACY OF THE OBSERVATIONS</u>.

CC 77-80 EXTERNAL CONSISTENCY. SIGMA IN PARTS PER MILLION (XXXx). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGE 2-25 AND PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

VISIBILITY CODES

Code	Description
R	TARGET STATION (FOREPOINT) IS A REFERENCE MARK
Z	TARGET STATION IS AN AZIMUTH MARK
V	TARGET STATION IS VISIBLE FROM THE GROUND
N	TARGET STATION IS NOT VISIBLE FROM THE GROUND

REDUCED DISTANCE CODES

Code	Description
G	MEASURED DISTANCES REDUCED TO THE GEOID
E	MEASURED DISTANCES REDUCED TO THE ELLIPSOID
X	MEASURED DISTANCES REDUCED TO MARK-TO-MARK

UNREDUCED LONG LINE RECORD (*53*)

Use this record for instrument-to-instrument spatial-chord distances derived from long-range electronic DME observations (e.g., HIRAN), obtained by extra-terrestrial methods (e.g., VLBI), or for slant-range distances measured by coarse-resolution DME. This record is intended for measured distances of 100 kilometers and longer. Since long-line and/or course-resolution distance measurements do not normally exhibit any proportional relationship with the length of the line, the External Consistency Sigma on the *53* and *54* records is expressed in meters.

53 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.

CC 07-10 DATA CODE. MUST BE *53*.
CC 11-14 STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-22 BLANK
CC 23-25 JOB SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS MEASUREMENT. SEE PAGES 2-10 AND 2-28.
CC 26-29 HEIGHT OF INSTRUMENT (ANTENNA). IN METERS (MMmm). ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE INSTRUMENT STATION (STANDPOINT) MARK TO THE ACTUAL ORIGIN OF THE MEASURED DISTANCE ABOVE/BELOW THE MARK.
CC 30-34 BLANK
CC 35-40 DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD).
CC 41-44 LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGE 2-25, DATE AND TIME.
CC 45 TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED. REFER TO PAGE 2-7, TIME ZONE.
CC 46-49 STATION SERIAL NUMBER (SSN). TARGET STATION (FOREPOINT).
CC 50-53 HEIGHT OF INSTRUMENT (ANTENNA). IN METERS (MMmm). ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE TARGET STATION (FOREPOINT) MARK TO THE ACTUAL TERMINAL POINT OF THE MEASURED DISTANCE ABOVE/BELOW THE MARK.
CC 54-58 BLANK
CC 59-60 NUMBER OF REPLICATIONS. NUMBER OF COMPLETE MEASUREMENTS USED TO CALCULATE THE MEAN CORRECTED SLANT-RANGE DISTANCE CODED IN THIS RECORD.
CC 61-63 REJECTION LIMIT. MAXIMUM ALLOWED DEVIATION OF OBSERVATIONS FROM THE MEAN VALUE. IN METERS (MMm).
CC 64-73 CORRECTED SPATIAL-CHORD DISTANCE. DERIVED INSTRUMENT-TO-INSTRUMENT (ANTENNA-TO-ANTENNA) SPACIAL-CHORD (CODE C) OR DIRECTLY-OBSERVED SLANT RANGE (CODE S) WITH ALL APPLICABLE CORRECTIONS APPLIED. IN METERS (MMMMMMMmmm).
CC 74 DISTANCE CODE. SEE ABOVE.
CC 75-77 INTERNAL CONSISTENCY. SIGMA IN METERS (Mmm). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. REFER TO PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.
CC 78-80 EXTERNAL CONSISTENCY. SIGMA IN METERS (Mmm). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGE 2-25.

2-70
REDUCED LONG LINE RECORD (*54*)

Use this record for long lines, 100 kilometers and longer, or for any distances measured to a precision coarser than 1 centimeter, which have been reduced to sea level or the geoid (Code G), to the ellipsoid (Code E), or to mark-to-mark spatial-chord distance (Code X). Since the predominate external random errors associated with long-line and/or coarse-resolution distance measurements do not normally exhibit any proportional relationship with the length of the line, the External Consistency Sigma on the *53* and *54* records is expressed in meters.

54 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *54*.
CC 11-14 STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-22 BLANK
CC 23-25 JOB SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS MEASUREMENT. SEE PAGES 2-10 AND 2-28.
CC 26-29 GEOID HEIGHT. IN METERS (MMMm). VALUE USED IN THE REDUCTION PROCESS FOR THE INSTRUMENT STATION (STANDPOINT). LEAVE BLANK FOR CODE G DISTANCE. IF THE GEOID HEIGHT IS NEGATIVE, CODE THE MINUS

SIGN (-) IMMEDIATELY PRECEDING THE LEFTMOST DIGIT AND BLANK FILL THE COLUMNS LEFT OF THE MINUS SIGN.

CC 30-34 ELEVATION OF THE INSTRUMENT STATION (STANDPOINT) MARK. RECORD THE VALUE USED IN THE REDUCTION PROCESS. (POSSIBLY DIFFERENT THAN THE ELEVATION GIVEN ON THE CORRESPONDING *80* OR *81* RECORD. IN METERS (MMMMm).

CC 35-40 DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD).

CC 41-44 LOCAL TIME. HOURS, MINUTES (HHMM).

CC 45 TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED.

CC 46-49 STATION SERIAL NUMBER (SSN). TARGET STATION (FOREPOINT).

CC 50-53 GEOID HEIGHT. IN METERS (MMMm). VALUE USED IN THE REDUCTION PROCESS FOR THE TARGET STATION (FOREPOINT). LEAVE BLANK FOR CODE G DISTANCE. IF THE GEOID HEIGHT IS NEGATIVE, CODE THE MINUS SIGN (-) IMMEDIATELY PRECEDING THE LEFTMOST DIGIT AND BLANK FILL THE COLUMNS LEFT OF THE MINUS SIGN.

CC 54-58 ELEVATION OF THE TARGET STATION (FOREPOINT) MARK. RECORD THE VALUE USED IN THE REDUCTION PROCESS (POSSIBLY DIFFERENT THAN THE ELEVATION GIVEN ON THE CORRESPONDING *80* OR *81* RECORD. IN METERS (MMMMm).

CC 59-60 NUMBER OF REPLICATIONS. NUMBER OF COMPLETE MEASUREMENTS USED TO CALCULATE THE MEAN REDUCED OBSERVATION CODED IN THIS RECORD.

CC 61-63 REJECTION LIMIT. MAXIMUM ALLOWED DEVIATION OF MEASUREMENTS FROM THE MEAN VALUE. IN METERS (MMm).

CC 64-73 REDUCED DISTANCE. IN METERS (MMMMMMMmmm). ENTER DISTANCE REDUCED TO SEA LEVEL OR THE GEOID (CODE G), TO THE ELLIPSOID (CODE E), OR TO MARK-TO-MARK (CODE X). DO NOT ENTER TO MORE DECIMAL PLACES THAN IS WARRANTED BY THE PRECISION OF THE OBSERVATION.

CC 74 DISTANCE CODE. ENTER THE APPROPRIATE G, E, OR X DESCRIBED ABOVE AND ON PAGE 2-28.

CC 75-77 INTERNAL CONSISTENCY. SIGMA IN METERS (Mmm). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. REFER TO PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

CC 78-80 EXTERNAL CONSISTENCY. SIGMA IN METERS (Mmm). ENTER ONLY IF RELIABLE ESTIMATES ARE AVAILABLE. SEE PAGES 2-25 AND PAGES 2-15 THRU 2-17, ACCURACY OF THE OBSERVATIONS.

HORIZONTAL DISTANCE COMMENT RECORD (*55*)

Use this record for comments pertaining to the set of observed horizontal distances. This record is required to explain the problem encountered when the problem indicator (column 15) on the preceding Horizontal Distance Records (*50*, *51*, or *52*) is "1". Otherwise, this record is optional.

55 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM PREVIOUS RECORD.

CC 07-10 DATA CODE. MUST BE *55*.

CC 11-80 COMMENT. IF THE COMMENT(s) EXCEED 70 CHARACTERS, USE ANOTHER *55* RECORD FOR CONTINUATION. ANY NUMBER OF *55* RECORDS IS ALLOWED. BUT, DO NOT DIVIDE WORDS BETWEEN CONSECUTIVE *55* RECORDS.

ASTRONOMIC AZIMUTH/LAPLACE RECORD (*60*)

Submit this record for every astronomic azimuth observed in the project. If two or more sets of astronomic azimuth observations are taken (e.g., sets observed on different nights), submit a separate *60* record for each set.

The desired **astronomic azimuth** coded in this record is the mean value of the respective set of astronomic observations to which all applicable corrections have been applied.

A Laplace azimuth is an astronomic azimuth determination (from observations of a star) converted to the corresponding geodetic azimuth by the application of the Laplace correction (n * tan L). A data element necessary for the computation of a Laplace correction is the east-west (prime-vertical) component of the deflection of vertical (eta) at the respective instrument station (standpoint). Use the following formula to compute a Laplace azimuth:

$$G = A + n * \tan L$$

where :

G = geodetic azimuth (d,m,s)
A = astronomic azimuth (d,m,s)
n = eta (seconds)
L = geodetic latitude of the instrument station (standpoint)

If a reliable Eta value is unavailable, submit the *60* record with blanks in columns 15-19 and enter a code "A" in column 20 to designate the azimuth in columns 64-71 as Astronomic. Enter a code "L" in column 20 to designate the azimuth in columns 64-71 as Laplace, indicating that the Laplace correction has been applied.

60 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *60*.
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-18	PRIME-VERTICAL COMPONENT OF DEFLECTION (ETA) VALUE USED IN LAPLACE CORRECTION. IN SECONDS (SSSs).
CC 19	DIRECTION OF ETA. ENTER CODE "E" FOR EAST OR CODE "W" FOR WEST.

CC 20 COMPUTATION CODE. ENTER CODE "A" FOR ASTRONOMIC OR CODE "L" FOR LAPLACE.

CC 21-29 BLANK

CC 30-32 INITIALS OF THE OBSERVER.

CC 33-35 JOB-SPECIFIC INSTRUMENT NUMBER. THE UNIQUE THREE-DIGIT NUMBER ASSIGNED TO THE INSTRUMENT USED TO OBTAIN THIS OBSERVATION. REFER TO PAGES 2-10 AND 2-28.

CC 36-39 HEIGHT OF INSTRUMENT. ENTER THE VERTICAL DISTANCE FROM THE TOP OF THE INSTRUMENT STATION (STANDPOINT) MARK TO THE OPTICAL CENTER OF THE SURVEYING INSTRUMENT. IN METERS (MMmm). SEE PAGE 2-11, HEIGHT OF INSTRUMENT AND HEIGHT OF TARGET.

CC 40-45 DATE OF OBSERVATION. YEAR, MONTH, DAY (YYMMDD).

CC 46-49 LOCAL TIME. HOURS, MINUTES (HHMM). SEE PAGES 2-7, TIME AND 2-27, DATE AND TIME.

CC 50 TIME ZONE. ENTER THE LETTER CODE FROM ANNEX H WHICH REPRESENTS THE TIME ZONE OCCUPIED. REFER TO PAGE 2-7, TIME ZONE.

CC 51-54 STATION SERIAL NUMBER. TARGET STATION (FOREPOINT).

CC 55-58 HEIGHT OF TARGET. ENTER THE VERTICAL DISTANCE.

CC 59 VISIBILITY CODE. SEE PAGE 2-11.

CC 60-61 NUMBER OF REPLICATIONS. NUMBER OF COMPLETE MEASUREMENTS OR DETERMINATIONS USED TO CALCULATE THE MEAN CORRECTED AZIMUTH OBSERVATION IN THIS RECORD.

CC 62-63 REJECTION LIMIT. MAXIMUM ALLOWED DEVIATION OF OBSERVATIONS FROM THE MEAN VALUE. IN SECONDS.

CC 64-71 ASTRONOMIC/LAPLACE AZIMUTH. DEGREES, MINUTES, SECONDS (DDDMMSSs). ASTRONOMIC AZIMUTH OBSERVATION (MEAN OF ONE SET) WITHOUT THE LAPLACE CORRECTION APPLIED (CODE A) OR WITH THE LAPLACE CORRECTION APPLIED (CODE L). DO NOT APPLY A SKEW NORMAL, GEODESIC, OR DEFLECTION CORRECTION.

CC 72 ORIGIN OF AZIMUTH. ENTER CODE "N" FOR NORTH OR CODE "S" FOR SOUTH.

CC 73-76 INTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss). ENTER ONLY IF A RELIABLE ESTIMATE IS AVAILABLE. REFER TO PAGES 2-15 THRU 2-17.

CC 77-80 EXTERNAL CONSISTENCY. SIGMA IN SECONDS (SSss). ENTER ONLY IF A RELIABLE ESTIMATE IS AVAILABLE.

2-74

GEODETIC AZIMUTH RECORD (*61*)

Use this record for each computed geodetic azimuth used to orient this survey project. Record either a published azimuth to an azimuth mark from a previously established (published) control station that was occupied in this project, or geodetic azimuth obtained from an inverse position computation.

61 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *61*.
CC 11-14	STATION SERIAL NUMBER (SSN). INSTRUMENT STATION (STANDPOINT).
CC 15-50	BLANK
CC 51-54	STATION SERIAL NUMBER (SSN). TARGET STATION (FOREPOINT).
CC 55-63	BLANK
CC 64-71	GEODETIC AZIMUTH. DEGREES, MINUTES, SECONDS (DDDMMSSs).
CC 72	ORIGIN OF AZIMUTH. CODE "N" FOR NORTH OR CODE "S" FOR SOUTH.
CC 73-80	BLANK

2-75

INSTRUMENT RECORD (*70*)

Use this record to provide descriptive information for each item of survey equipment used in the job. This information will be used as an accuracy indicator for each observation in the survey. Assign a **unique** three-digit Job-Specific Instrument Number (JSIN) to each piece of equipment used in the project. This record will cross-reference the assigned JSIN to the NGS Survey Equipment Codes found in Annex F. More than one *70* record is required for any instrument used for more than one type of measurement. See Chapter 2, page 2-28, Survey Equipment Data Records.

70 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *70*.
CC 11-13	JOB-SPECIFIC INSTRUMENT NUMBER (JSIN). MUST BE UNIQUE FOR EACH INSTRUMENT IN JOB. SEE PAGES 2-10 AND 2-28.
CC 14-16	NGS SURVEY EQUIPMENT CODE. SEE ANNEX F. USED TO IDENTIFY THE INSTRUMENT WHICH WAS ASSIGNED THE JSIN IN CC 11-13 ABOVE.
CC 17-20	RESOLUTION OF THE INSTRUMENT. RECORD THE SIZE OF THE SMALLEST DIRECTLY READABLE MEASUREMENT UNIT OR THE RESOLUTION PUBLISHED BY THE INSTRUMENT MANUFACTURER, WHICHEVER IS LARGER (XXxx).
CC 21-22	UNITS. UNITS OF THE RESOLUTION USED IN CC 17-20 ABOVE. SEE PAGE 2-28, RESOLUTION OF THE INSTRUMENT AND UNITS.
CC 23-40	MANUFACTURER OF THE INSTRUMENT. SEE ANNEX F. (EXAMPLES: WILD, ZEISS/JENA, HEWLETT PACKARD).
CC 41-62	TYPE OF INSTRUMENT OR TRADE NAME. SEE ANNEX F. (EXAMPLES; DIRECTION THEODOLITE, CALIB INVAR TAPE, RANGE MASTER, TELLUROMETER).
CC 63-70	MODEL OR CLASS OF INSTRUMENT. SEE ANNEX F. (EXAMPLES: T-3, MA-100, 30-MT, 100-FT).
CC 71-80	SERIAL NUMBER. ALPHANUMERIC AND LEFT JUSTIFIED. LEAVE BLANK IF THE SERIAL NUMBER IS NOT KNOWN.

GPS ANTENNA RECORD (*71*)

Use this record to provide descriptive information for each GPS antenna used in the job. Assign a **unique** three-digit Job-Specific Antenna Number (JSAN) to each GPS antenna used in the project. This record will cross-reference the assigned JSAN to the NGS GPS Antenna Codes found in Annex J. See Chapter 2, pages 2-28 and 2-28a, Survey Equipment Data Records.

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. MUST BE AN INCREMENT OF 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *71*
CC 11-13	JOB SPECIFIC ANTENNA NUMBER (JSAN). MUST BE UNIQUE FOR EACH ANTENNA IN JOB.
CC 14-29	NGS ANTENNA CODE. SEE ANNEX J. USED TO IDENTIFY THE ANTENNA WHICH WAS ASSIGNED THE JSAN IN CC 11-13 ABOVE.
CC 30-41	SERIAL NUMBER. ALPHANUMERIC AND LEFT JUSTIFIED. LEAVE BLANK IF THE SERIAL NUMBER IS NOT KNOWN.
CC 42-53	ANTENNA PHASE PATTERN FILE. SEE PAGE 2-28a.
CC 54-59	SOURCE ORGANIZATION
CC 60-80	BLANK

CONTROL POINT RECORD (*80*)

Use this record for the designation (name) and geographic position in geodetic coordinates (latitude and longitude) of each control point in the project. If the position is given in Universal Transverse Mercator (UTM) coordinates or in State Plane Coordinates (SPC), use the *81* record. The geodetic position of every horizontal control point for which a *80* record is submitted must be provided in order to serve as either a fixed (constrained) position or as a preliminary position in the adjustment of the horizontal control survey project.

NOTE: Although columns 70-75 and column 76 of this record are currently used for recording the elevation and elevation code, NGS may discontinue this in the near future. NGS prefers that you use the new *86* record for this purpose.

For every *80* or *81* record submitted, the elevation of each control point must be provided, except for unmonumented recoverable landmarks positioned by intersection. For such landmarks, the elevation field may be left blank. However, when the elevation of an unmonumented recoverable landmark is given, it should be the ground level elevation and the height above ground level of the point actually sighted should be entered as the height of target on the respective observation record.

The first character of the order and type code indicates the order of accuracy of the main-scheme network in the project. It reflects the surveying methods used, procedures followed and specifications enforced to obtain the observations of the project.

The second character of the order and type code indicates the type of survey scheme of which the control point in question is a part and/or the (primary) surveying method used to position the control point. Refer to pages 2-35 thru 2-38 for additional information.

TABLE OF ELEVATION CODES

CODE	EXPLANATION
A	The control point is a bench mark (BM) in the NGSIDB.
B	BM determined using FGCS/NGS procedures but the **leveling data are not** in the NGSIDB.
C	The control point is a ’posted’ bench mark.
D	OHT determined by datum transformation.
H	OHT determined using FGCS procedures but tied to only one (1) BM.
L	OHT established using NGS leveling RESET procedures.
F	OHT established using fly-leveling.
T	OHT determined by leveling between control points which are not BMs.
R	OHT determined by reciprocal vertical angles.
V	OHT determined by non-reciprocal vertical angles.
P	OHT determined by a photogrammetric method.
M	OHT scaled from a topographic map.
G	**OHT derived from GPS-observed heights with decimeter accuracy.**
J	**OHT derived from GPS-observed heights tied to meter accuracy control.**
K	**OHT derived from GPS-observed heights, according to the 2cm/5cm ellipsoid height standards, and a high resolution national geoid model.**

80 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *80*.
CC 11-14	STATION SERIAL NUMBER (SSN). SEE PAGES 1-1, JOB CODE AND SURVEY POINT NUMBERING AND 2-12, ASSIGNMENT OF STATION SERIAL NUMBERS.
CC 15-44	STATION NAME. MUST NOT EXCEED 30 CHARACTERS. THE NAME OF A HORIZONTAL CONTROL POINT WITH PERIPHERAL REFERENCE MARKS AND/OR AZIMUTH MARKS MUST NOT EXCEED 24 CHARACTERS TO ALLOW FOR ADDING RM 1, RM 2, AND/OR AZ MK TO THE NAME WITHOUT EXCEEDING THE 30 CHARACTER LENGTH LIMIT.
CC 45-55	LATITUDE. DEGREES, MINUTES, SECONDS (DDMMSSsssss).
CC 56	DIRECTION OF LATITUDE. RECORD CODE "N" FOR NORTH OR CODE "S" FOR SOUTH.
CC 57-68	LONGITUDE. DEGREES, MINUTES, SECONDS, (DDDMMSSsssss).
CC 69	DIRECTION OF LONGITUDE. RECORD CODE "E" FOR EAST OR CODE "W" FOR WEST.

NGS PREFERS THAT YOU USE THE NEW *86* RECORD FOR RECORDING THE ELEVATION (ORTHOMETRIC HEIGHT) AND ELEVATION CODE INSTEAD OF THE TWO DATA FIELDS THAT

FOLLOW. REFER TO PAGES 2-83 THRU 2-85.

CC 70-75 ELEVATION. RECORD ELEVATION OF MARK ABOVE MEAN SEA LEVEL. IN METERS (MMMMmm). ENTER THE ELEVATION TO THE NEAREST CENTIMETER (cm). IF MEASUREMENT IS ONLY OBSERVED TO THE NEAREST DECIMETER (dm), LEAVE CC 75 BLANK, IF OBSERVED ONLY TO THE NEAREST METER (M), LEAVE CC 74-75 BLANK. THE APPROPRIATE ELEVATION CODE MUST BE ENTERED IN CC 76. REFER TO PAGES 2-34 and 2-35, ELEVATION AND ELEVATION CODE.

CC 76 ELEVATION CODE.

CC 77-78 STATE OR COUNTRY CODE. IF THE CONTROL STATE IS LOCATED IN THE UNITED STATES/CANADA, ENTER THE CODE FROM ANNEX A FOR THE STATE/PROVINCE OR TERRITORY WHICH CONTAINS THE STATION. IF NOT, ENTER THE CODE FROM ANNEX A FOR THE COUNTRY WHICH CONTAINS THE STATION. SEE ANNEX A.

CC 79-80 STATION ORDER AND TYPE. REFER TO PAGES 2-35 THRU 2-38, STATION ORDER AND TYPE AND SEE ANNEX E.

CONTROL POINT (UTM/SPC) RECORD (*81*)

Use this record for the designation (name) and position in Universal Transverse Mercator (UTM) coordinates or in State Plane Coordinates (SPC) of each control point in the project. If the position is expressed in geodetic latitude and longitude, use the *80* record. The geodetic position of every horizontal control point for which a *81* record is submitted must be provided to serve as either a fixed (constrained) position or as a preliminary position in the adjustment of the horizontal control survey project.

NOTE: Although columns 70-75 and column 76 of this record are currently used for recording the elevation and elevation code, NGS may discontinue this in the near future. NGS prefers that you use the new *86* record for this purpose.

81 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.

CC 07-10 DATA CODE. MUST BE *81*.

CC 11-14 STATION SERIAL NUMBER (SSN). SEE PAGES 1-1, JOB CODE AND SURVEY POINT NUMBERING AND 2-12, ASSIGNMENT OF STATION SERIAL NUMBERS.

CC 15-44 STATION NAME. MUST NOT EXCEED 30 CHARACTERS. THE NAME OF A HORIZONTAL CONTROL POINT WITH PERIPHERAL REFERENCE MARKS AND/OR AZIMUTH MARKS MUST NOT EXCEED 24 CHARACTERS TO ALLOW FOR ADDING RM 1, RM 2, AND/OR AZ MK TO THE NAME WITHOUT EXCEEDING THE 30 CHARACTER LENGTH LIMIT.

CC 45-55 UTM/SPC NORTHING (Y COORDINATE). IN METERS (MMMMMMMMmmm).
CC 56-65 UTM/SPC EASTING (X COORDINATE). IN METERS (MMMMMMMmmm).
CC 66-69 UTM/SPC ZONE CODE.

NGS PREFERS THAT YOU USE THE NEW *86* RECORD FOR RECORDING THE ELEVATION (ORTHOMETRIC HEIGHT) AND ELEVATION CODE INSTEAD OF THE TWO DATA FIELDS THAT FOLLOW. REFER TO PAGES 2-83 THRU 2-85.

CC 70-75 ELEVATION. RECORD ELEVATION OF MARK ABOVE MEAN SEA LEVEL. IN METERS (MMMMmm). ENTER THE ELEVATION TO THE NEAREST CENTIMETER (cm). IF THE MEASUREMENT IS ONLY OBSERVED TO THE NEAREST DECIMETER (dm), LEAVE CC 75 BLANK, IF OBSERVED ONLY TO THE NEAREST METER (M), LEAVE CC 74-75 BLANK. REFER TO PAGES 2-34 and 2-35, ELEVATION AND ELEVATION CODE.
CC 76 ELEVATION CODE.
CC 77-78 STATE OR COUNTRY CODE. IF THE CONTROL STATE IS LOCATED IN THE UNITED STATES/CANADA, ENTER THE CODE FROM ANNEX A FOR THE STATE/PROVINCE OR TERRITORY WHICH CONTAINS THE STATION. IF NOT, ENTER THE CODE FROM ANNEX A FOR THE COUNTRY WHICH CONTAINS THE STATION. SEE ANNEX A.
CC 79-80 STATION ORDER AND TYPE. REFER TO PAGES 2-35 THRU 2-38, STATION ORDER AND TYPE. SEE ANNEX E.

REFERENCE OR AZIMUTH MARK RECORD (*82*)

Use this record to give the name or destination of each reference mark (RM) or azimuth mark (AZ MK). Follow each horizontal control point record, *80* or *81*, with as many *82* records as there are peripheral reference marks and/or azimuth marks associated with the horizontal control point in question. Distance, direction and/or angle observations to an RM or AZ MK must appear among the *20*-series (direction) and/or the 30*-series (angle) and the *50*-series (distance) observation records. Do not submit a *82* record for a RM or AZ MK which is being used as a horizontal control point (i.e., when the RM or AZ MK has an adjusted geodetic position or when the position is to be determined). Instead, submit a *80* or *81* record, identifying the station with a four-digit station serial number (SSN).

Use this record in lieu of the *80* or *81* record for observed horizontal points to which direction, angle, and/or distance observations were made but which (1) cannot be positioned using data of this project alone, and (2) for which a position is not available from other sources.

For submitting unpositionable vertical control points, use the *82* record.

82 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *82*.
CC 11-14 STATION SERIAL NUMBER (SSN). REFER TO PAGES 1-1 THRU 1-3, JOB CODE AND SURVEY POINT NUMBERING AND 2-12 THRU 2-13, ASSIGNMENT OF STATION SERIAL NUMBERS.
CC 15-44 NAME OF RM OR AZ MK. MUST NOT EXCEED 30 CHARACTERS. NORMALLY, THE NAME OF A RM OR AN AZ MK IS COMPOSED BY APPENDING "RM 1", "RM 2", ETC. OR "AZ MK" TO THE NAME OF THE CONTROL (PARENT)

STATION REFERENCED. SEE PAGE 2-32, NAME OR DESIGNATION OF RM OR AZ MK.

CC 45-50 BLANK

CC 51-54 CONTROL STATION (SSN). ENTER THE SSN OF THE CONTROL (PARENT) STATION FOR WHICH THE STATION IDENTIFIED IN CC 11-14 IS A REFERENCE OR AZIMUTH MARK.

CC 55-80 BLANK

BENCH MARK RECORD (*83*)

NGS has discontinued the use of this record. Effective immediately, record this vertical control data in the Orthometric Height, Geoid Height, Ellipsoid Height Record (*86*). See pages 2-83 thru 2-85.

GEOID HEIGHT RECORD (*84*)

NGS has discontinued the use of this record. Effective immediately, record this data, if required, in the Orthometric Height, Geoid Height, Ellipsoid Height Record (*86*). See page 2-83 thru 85.

DEFLECTION RECORD (*85*)

Use this record to give the source and the values of the meridional component (Xi) and/or prime-vertical component (Eta) of the deflection of vertical. The datum must be North American 1983 or as specified on the Datum and Ellipsoid (*13*) record. This record is optional.

85 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *85*.
CC 11-14	STATION SERIAL NUMBER (SSN). HORIZONTAL CONTROL POINT.
CC 15-20	SOURCE. AGENCY OR ORGANIZATION WHICH DETERMINED THE DEFLECTION. USE THE ABBREVIATIONS LISTED IN ANNEX C OR THE ONE SPECIFIED ON THE DATA SET IDENTIFICATION RECORD (*aa*).
CC 21-61	COMMENT. USE THIS SPACE TO CLARIFY THE SOURCE OF THE DEFLECTION INFORMATION.
CC 62	**DEFLECTION MODEL CODE. SEE THE LIST BELOW.**
CC 63-67	MERIDIONAL COMPONENT (Xi) OF THE DEFLECTION OF VERTICAL. IN SECONDS (XXXxx).
CC 68	DIRECTION OF Xi. USE CODE "N" FOR NORTH OR CODE "S" FOR SOUTH.
CC 69-71	SIGMA. ESTIMATED ACCURACY (STANDARD ERROR) OF Xi. IN SECONDS (Xxx).
CC 72-76	PRIME-VERTICAL COMPONENT (Eta) OF THE DEFLECTION OF VERTICAL. IN SECONDS (XXXxx).
CC 77	DIRECTION OF Eta. USE CODE "E" FOR EAST OR CODE "W" FOR WEST.
CC 78-80	SIGMA. ESTIMATED ACCURACY (STANDARD ERROR) OF Eta. IN SECONDS (Xxx).

For a more detailed explanation of the contents of this record see Chapter 2, pages 2-39 and 2-40, Deflection of Vertical.

DEFLECTION MODEL CODES:

Model Name	**Code**
DEFLEC90	**C**
DEFLEC93	**H**
DEFLEC96	**J**
DCAR97	**L**
POST NAD83 180 MODEL	**M**
DMEX97	**N**
NAD83 180 MODEL	**P**
360 MODEL	**Q**
PRE NAD83 DEFLECTION	**T**

ORTHOMETRIC HEIGHT, GEOID HEIGHT, ELLIPSOID HEIGHT RECORD (*86*)

Use this record to give the values of orthometric height, geoid height, and/or ellipsoid height of control points in this project.

For every Control Point Record (*80* or *81*), the orthometric height, commonly referred to as the elevation, of each control point must be provided, **except** for unmonumented recoverable landmarks positioned by intersection. For such landmarks, this record need not be submitted. However, when the elevation of an unmonumented recoverable landmark is given, it should be the orthometric height at ground level , and the height above ground level of the point actually sighted should be entered as the height of target on the respective observation record.

The geoid height and ellipsoid height values are optional, with one exception. The geoid height is required if the orthometric height is determined from GPS observations (code G in the Table of Orthometric Height Codes listed on the following page). If values for the geoid height and/or ellipsoid height are provided, then the associated codes for each are required.

The submitting organization may leave the orthometric height Order and Class code blank. These fields should only be filled if the orthometric height is adjusted and included in the National Geodetic Survey Integrated Database (NGSIDB).

The submitting organization may leave the Orthometric Height (OHT) Code field blank if the orthometric height was obtained from the NGSIDB. The Orthometric Height (OHT) NGSIDB Indicator field must be used to say whether the orthometric height came from the NGSIDB or not.

86 FORMAT

CC 01-06	SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10	DATA CODE. MUST BE *86*.
CC 11-14	STATION SERIAL NUMBER (SSN).
CC 15-16	BLANK
CC 17-23	ORTHOMETRIC HEIGHT. IN METERS (MMMMmmm).
CC 24	ORTHOMETRIC HEIGHT CODE. SEE FOLLOWING TABLES.
CC 25-26	ORTHOMETRIC HEIGHT ORDER AND CLASS. USE PUBLISHED VERTICAL ORDER AND CLASS, OTHERWISE LEAVE BLANK.
CC 27	ORTHOMETRIC HEIGHT NGSIDB INDICATOR. SEE FOLLOWING TABLES.
CC 28-29	ORTHOMETRIC HEIGHT DATUM. SEE FOLLOWING TABLES.
CC 30-35	ORGANIZATION WHICH ESTABLISHED AND/OR MAINTAINS THE ORTHOMETRIC HEIGHT OF THE CONTROL POINT. ENTER THE ABBREVIATION LISTED IN ANNEX C OR ON THE DATASET IDENTIFICATION RECORD.
CC 36-42	GEOID HEIGHT. ABOVE (POSITIVE) OR BELOW (NEGATIVE) THE REFERENCE ELLIPSOID. IN METERS (MMMMmmm).
CC 43	GEOID HEIGHT CODE. SEE FOLLOWING TABLES.
CC 44-45	BLANK.

CC 46-52 ELLIPSOID HEIGHT. IN METERS (MMMMmmm).
CC 53   ELLIPSOID HEIGHT CODE. SEE FOLLOWING TABLES.
CC 54-55 ELLIPSOID HEIGHT ORDER AND CLASS. SEE ANNEX G.
CC 56   ELLIPSOID HEIGHT DATUM.
CC 57-80 COMMENTS.

ORTHOMETRIC HEIGHT (OHT) NGSIDB INDICATOR

CODE	EXPLANATION
Y	OHT OBTAINED FROM THE NGSIDB.
N	OHT IS **NOT** IN THE NGSIDB.

TABLE OF ORTHOMETRIC HEIGHT (OHT) CODES

CODE	EXPLANATION
A	OHT ESTABLISHED USING FGCS LEVELING SPECIFICATIONS AND PROCEDURES, ADJUSTED HEIGHT DETERMINED USING NGS VERTICAL NETWORK BRANCH PROCEDURES, LEVELING DATA IS IN THE NGSIDB.
B	OHT ESTABLISHED USING FGCS LEVELING SPECIFICATIONS AND PROCEDURES, ADJUSTED HEIGHT DETERMINED USING NGS VERTICAL NETWORK BRANCH PROCEDURES, LEVELING DATA IS **NOT** IN THE NGSIDB. (USGS, COE, SOME STATE DOT DATA.)
C	OHT ESTABLISHED USING FGCS LEVELING SPECIFICATIONS AND PROCEDURES, ADJUSTED HEIGHT IS 'POSTED'. SEE EXPLANATION IN THE FOOTNOTE (*) BELOW.
D	OHT ESTABLISHED BY DATUM TRANSFORMATIONS.
H	OHT ESTABLISHED USING FGCS LEVELING SPECIFICATIONS AND PROCEDURES EXCEPT FOR THE TWO-MARK LEVELING TIE REQUIREMENT. (HORIZONTAL FIELD PARTY LEVEL TIES, SOME STATE DOTS, SOME GPS LEVEL TIES.)
L	OHT ESTABLISHED USING LEVELING RESET SPECIFICATIONS AND PROCEDURES.
F	OHT ESTABLISHED BY FLY-LEVELING.
T	OHT ESTABLISHED BY LEVELING BETWEEN CONTROL POINTS WHICH ARE **NOT** BENCH MARKS.
R	OHT ESTABLISHED BY RECIPROCAL VERTICAL ANGLES.
V	OHT ESTABLISHED BY NON-RECIPROCAL VERTICAL ANGLES.
P	OHT ESTABLISHED BY PHOTOGRAMMETRY.
M	OHT ESTABLISHED BY SCALING FROM A CONTOURED MAP.
G	**OHT ESTABLISHED FROM GPS-OBSERVED HEIGHTS WITH DECIMETER ACCURACY.**
J	**OHT ESTABLISHED FROM GPS-OBSERVED HEIGHTS TIED TO METER ACCURACY CONTROL.**
K	**OHT ESTABLISHED FROM GPS-OBSERVED HEIGHTS, ACCORDING TO THE 2CM/5CM ELLIPSOID HEIGHT STANDARDS, AND A HIGH RESOLUTION NATIONAL GEOID MODEL.**

* DATA FOR LEVEL LINES CONTAINING 'POSTED' BENCH MARKS WERE PURPOSELY NOT INCLUDED IN THE NAVD88 GENERAL ADJUSTMENT. SUBSEQUENTLY, THESE DATA WERE ADJUSTED TO NAVD88 BY FORCING THEM TO FIT THE EXISTING NAVD88 GENERAL ADJUSTMENT HEIGHTS.

TABLE OF ORTHOMETRIC HEIGHT (OHT) DATUMS

CODE	EXPLANATION
29	NATIONAL GEODETIC VERTICAL DATUM OF 1929

88	NORTH AMERICAN VERTICAL DATUM OF 1988
55	INTERNATIONAL GREAT LAKES DATUM OF 1955
85	INTERNATIONAL GREAT LAKES DATUM OF 1985
00	ANY OTHER DATUM. SPECIFY IN COMMENTS.

TABLE OF GEOID HEIGHT (GHT) CODES

CODE	EXPLANATION
P	OSU78 GEOID MODEL
Q	OSU86F GEOID MODEL
B	OSU89B GEOID MODEL
C	GEOID90 GEOID MODEL
D	GEOID93 GEOID MODEL
E	**GEOID96 GEOID MODEL**
F	**G96SSS GEOID MODEL**
G	**EGM96 GEOID MODEL**
H	**CARIBBEAN GEOID MODEL**
J	**MEXICO97 GEOID MODEL**

TABLE OF ELLIPSOID HEIGHT (EHT) CODES

CODE	EXPLANATION
A	EHT DETERMINED BY GPS IN A HIGH PRECISION GEODETIC NETWORK OR TIED TO A HIGH PRECISION GEODETIC NETWORK (HPGN).
B	EHT DETERMINED BY GPS **NOT** TIED TO A HPGN.
C	EHT DETERMINED BY ADDING A GEOID HEIGHT TO AN ORTHOMETRIC HEIGHT WITH AN OHT CODE OF A, B, C, F, H, OR L.
D	EHT DETERMINED BY ADDING A GEOID HEIGHT TO AN ORTHOMETRIC HEIGHT WITH AN OHT CODE OF G, R, OR T.
E	EHT DETERMINED BY ADDING A GEOID HEIGHT TO AN ORTHOMETRIC HEIGHT WITH AN OHT CODE OF V, M, P, OR D.

TABLE OF ELLIPSOID HEIGHT (EHT) DATUMS

CODE	EXPLANATION
A	NORTH AMERICAN DATUM OF 1983
B	INTERNATIONAL TERRESTRIAL REFERENCE FRAME OF 1989
C	NATIONAL EARTH ORIENTATION SERVICE (NEOS ANNUAL REPORT FOR 1990)
D	**INTERNATIONAL TERRESTRIAL REFERENCE FRAME OF 1994 (ITRF 94)**
E	**INTERNATIONAL TERRESTRIAL REFERENCE FRAME OF 1996 (ITRF 96)**
Z	ANY OTHER DATUM. SPECIFY IN COMMENTS.

FIXED CONTROL RECORD (*90*)

Use this record to identify previously established horizontal control points contained in the NGS Data Base, from which and/or to which horizontal control was extended in this project. Two or more fixed control points are expected in a horizontal control survey project. But, if only one previously established horizontal control point is identified as fixed, scale and orientation must be provided by *50*-series (distance) and *60*-series (azimuth) records.

90 FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *90*.
CC 11-14 STATION SERIAL NUMBER (SSN). ESTABLISHED HORIZONTAL CONTROL POINT.
CC 15-20 SOURCE. AGENCY OR ORGANIZATION WHICH DETERMINED THE COORDINATES. USE THE ABBREVIATIONS LISTED IN ANNEX C OR THE ONE ON THE DATA SET IDENTIFICATION RECORD (*aa*).
CC 21-74 COMMENT. IF THE NAME OF THE ORGANIZATION WHICH DETERMINED THE FIXED COORDINATES DOES NOT APPEAR IN ANNEX C OR ON THE DATA SET IDENTIFICATION RECORD, GIVE THE FULL NAME OF THE ORGANIZATION IN THIS SPACE. OTHERWISE, USE THIS SPACE FOR COMMENTS PERTINENT TO THE CONTROL POINT.
CC 75-80 NGS CONTROL NUMBER. LEAVE BLANK UNLESS THIS NUMBER IS OBTAINED FROM THE NGS. CODE THE LETTER "G" IN CC 75.

DATA SET TERMINATION RECORD (*aa*)

The last record in a Horizontal Observation Data set must be the Data Set Termination Record. The job code used in this record must be identical to the job code in the Data Set Identification Record, the first record in the Horizontal Observation Data Set (HZTL OBS), and identical to the job code used in both the Data Set Identification Record and the Data Set Termination Record of the Geodetic Control Point Descriptive Data Set (GEOD DESC). **This record is required.**

aa FORMAT

CC 01-06 SEQUENCE NUMBER. RIGHT JUSTIFIED.

CC 07-10 JOB CODE. MUST BE *aa*. THE SYMBOL "aa" DENOTES THE
TWO-CHARACTER JOB CODE ASSIGNED BY THE SUBMITTING ORGANIZATION.

CC 11-80 BLANK

For a more detailed explanation of the contents of the record see Chapter 1, page 1-1, JOB CODE AND POINT NUMBERING and Chapter 2, pages 2-1 thru 2-3, HZTL OBS DATA SET RECORDS.

FORMAT DIAGRAMS APPEAR ON THE
REMAINING PAGES OF THIS CHAPTER

HORIZONTAL OBSERVATION DATA SET RECORDS

DATA SET IDENTIFICATION RECORD

Columns	Field
1–6	**SEQUENCE NUMBER**
7–10	**JOB CODE**
11–14	**DATA CLASS**
15–18	**DATA TYPE**
19–24	**ORGANIZATION ABBREVIATION (See Annex C)**
25–46	SUBMITTING ORGANIZATION NAME
47–66	SUBMITTING ORGANIZATION NAME CONTINUED
67–72	BLANK
73–80	**Y Y Y Y M M D D DATE CREATED**

---

10 PROJECT TITLE RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–45	**PROJECT TITLE**
46–80	**PROJECT TITLE CONTINUED**

---

11 PROJECT TITLE CONTINUATION RECORD (OPTIONAL)

Columns	Field
1–6	SEQUENCE NUMBER (INC BY 10)
7–10	DATA CODE
11–45	PROJECT TITLE CONTINUATION
46–80	PROJECT TITLE CONTINUATION

12 PROJECT INFORMATION RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–16	**Y Y Y Y M M DATE FIELD OBS BEGAN**
17–22	**Y Y Y Y M M DATE FIELD OBS ENDED**
23–25	INITIALS C OF P
26–43	FULL NAME CHIEF OF PARTY (FIRST)
44–46	INITIALS C OF P
47–64	FULL NAME CHIEF OF PARTY (SECOND)
65–75	BLANK
76	**TYPE SURVEY**
77	**STATE/ COUNTRY CODE**
79	**SURVEY ORDER AND CLASS**

----

13 GEODETIC DATUM AND ELLIPSOID RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–34	**DATUM NAME**
35–50	**ELLIPSOID NAME**
51–57 . 58–60	**M M M M M M M . m m m SEMI-MAJOR AXIS (METERS)**
61–63 . 64–70	**X X X . x x x x x x x INVERSE FLATTENING (1/f)**
71–77 . 78–80	**M M M M M M M . m m m SEMI-MINOR AXIS (METERS)**

20 HORIZONTAL DIRECTION SET RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN INST.**
15	**SET NO.**
17–22	FIELD RECORD BOOK NO.
23	**NO. OF TARGETS SIGHTED**
25–29	WEATHER CODE
30–32	OBSERVER INITIALS
33–35	**JSIN**
36–39	M M . m m H.I. (METERS)
40–45	**Y Y M M D D DATE OF OBS.**
46–49	H H M M TIME
50	ZONE CODE
51–54	**SSN TARGET**
55–58	M M . m m H.T. (METERS)
59	VISIBILITY CODE
60	**NO. OF REP.**
63	S S REJECTION LIMIT (SECONDS)
64–71	**D D D M M S S . s s INITIAL DIRECTION**
73–76	S S . s s INT. SIGMA (SECONDS)
77–80	S S . s s EXT. SIGMA (SECONDS)

---

21 HORIZONTAL DIRECTION COMMENT RECORD (OPTIONAL)

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–45	COMMENT(S)
46–80	COMMENT(S) CONTINUED

22 HORIZONTAL DIRECTION RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN INST.**
15	**SET NO.**
17–45	BLANK
46–49	H H M M TIME
50	ZONE CODE
51–54	**SSN TARGET**
55–58	M M . m m H.T. (METERS)
59	VISIBILITY CODE
60	**NO. OF REP.**
62	S S REJ LIMIT
64–70, 71	**D D D M M S S . s s CLOCKWISE DIRECTION**
73–76	S S . s s INT. SIGMA (SECONDS)
77–80	S S . s s EXT. SIGMA (SECONDS)

25 GPS OCCUPATION HEADER RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN**
15–24	**DATA MEDIA IDENTIFIER**
25–27	**OBSERVER'S INITIALS**
28–30	**INSTRUMENT NUMBER**
31–32	**CABLE LENGTH**
33–80	BLANK

---

26 GPS OCCUPATION COMMENT RECORD (OPTIONAL)

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–45	COMMENT
46–80	CONTINUED COMMENT

---

27 GPS OCCUPATION MEASUREMENT RECORD

Columns	Format	Field
1–6		**SEQUENCE NUMBER (INC BY 10)**
7–10		**DATA CODE**
11–14		**SSN**
15–20	**Y Y M M D D**	**OBSERVATION DATE**
21–24	**H H M M**	**OBSERVATION TIME**
25–29	**X X . x x x**	**ANTENNA HEIGHT (METERS)**
30–33	**X X X . x**	**DRY BULB TEMPERATURE**
34		**DRY BULB TEMPERATURE CODE**
35–38	**X X X . x**	**WET BULB TEMPERATURE**
39		**WET BULB TEMPERATURE CODE**
40–42	**X X . x**	**RELATIVE HUMIDITY**
43–47	**X X X X . x x**	**BAROMETRIC PRESSURE**
49		**PRESSURE CODE**
51–55		**WEATHER CODE**
56–80		BLANK

28 GPS CLOCK SYNCHRONIZATION RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–16	**Y Y M M D D SYNCHRONIZATION DATE**
17–20	**H H M M SYNCHRONIZATION TIME**
21–23	**INSTRUMENT NUMBER A**
24–26	**INSTRUMENT NUMBER B**
27–31	BLANK
32–36	**X X X . x x TIMING DIFFERENCE (MICROSECONDS)**
37	INTEGER TIME SECOND SYNCH Y OR N
38–40	OBSERVER'S INITIALS
41–80	BLANK

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29 GPS CLOCK SYNCHRONIZATION COMMENT RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–45	COMMENT
46–80	CONTINUED COMMENT

30 HORIZONTAL ANGLE SET RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN INST.**
15	**SET NO.**
17–22	FIELD RECORD BOOK NUMBER
23	**NO. OF ANGLES OBSERVED**
25–29	WEATHER CODE
30–32	OBSERVER INITIALS
33–35	**JSIN**
36–39	M M . m m H.I. (METERS)
40–45	**Y Y M M D D DATE OF OBS.**
46–49	H H M M TIME
50	ZONE CODE
51–54	**SSN FIRST TARGET**
55–58	M M . m m H.T (METERS)
59	VISIBILITY CODE
60	**NO. OF REPL.**
62	S S REJECTION LIMIT (SECONDS)
64–71	**D D D M M S S . s CLOCKWISE ANGLE**
72–75	**SSN SECOND TARGET**
76–79	M M . m m H.T. (METERS)
80	VISIBILITY CODE

---

31 HORIZONTAL ANGLE COMMENT RECORD (OPTIONAL)

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–45	COMMENT(S)
46–80	COMMENT(S) CONTINUED

32 HORIZONTAL ANGLE RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN INST.**
15	**SET NO.**
17–45	BLANK
46–49	H H M M TIME
50	ZONE CODE
51–54	**SSN FIRST TARGET**
55–58	M M . m m H.T. (METERS)
59	VISIBILITY CODE
60	**NO. OF REP.**
62	S S REJECTION LIMIT (SECONDS)
64–71	**D D D M M S S . s CLOCKWISE ANGLE**
72–75	**SSN SECOND TARGET**
76–79	M M . m m H.T. (METERS)
80	VISIBILITY CODE

40 VERTICAL ANGLE SET RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN INST.**
15	**SET NO.**
17–22	FIELD RECORD BOOK NUMBER
23	**NO. OF VAs/ZDs OBSERVED**
25–29	WEATHER CODE
30–32	OBSERVER INITIALS
33–35	**JSIN**
36–39	**M M . m m H.I. (METERS)**
40–45	**Y Y M M D D DATE**
46–49	H H M M TIME
50	ZONE CODE
51–54	**SSN TARGET**
55–58	**M M . m m H.T. (METERS)**
59	VISIBILITY CODE
60	**NO. OF REP.**
62	S S REJ. LIMIT (SECONDS)
64–71	**D D D M M S S . s VA OR ZD OBSERVATION**
72	ANGLE CODE
73–76	S S . s s INT. SIGMA (SECONDS)
77–80	S S . s s EXT. SIGMA (SECONDS/KM)

---

41 VERTICAL ANGLE COMMENT RECORD (OPTIONAL)

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–45	COMMENT(S)
46–80	COMMENT(S) CONTINUED

42 VERTICAL ANGLE RECORD

1–6	7–10	11–14	15	17–45	46–49	50	51–54
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN INST.**	**SET NO.**	BLANK	H H M M TIME	ZONE CODE	**SSN TARGET**

55–58	59	60	62	64–71	72	73–76	77–80
M M . m m H.T. (METERS)	VISIBILITY CODE	**NO. OF REP.**	S S REJECTION LIMIT (SECONDS)	**D D D M M S S . s VA/ZD OBSERVATION**	**ANGLE CODE**	S S . s s INT. SIGMA (SECONDS)	S S . s s EXT. SIGMA (SECONDS/KM)

45 OBSERVED DIFFERENCE OF ELEVATION RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN INST.**
15–16	BLANK
17–22	FIELD RECORD BOOK NUMBER
23–24	BLANK
25–29	WEATHER CODE
30–32	OBSERVER INITIALS
33–35	**JSIN**
36–38	NO. OF SETUPS
39	BLANK
40–45	**Y Y M M D D DATE OF OBS.**
46–49	H H M M TIME
50	ZONE CODE
51–54	**SSN TARGET**
55–58	BLANK
59	VISIBILITY CODE
60–61	**NO. OF REP.**
62–63	BLANK
64–72	**M M M M M . m m m m DIFF. OF ELEVATION (METERS)**
73–76	X X . x x LEVELING SIGMA (MILLIMETERS)
77–80	X X . x x LENGTH OF SECTION (KILOMETERS)

---

46 DIFFERENCE OF ELEVATION COMMENT RECORD (OPTIONAL)

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–40	COMMENT(S)
41–80	COMMENT(S) CONTINUED

47 OBSERVED DIFFERENCE OF ELEVATION CONTINUATION RECORD

1–6	7–10	11–14	15–45
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN INST.**	BLANK

46–54	55–57	58–63	64–80
BLANK	**JSIN LEVEL ROD**	OBSERVING ORGANIZATION ABBREVIATION	BLANK

50 TAPED DISTANCE RECORD

1–6	7–10	11–14	15–19	20–22	23–25	26–29	30–34	35–40
						M M . m m	M M M M . m	**Y Y M M D D**
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN INST.**	WEATHER CODE	OBSERVER INITIALS	**JSIN**	**TAPE SUPPORT HEIGHT (METERS)**	STATION ELEV. (METERS)	**DATE OF OBS.**

41–44	45	46–49	50–53	54–58	59	60–61	62–63	64–72
H H M M			**M M . m m**	**M M M . m m**			X X	**M M M M M . m m m m**
TIME	ZONE CODE	**SSN TARGET**	**TAPE SUPPORT HEIGHT (METERS)**	**ELEVATION DIFFERENCE (METERS)**	VISIBILITY CODE	**NO. OF REP.**	REJECTION LIMIT (mm)	**CORRECTED TAPED DISTANCE (METERS)**

73	74–76	77–80
	X X . x	X X X . x
DIST. CODE	INT. SIGMA (mm)	EXT. SIGMA (ppm)

---

51 UNREDUCED DISTANCE RECORD

1–6	7–10	11–14	15–19	20–22	23–25	26–29	30–34	35–40
						M M . m m		**Y Y M M D D**
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN INST.**	WEATHER CODE	OBSERVER INITIALS	**JSIN**	**H.I. (METERS)**	BLANK	**DATE OF OBS.**

41–44	45	46–49	50–53	54–58	59	60–61	62–63	64–72
H H M M			**M M . m m**				X X	**M M M M M . m m m m**
TIME	ZONE CODE	**SSN TARGET**	**H.T.**	BLANK	VISIBILITY CODE	**NO. OF REP.**	REJECTION LIMIT (mm)	**CORRECTED SLANT RANGE DISTANCE (METERS)**

73	74–76	77–80
	X X . x	X X X . x
DIST. CODE	INT. SIGMA (mm)	EXT. SIGMA (ppm)

52 REDUCED DISTANCE RECORD

Columns	Format	Field
1–6		**SEQUENCE NUMBER (INC BY 10)**
7–10		**DATA CODE**
11–14		**SSN INST.**
15–19		WEATHER CODE
20–22		OBSERVER INITIALS
23–25		**JSIN**
26–29	**M M M . m**	**G.H. (METERS)**
30–34	**M M M M . m**	**MARK ELEV. (METERS)**
35–40	**Y Y M M D D**	**DATE OF OBS.**
41–44	H H M M	TIME
45		ZONE CODE
46–49		**SSN TARGET**
50–53	**M M M . m**	**G.H. (METERS)**
54–58	**M M M M . m**	**MARK ELEV. (METERS)**
59		VISIBILITY CODE
60–61		**NO. OF REP.**
62–63	X X	REJECTION LIMIT (mm)
64–72	**M M M M M . m m m m**	**REDUCED DISTANCE (METERS)**
73		**DIST CODE**
74–76	X X . x	INT. SIGMA (mm)
77–80	X X X . x	EXT. SIGMA (ppm)

---

53 UNREDUCED LONG LINE RECORD

Columns	Format	Field
1–6		**SEQUENCE NUMBER (INC BY 10)**
7–10		**DATA CODE**
11–14		**SSN INST.**
15–22		BLANK
23–25		**JSIN**
26–29	**M M . m m**	**H.I. (METERS)**
30–34		BLANK
35–40	**Y Y M M D D**	**DATE OF OBS.**
41–44	H H M M	TIME
45		ZONE CODE
46–49		**SSN TARGET**
50–53	**M M . m m**	**H.T. (METERS)**
54–58		BLANK
59–60		**NO. OF REP.**
61–63	M M . m	REJECTION LIMIT (METERS)
64–73	**M M M M M M M . m m m**	**CORRECTED SPATIAL CHORD DISTANCE (METERS)**
74		**DIST CODE**
75–77	X . x x	INT. SIGMA (mm)
78–80	X . x x	EXT. SIGMA (ppm)

54 REDUCED LONG LINE RECORD

Columns	Format	Field
1–6		**SEQUENCE NUMBER (INC BY 10)**
7–10		**DATA CODE**
11–14		**SSN INST.**
15–22		BLANK
23–25		**JSIN**
26–29	**M M M . m**	**G.H. (METERS)**
30–34	**M M M M . m**	**MARK ELEV. (METERS)**
35–40	**Y Y M M D D**	**DATE OF OBS.**
41–44	H H M M	TIME
45		ZONE CODE
46–49		**SSN TARGET**
50–53	**M M M . m**	**G.H. (METERS)**
54–58	**M M M M . m**	**MARK ELEV. (METERS)**
59–60		**NO. OF REP.**
61–63	M M . m	REJECTION LIMIT (METERS)
64–73	**M M M M M M M . m m m**	**REDUCED DISTANCE (METERS)**
74		**DIST CODE**
75–77	M . m m	INT. SIGMA (mm)
78–80	M . m m	EXT.SIGMA (ppm)

---

55 DISTANCE COMMENT RECORD (OPTIONAL)

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–40	COMMENT(S)
41–80	COMMENT(S) CONTINUED

60 ASTRONOMIC AZIMUTH / LAPLACE RECORD

1 – 6	7 – 10	11 – 14	15 – 17	18	19	20	21 – 29	30 – 32	33 – 35	36 – 37	38 – 39
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN INST.**	**S S S**	**. s**	**DIR.. OF ETA (E OR W)**	**COMP. CODE (A or L)**	BLANK	OBSERVER INITIALS	**JSIN**	M M	. m m
			ETA (SECONDS)							H.I. (METERS)	

40 – 45	46 – 49	50	51 – 54	55 – 56	57 – 58	59	60 – 61	62 – 63	64 – 70	71	72
Y Y M M D D	H H M M	ZONE CODE	**SSN TARGET**	M M	. m m	VISIBILITY CODE	**NO. OF REP.**	S S	**D D D M M S S**	**. s**	**ORIG. OF AZ. (N/S)**
DATE OF OBS.	TIME			H.T. (METERS)				REJECTION LIMIT (SECONDS)	**AZIMUTH OBSERVED**		

73 – 74	75 – 76	77 – 78	79 – 80
S S	. s s	S S	. s s
INT. SIGMA (SECONDS)		EXT. SIGMA (SECONDS)	

----

61 GEODETIC AZIMUTH RECORD

1 – 6	7 – 10	11 – 14	15 – 50	51 – 54	55 – 63
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN INST.**	BLANK	**SSN TARGET**	BLANK

64 – 70	71	72	73 – 80
D D D M M S S	**. s**	**ORIG. OF AZ. (N/S)**	BLANK
GEODETIC AZIMUTH			

70 INSTRUMENT RECORD

1–6	7–10	11–13	14–16	17–20	21–22	23–40
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**JSIN**	**EQUIPMENT CODE**	**X X . x x INSTRUMENT RESOLUTION**	**UNITS**	INSTRUMENT MANUFACTURER

41–62	63–70	71–80
TYPE OF INSTRUMENT OR TRADE NAME	MODEL OF INSTRUMENT	SERIAL NUMBER

---

71 GPS ANTENNA RECORD

1–6	7–10	11–13	14–29	30–41
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**JSAN**	**NGS ANTENNA CODE**	SERIAL NUMBER

42–53	54–59	60–80
ANTENNA PHASE PATTERN FILE	**SOURCE**	BLANK

80 CONTROL POINT RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN**
15–44	**STATION NAME**

Use *86* Record (columns 69–76)

Columns	Format	Field
45–55	D D M M S S . s s s s s	**LATITUDE**
56		**DIR. OF LAT. (N/S)**
57–68	D D D M M S S . s s s s s	**LONGITUDE**
69		**DIR. OF LONG. (E/W)**
70–75	M M M M . m m	**ELEVATION (METERS)**
76		**ELEV. CODE**
77–78		**STATE CODE**
79		**STA. ORDER**
80		**STA. TYPE**

---

81 CONTROL POINT RECORD (SPC/UTM)

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN**
15–44	**STATION NAME**

Use *86* Record (columns 70–76)

Columns	Format	Field
45–55	M M M M M M M M . m m m	**Y-COORDINATE (NORTHING) (METERS)**
56–65	M M M M M M M . m m m	**X-COORDINATE (EASTING) (METERS)**
66–69		**SPC/UTM ZONE**
70–75	M M M M . m m	**ELEVATION (METERS)**
76		**ELEV. CODE**
77–78		**STATE CODE**
79		**STA. ORDER**
80		**STA. TYPE**

82 REFERENCE OR AZIMUTH MARK RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN**
15–44	**STATION NAME**
45–50	BLANK
51–54	**SSN CONTROL STATION**
55–80	BLANK

---

83 BENCH MARK RECORD

NGS has discontinued the use of this record. Effective immediately, record this vertical control data in the Orthometric Height, Geoid Height, Ellipsoid Height Record (*86*) format diagram.

84 GEOID HEIGHT RECORD (OPTIONAL)

NGS has discontinued the use of this record. Effective immediately, record this data, if required, in the Orthometric Height, Geoid Height, Ellipsoid Height Record (*86*) format diagram.

85 DEFLECTION RECORD (OPTIONAL)

1–6	7–10	11–14	15–20	21–45
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN**	SOURCE ORGANIZATION	COMMENT(S)

46–61	62	63–67	68	69–71	72–76	77	78–80
COMMENT(S) CONTINUED	DEFL CODE	**S S S . s s XI (SECONDS)**	**DIR. OF XI (N/S)**	S . s s SIGMA OF XI (SECONDS)	**S S S . s s ETA (SECONDS)**	**DIR. OF ETA (E/W)**	S . s s SIGMA OF ETA (SECONDS)

---

86 ORTHOMETRIC / ELLIPSOID / GEOID HEIGHT RECORD (OPTIONAL)

1–6	7–10	11–14	15–16	17–23	24	25	26	27	28–29
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	**SSN**	BLANK	**M M M M . m m m ORTHOMETRIC HEIGHT (METERS)**	**OHT CODE**	OHT ORDER	OHT CLASS	OHT NGSIDB INDICATOR	OHT DATUM

30–35	36–42	43	44–45	46–52	53	54	55	56
ORGANIZATION	M M M M . m m m GEOID HEIGHT (GHT) (METERS)	GHT CODE	BLANK	M M M M . m m m ELLIPSOID HEIGHT (METERS)	EHT CODE	EHT ORDER	EHT CLASS	EHT DATUM

57–80
COMMENT

90 FIXED CONTROL RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–14	**SSN**
15–20	SOURCE ORGANIZATION
21–45	COMMENT(S)
46–74	COMMENT(S) CONTINUED
75	"G"
76–80	X X X X X NGS SOURCE NUMBER

DATA SET TERMINATION RECORD

Columns	Field
1–6	**SEQUENCE NUMBER (INC BY 10)**
7–10	**DATA CODE**
11–80	BLANK

CHAPTER 3

GEODETIC CONTROL DESCRIPTIVE (GEOD DESC) DATA

INTRODUCTION

The purpose of the description of a survey point is to convey to the next user, in a concise and standard manner, information sufficient to locate and positively identify the survey point, and to record its suitability for various uses.

This chapter gives detailed instructions for the entry and interpretation of descriptive information for survey points of all types. A survey point (or station) may be a monumented control point, a reference mark or azimuth mark, a landmark, or a temporary, auxiliary, or eccentric point. A description must be submitted for every recoverable survey point which is observed in a project, and for each of its peripheral points (if it has any). A collection of these descriptions constitutes the GEOD DESC data set which must accompany any submitted project. Descriptions can also be submitted independently for miscellaneous recoveries of monumented points already present in the NGS data base.

NGS has begun the distribution of descriptions from the data base for use in the field. These descriptions can easily be modified to make them current, and can then be resubmitted as complete recovery descriptions. This practice will greatly improve the quality of descriptions available from the NGS data base, and will save work in the long run.

WRITING DESCRIPTIONS

A separate description is to be written for each monumented survey point, be it a "main" station, a reference mark, or azimuth mark. "Underground" marks are an exception. When a control point has reference marks which are included in the NGS data base, or are monumented well enough to carry geodetic control themselves, each is to have its own separate description. The descriptive text for each mark in such a group would include location references from the other marks in the group. Such a location reference to the described mark from a second mark would identify the second mark by agency and designation, and would not include a description of the second mark. Peripheral marks, points, or objects which are not included in the NGS data base and are not suitable for holding control need not be separately described. In this case a short descriptive phrase may be included in the location reference to the described mark from that object, if necessary.

When new text is submitted for a recovered mark, it must be complete in itself as if it were for an original description. **Text which merely amends a previous description will no longer be allowed for recovered marks used in a project.** Now that descriptions from the data base are being distributed in the same format in which they are collected, the previous description can simply be edited as necessary. If no editing is necessary (that is, if the description which was distributed from the data base is still current, is complete, and is a single report), the mark may be reported "recovered as described", and no new text need be submitted.

A six-character Permanent Identifier (PID, formerly known as ACRN) now serves as the primary means for matching recovery description data against the data base for marks known to NGS. Where the PID is known, it must be entered in the description. A mark newly set or new to NGS will not have a PID until it is loaded into the data base. Any description without a PID must be complete.

STRUCTURE OF THE GEOD DESC DATA SET

Descriptive data are organized into 80-column fixed-format records. The record type is identified by a code in columns 7-10 of each description record. Most descriptions must contain records coded *10*, *13*, *20*, *26*, and *30* and may also contain records coded *15*, *28*, and *29*. Specific locations within the records are reserved for the different data fields. Detailed explanations of the fields in each record type appear later in this chapter. All alphanumeric fields must be left-justified. All numeric data must be right-justified and zero filled. All alphabetic characters must be entered in upper case (capitals) only.

The first and last records of the data set (the Data Set Identification Record and the Data Set Termination Record) display the two-character alphanumeric job code preceded and followed by an asterisk in the field normally occupied by the first data code (columns 7-10). Unless a job code is specifically assigned to a project by NGS, this job code may be sequentially assigned (*A1*,*A2*,...*ZZ*) by the submitting agency. Other fields in the identification record include the name of the submitting agency and the date the data set was created. Detailed format definition of this record can be found on the first page of the format diagram section. In every record of the data set, columns 1 through 6 are reserved for a record sequence number.

Each description in a file is identified by its station serial number (SSN). The SSN is a unique four-digit number assigned to each mark in a project. It is given in the *10* record which begins the block of records for that station. Sample data sets appear at the end of the chapter, before the format diagrams.

RECORD DEFINITIONS

Each record type and the acceptable entries for each data field are explained in the following paragraphs. Diagrams of the formats are found at the end of the chapter.

TITLE AND COMMENT RECORDS

These records, if used, must appear immediately after the data set identification record.

CODE *00*, *01*, *02*, *03*, *04* (PROJECT AND TITLE INFORMATION RECORDS)

These records are optional, and each can occur only once. Usage may vary. They may correspond to the *10* and *11* records in the horizontal observation data set documented in chapter 2, or to the *10* through *14* records in the vertical observation data set documented in volume II, chapter 6. When data are exported from the NGS data base, these records may indicate this, and give information about what marks are included. Do not split words between these records.

CODE *05* (COMMENT RECORD) (optional)

Comment records may contain additional text describing the data set or the project. Up to 11 are allowed. Again, do not split words between records.

DESCRIPTION RECORDS

CODE *10* (STATION LOCATION RECORD)

This first record primarily contains information pertinent to station location. The individual entries made in this record are as follows:

Station Serial Number (SSN) [CC 11-14] - This four-digit numeric field is the project-specific link between descriptive and observational data. The field must be unique for each station residing in the descriptive and observational data sets. Recovery descriptions for stations not included in the observational data set may reside in the description data set, but in no case should their station serial numbers correspond to station serial numbers in the companion observation data set.

DR Code [CC 15] - This one-character code indicates whether this description is an original description or a recovery description. The allowable entries are "D" and "R".

ENTRY	DEFINITION
D	An original description of a newly set mark.
R	Everything else (includes recovered, not recovered, destroyed, and the first report to NGS of a pre-existing mark not in the NGS data base).

Recovery Type Code (optional) [CC 16] - This one-character code provides additional information about the type of recovery description being included in the description data set. It is used only when the DR Code = "R". The allowable entries are:

ENTRY	DEFINITION
F	A full recovery description of a survey point which you think is not included in the NGS Data Base.
M	A recovery description which does not contain a complete textual description of the mark, but **may** contain updates or modifications to the most current description. This is used when a mark is **destroyed or not recovered**, or when the text of the previous description of this mark in the NGS data base requires no update (i.e., the text is in accord with current practice, and the situation at the mark has not changed).
T	A complete re-description of a mark which is included in the NGS data base.

Note: The practice of submitting recovery notes for stations used in a project which give only text modifications to a previous description is no longer permitted.

Approximate Position [CC 17-31] - The approximate geographic position in degrees, minutes, and the nearest whole seconds of latitude and longitude must be entered. The latitude [CC 17-23] must begin with a hemisphere code (N=NORTH, S=SOUTH) and the longitude [CC 24-31] must begin with the direction-letter "W" . Leading zeros must be entered where appropriate. If no other source is available, the point should be carefully plotted on the largest scale topographic map available and the respective latitude and longitude extracted therefrom. **Latitude and longitude are required under all circumstances.**

Approximate Height [CC 32-36] - An estimated height of the geodetic control point is entered here. If no other source is available, the height may be estimated by examining contour lines on the largest scale topographic map available on which the point is plotted. The entry should be made to the nearest whole unit of measurement used. The unit of measurement (M=METERS, F=FEET) is also recorded [CC 37].

Quad Identifier (Quadrangle or QID) (optional) [CC 39-45] - This was at one time part of the primary identification system adopted by the National Geodetic Survey Data Base for control points. The new Datum has rendered it obsolete. It will be phased out, but is still provided as a convenience in the interim. It is based on 1°x 1° "quads" defined by integer-degree latitude and longitude gridlines (parallels and meridians) and on successive quadrangle subdivision of the basic 1°x 1° quads into 30'x 30' quads, 15'x 15' quads, and 7½'x 7½' quads accomplished by successive halving of the latitude and longitude gridline intervals. For description purposes, only the 30' quad identifier will be recorded. This quad identifier is a seven-character symbol coded as HLLWWWA, where:

H=Hemisphere (N for Northern, S for Southern)
LL=Latitude of SE corner of the 1°x 1° quad (00°-89°N, 01°-90°S)
WWW=Longitude of SE corner of the 1°x 1° quad (000°-359°W)
A=30' subdivision indicator (1-NE,2-SE,3-SW,4-NW subquad)

Note that for some marks the Quad value based on the NAD 83 position will not be the same as the traditional Quad value based on the NAD 27 position. It is these latter values which were once published.

Figure 3-1 depicts this scheme in graphic format.

```
                                                     31
DEGREES
    ┌────────────────────────┬──────────────────────┐
    │                        │          |     |     
X──┼──>POINT TO BE                                
    │                        │          |.....1.....|
IDENTIFIED
    │                        │          |     |     │
    │           4            ├──  ──  ──1──  ──  ── │
    │                        │          |           │
    │                        │          |           │
    │                        │          |           │
    │                        │          |           │
    ├────────────────────────┼──────────────────────┤ 30 DEG
30 MIN
    │                        │                      │
    │                        │                      │
    │           3            │          2           │
    │                        │                      │
    │                        │                      │
    └────────────────────────┴──────────────────────┘ 30
   110 DEGREES                                     109

                                                QID =│N 3 0
1 0 9 1│1 1

└───────v───────┘
                                                         30
Minute Quad
               30 Minute indicator
Identifier
```

30 Minute indicator

Numbers describe 30 minute area in clockwise direction.

Number range (1 thru 4)

15 Minute indicator
Division shown by dashed lines
Numbering same as 30 minute sequence.

7.5 Minute indicator
Division shown by dotted line
Numbering same as 30 minute sequence.

FIGURE 3-1 - QUAD IDENTIFIER.

State or Country Code [CC 47-48] - This is a two-letter code which indicates the political unit and/or geographic area in which the control point is located. For points in the United States or Canada, enter the appropriate code for the respective state, commonwealth, province, or territory. For points outside the United States or Canada, enter the appropriate code for the respective country, island group, or geographic area. A complete list of the two-letter codes is given in ANNEX A.

County [CC 49-68] - For points in the United States or Puerto Rico, enter the name of the county or equivalent in which the control point is located. The name of an independent city must be preceded by the prefix "C OF" (i.e., C OF RICHMOND for RICHMOND, VA). For points in other countries, leave the field blank.

Special Application Codes [CC 69-72] - Up to four alpha characters, left justified, are allowed in this field. These characters represent certain specialized information about the control point. All entries must be selected from the following list:

ENTRY	DEFINITION
F	Fault monitoring site
P	Site determined suitable for receiving satellite signals in connection with geodetic surveys
O	Other (see descriptive text)
T	Tidal station
N	Site not suitable for receiving satellite signals

Permanent Identifier (PID) (optional) [CC 73-78] - The PID is now the primary identification system used by NGS for control points. For a mark that had an ACRN, the ACRN is now the PID. The PID is a unique six-character identifier assigned to every monumented, recoverable survey point residing in the National Geodetic Survey Data Base. For an existing point, the PID assigned by NGS must be entered if it is available. If it cannot be determined, the field should be left blank. For a new point, this field must be left blank, and a PID will be assigned when the mark is loaded into the NGS data base.

CODE *13* (STATION IDENTIFICATION RECORD)

The second record required for geodetic control stations contains the agency name for the point. The entries made are as follows:

Designation [CC 11-50] - Up to 40 characters of alphanumeric data may be entered into this field. In the case of existing marks already included in the NGS data base, the designation should precisely reflect the published designation of the station. This is the official designation. As control points are added to the geodetic network, station designations should be unique within a clearly defined geographic locale (e.g., state, province). Where station monuments have been stamped, the designation is an edited version of what is stamped on the marker. This practice should be followed as nearly as possible. ANNEX D supplies detailed instructions concerning naming conventions for geodetic control points. Assistance concerning determination of unique designations can be obtained by contacting NGS.

Underground Marker Type and Magnetic Property Code (optional) [CC 52-53] and [CC 55] - These codes are similar to the codes used for surface marker type and magnetic code on the setting record. If an underground marker exists and these codes can be determined for it, they are entered here. Entries must be left-justified. A complete list of the codes is contained in ANNEX I.

Setting Code (Underground Marker) (optional) [CC 57-58] - The setting code is from a comprehensive set of two-digit numerical codes covering a wide variety of possible settings for a survey point marker. A complete list of the setting codes is found in ANNEX I.

Transportation Code [CC 60] - This is a one-letter code that indicates the mode of transportation to reach the station. If backpacking is required to reach the station, the transportation code reflects the mode of travel used to reach the point where backpacking begins. A complete list of the specific transportation codes is given below. The possible entries are as follows:

CODE	TRANSPORTATION MODE
A	Light Airplane
B	Boat
C	Car (or Station Wagon)
F	Float Airplane
H	Helicopter
O	Other (See Descriptive Text)
P	Light Truck (Pickup,Carry-All, etc.)
T	Truck (larger than 3/4 ton)
W	Tracked Vehicle (Weasel,Snowcat,etc.)
X	Four-Wheel Drive Vehicle

Backpack-Time (optional) [CC 63-66] - Enter the time required to carry equipment on foot from the last point of transportation to the station, expressed in hours and minutes (HHMM). If the immediate vicinity of the station can be reached using the mode of transportation indicated by the preceding transportation code, enter zero in both the hours and minutes fields (0000).

CODE *15* (ALIAS RECORD) (optional) [CC 11-50] - Up to 40 characters of text which represent an alternate form of the name used to identify the control point. These alias entries arise due to non-standard naming conventions used by various agencies and individuals. **NGS strongly discourages the use of aliases.**

CODE *20* (MONUMENTED/RECOVERED RECORD) - Entries in this record primarily provide historical information concerning creation of and subsequent return visits to the control point. The first four fields are normally used only when the DR Code = "D" and the remaining five fields are used only when the DR Code = "R". Acceptable entries for each field are defined as follows:

Monumenting Agency Group Code [CC 11] - The code for the monumenting agency group is a one-character alpha entry used to subdivide specific monumenting organizations into distinct groups. These codes follow:

CODE	GROUP
A	National Agencies
B	Inter-State or Inter-Province Agencies
C	State, Province, Commonwealth, and Territorial Agencies
D	County Agencies
E	Municipal Agencies (Cities)
F	Inter-City and Inter-County Agencies
G	Railroads
H	Utility and Natural Resource Companies
I	Surveying, Engineering, and Construction Industry
J	Educational Institutions
K	Professional and Amateur Associations
L	Miscellaneous Commercial or Private Firms
M	Non-Specific Designators

Monumenting Agency Symbol [CC 13-18] - This is the NGS-defined symbol of up to six (6) characters for the organization which set the monument (disk). It is required when the DR Code is "D", and is optional if the DR Code is "R". The symbols are given in ANNEX C. If the organization is not listed in ANNEX C, contact NGS to have a symbol assigned to that organization.

Year Monumented [CC 33-36] - Enter the year the marker was monumented. It is required when the DR Code is "D", and is optional if the DR Code is "R".

Chief of Party [CC 37-39] - Enter up to three initials for the person who was in charge of the survey party which monumented the control point. If this information cannot be determined, as in the case of recovery stations, leave the field blank. This field is always optional.

Recovering Agency Group Code [CC 42] - In a manner similar to that described for the Monumenting Agency Code, enter the appropriate group code from the list above for the recovering organization.

Recovering Agency Symbol [CC 44-49] - This is the NGS-defined symbol of up to six (6) characters for the organization which recovered the mark. It is required when the DR Code is "R", and is not allowed if the DR Code is "D".

Date Recovered [CC 64-71] - The exact date the control point was recovered is to be recorded in this eight-character field. The year,

month, and day of the month are to be recorded in that sequence (e.g., 19850815 would indicate August 15, 1985). It is required when the DR Code is "R", and is not allowed if the DR Code is "D".

Chief of Party [CC 72-74] - If DR Code = "R", enter up to three initials for the person who was in charge of the survey party which recovered the control point. This field is optional when the DR Code is "R", and is not allowed if the DR Code is "D".

Recovery Condition Code [CC 77] - If DR Code = "R", enter the appropriate one-letter code to indicate the condition of the control point. It is required when the DR Code is "R", and is not allowed if the DR Code is "D". The allowed values are as follows:

CODE	CURRENT CONDITION OF SURVEY POINT
G	Good
N	Not Recovered, Not Found
O	**Other (See descriptive text)**
P	Poor, Disturbed, Mutilated, Requires Maintenance
X	Destroyed (See Note Below)

Note: The control point should be reported as destroyed only when the actual marker is found separated from its setting (e.g., disk recovered from highway department personnel). If the marker was not found, notes concerning evidence of possible destruction should be entered as text records, but the recovery condition entry should be coded as "N".

CODE *26* (SETTING RECORD) - This record contains information about the setting of the surface marker, its stability, and in some cases, what identifying features are inscribed or cast (as opposed to hand-stamped) on the marker. The definition of each field is as follows:

Setting Code [CC 11-12] - This two-digit code is used to indicate the setting characteristics of the monument or mark. These characteristics include the type of setting (shallow or deep), the type of design and material used for the monument, and/or the natural or man-made object which serves as the setting for the control point. A complete list of the possible entries is found in ANNEX I.

Specific Setting Phrase [CC 14-45] - For setting codes 30 through 41, enter a more specific phrase describing the setting, but corresponding to the respective setting code chosen from the list in Annex I. A maximum of 32 characters, including imbedded blanks, may be entered. For the other setting codes, leave this field blank. **If the setting code or specific setting phrase does not adequately represent the setting of the mark, additional explanation should be given in the text.**

Surface Marker Type [CC 46-47] - This field identifies the object used to monument the geodetic control point. Landmark stations are represented by two (2) digit codes and all other markers represented by one or two character alpha codes. Entries must be left-justified. The most common types of surface marks are listed on the next page:

CODE	DESCRIPTION
A	Aluminum marker **(other than a disk)**
B	Bolt
C	Cap-and-Bolt Pair
DB	Bench Mark Disk
DD	Survey Disk
DE	Traverse Station Disk
DH	Horizontal Control Disk
DJ	Tidal Station Disk
DO	Disk of Unspecified Type (See Text)
DQ	Calibration Base Line Disk
DR	Reference Mark Disk
DS	Triangulation Station Disk

DU	Boundary Marker Disk
DV	Vertical Control Disk
DZ	Azimuth Mark Disk
I	Metal Rod
N	Nail

A complete list of these codes is contained in ANNEX I.

Magnetic Code (Surface Marker) [CC 49] - This one-character code indicates the magnetic property of the mark or monument. ANNEX I details acceptable entries for the magnetic property code.

Vertical Stability Override Code (optional) [CC 51] - This one-character entry allows the default vertical stability codes to be overridden when appropriate. The codes are from the following list:

CODE	DEFINITION
A	Monuments of the most reliable nature, expected to hold their elevations very well.
B	Monuments which generally hold their elevations fairly well.
C	Monuments which may be affected by surface ground movements.
D	Monuments of questionable or unknown vertical stability.

Marker Inscription [CC 54-59] - This field is the **symbol** from ANNEX C for the agency or organization whose identity is inscribed or precast on the disk/monument. This entry is not the same as the stamping which usually reflects the station designation. If the appropriate organization is not listed in ANNEX C, contact NGS to have a symbol assigned to that organization. If it is not possible to contact NGS, a longer entry (up to 26 characters) may be made. If there is no agency identification inscribed or precast on the marker (such as a chiseled square, nail, or unidentified disk), enter "UNK" .

CODE *28* (STAMPING RECORD) (optional) - The stamping field [CC 11-60] should contain the exact stamping as it appears on the geodetic control marker. The entry must not exceed 50 characters, including embedded blanks. If there is no stamping, make no entry here; however, if the marker is a type that is normally stamped, enter a short note about its being unstamped in the accompanying descriptive text.

CODE *29* (ROD/PIPE RECORD) (optional) - Inclusion of this record as a separate entity allows users to access specific information about this class of survey point. This record would be used in lieu of the phrase STAINLESS STEEL (or other material as per Setting code) ROD (OR PIPE) SET TO THE DEPTH OF ____ METERS (or FEET, depending on the UNITS CODE), IN A SLEEVE EXTENDING TO THE DEPTH OF ____ METERS (or FEET), ENCASED IN A PIPE FLUSH (F) WITH THE GROUND [or PROJECTING (P)/RECESSED (R) XX in centimeters (or XX in inches)] or, for an unsleeved rod mark, in lieu of the same phrase without reference to sleeve depth (if the sleeve depth field is left blank). For first-time recovery descriptions of pre-existing rod- or pipe-type markers, all pertinent data must be entered. Otherwise, enter any known information in the text instead of using a *29* Rod/Pipe Record. For example, if the actual rod depth is unknown, enter the projection/recession reference and a note (e.g., ROD DEPTH IS UNKNOWN), in the text. Left-justify any values recorded on this record. **NGS prefers metric values.**

UNITS CODE [CC 11]	DEFINITION
E	English - The units are feet and inches.
M	Metric - The units are meters and centimeters.

CODE *30* (TEXT RECORDS) - Descriptive text provides information about the mark which is not captured in the coded fields. It is entered in multiple records with up to 70 characters per record. Words must not be split between records. In addition to the expected alphanumeric character set (A-Z and 0-9), the following special characters are allowed:

(*)	asterisk	(+)	plus sign
( )	blank or space	(-)	minus sign
(,)	comma	(=)	equal sign
($)	dollar sign	(()	left parenthesis
(/)	slash	())	right parenthesis
(.)	period or decimal		

Every effort must be made to provide enough information for easy recovery of the point. A well written description should contain:

(1) one or more references to some well known, readily available, location in terms of distances and directions. Intersections of prominent highways, landmarks, and public buildings in nearby towns are examples of such locations. In some cases, this location will require some description;

(2) detailed directions concerning how one would proceed to the mark site from one or more of these prominent locations;

(3) distance and direction to, inscription, and designation of any monumented reference marks which are in the NGS data base. Specific descriptions of these reference marks themselves are **not** to be included: **each reference mark must have a separate complete description of its own;**

(4) distance and direction from one or more reference objects in the immediate locale should be noted. Examples of these reference objects are the centerlines of roads, fire plugs, telephone poles, chiseled marks in pavement, and survey marks which are not included in the NGS data base.

This item is more important when no monumented reference marks are associated with the geodetic control point;

(5) distance and direction to any witness post that was set or if any witness post was set;

(6) if applicable, a vertical reference to some nearby object (or the ground) stating the relationship to the object should be recorded. Distance above, below, or about flush with the object should be noted; and

(7) any information about the specific setting or exact location of the mark if the coded values are not sufficient to describe it completely.

When distance estimates or measurements are given in metric units, English equivalencies must follow in parentheses. Property ownership and contact point telephone numbers are desirable when private property must be crossed or occupied.

Varying styles of descriptive text are used by some local and regional agencies. This will not present a problem as long as the content is as specified. Examples of descriptive text are included in the sample data sets which follow.

```
000010*AA*GEODDESCNGS   NATIONAL GEODETIC SURVEY                         19910413
000020*00*GPS-301
000030*01*COLORADO HIGH PRECISION GEODETIC SURVEY, 1991
000040*05*THESE DESCRIPTIONS WERE TAKEN FROM THE ABOVE PROJECT AND MODIFIED TO
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000050*05*SERVE AS EXAMPLES.
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This description represents a fairly typical situation.

```
000060*10*0049RTN370756W103530801778M         COLAS ANIMAS          P   HJ0138
000070*13*D 85                                                  P  0000
000080*20* /                                A/NGS                   19910415GRH  G
000090*26*07/                                   DB N C  CGS
000100*28*D 85 1935
000110*30*STATION IS LOCATED ABOUT 55 KM (34.2 MI) EAST OF TRINIDAD, 14 KM
000120*30*(8.7 MI) NORTH OF BRANSON, 4 KM (2.5 MI) SOUTH OF WALTS CORNER
000130*30*(JUNCTION OF US HIGHWAY 160 AND STATE HIGHWAY 389), ALONG HIGHWAY
000140*30*389, AT MILE 10.1, IN A PASTURE, IN THE NORTHEAST CORNER OF SECTION
000150*30*34, T 33 S, R 58 W.  OWNERSHIP--WALDROUP RANCH, INC, BRANSON, CO
000160*30*81027.
000170*30*NOTE--IT IS NECESSARY TO PARK IN ROAD SO APPROPRIATE WARNING EQUIPMENT
000180*30*IS NEEDED.
000190*30*TO REACH FROM THE VEE FORMED BY HIGHWAY 389 SPLITTING TO JOIN HIGHWAY
000200*30*160, ABOUT 0.1 KM (0.1 MI) SOUTH OF HIGHWAY 160, GO SOUTH ON HIGHWAY
000210*30*389 FOR 3.39 KM (2.11 MI) TO A TRACK ROAD LEFT LEADING TO A WINDMILL.
000220*30*CONTINUE AHEAD FOR 0.64 KM (0.40 MI) TO THE STATION ON THE RIGHT.
000230*30*STATION MARK IS SET IN THE TOP OF A 20-CM SQUARE CONCRETE POST
000240*30*PROJECTING 15 CM.  IT IS 9.9 M (32.5 FT) WEST OF, AND 1 M (3.3 FT)
000250*30*LOWER THAN THE HIGHWAY CENTER, 1.3 M (4.3 FT) WEST OF A FIBERGLASS
000260*30*WITNESS POST IN THE RIGHT-OF-WAY FENCE, AND 161 M (528.2 FT) NORTH OF
000270*30*MILEPOST 10 (MEASURED ALONG THE ROAD).
```


More text is required under other circumstances.

```
000280*10*0216RFN350230W106365201619M         NMBERNALILLO
000290*13*NM BASE 1                                             P  0000
000300*20* /                                A/NGS                   19910531EAR  G
000310*26*00/                                   Z  N B
000320*30*THE STATION IS LOCATED ABOUT 4.8 KM (3.0 MI) SOUTHEAST OF ALBUQUERQUE,
000330*30*AT THE ALBUQUERQUE INTERNATIONAL AIRPORT, ABOUT 1.2 KM (0.7 MI)
000340*30*WEST-NORTHWEST OF THE AIRPORT CONTROL TOWER, ON THE NORTHEAST SIDE OF
000350*30*RUNWAY 12-30, NEAR A TAN BRICK BUILDING. OWNERSHIP--CITY OF
000360*30*ALBUQUERQUE, ROBERT E. GILL, AVIATION SUPERVISOR, P.O. BOX 9022,
000370*30*ALBUQUERQUE, NM 87119.  PHONE IS 505-842-4366.
000380*30*NOTE--ESCORT TO STATION BY AIRPORT POLICE IS MANDATORY.  AIRPORT
000390*30*SECURITY MAY BE REACHED BY PHONE AT WEST SECURITY ENTRANCE GATE BY
000400*30*DIALING 4380.
000410*30*TO REACH THE STATION FROM THE WEST SECURITY ENTRANCE GATE AT THE AIR
000420*30*FREIGHT LOADING DOCKS AT THE ALBUQUERQUE INTERNATIONAL AIRPORT, PASS
000430*30*THROUGH GATE AND GO SOUTH FOR 6 M (19.7 FT) ON ASPHALT SURFACE TO A
000440*30*FENCE.  TURN LEFT AND GO EAST FOR 0.1 KM (0.1 MI) ON ASPHALT SURFACE
000450*30*TO THE EAST END OF THE FENCE.  TURN RIGHT AND GO SOUTHWESTERLY FOR
000460*30*0.2 KM (0.1 MI) ON ASPHALT SURFACE TO SERVICE ROAD C.  TURN LEFT AND
000470*30*GO SOUTH FOR 0.9 KM (0.6 MI) ON SERVICE ROAD C TO A PAVED ROAD LEFT
000480*30*AND SIGN (T-16).  TURN LEFT AND GO EAST FOR 0.5 KM (0.3 MI) ON THE
000490*30*PAVED ROAD, PASSING CUTTER AVIATION, TO A DIRT ROAD LEFT AND SIGN
000500*30*(T-13). TURN LEFT AND GO NORTH FOR 0.2 KM (0.1 MI) ON THE DIRT ROAD,
000510*30*CROSSING TWO RAMPS TO A TAN BRICK BUILDING (RUNWAY LIGHTING VAULT)
000520*30*WITH TWO GREEN ELECTRICAL BOXES AND THE STATION ON THE SOUTH SIDE OF
000530*30*BUILDING.
000540*30*THE STATION IS THE TOP CENTER OF A ROUND METAL PLATE THAT IS
000550*30*UNSTAMPED, AFFIXED TO THE TOP OF A 15.24 M (50.00 FT) LONG STEEL
000560*30*H-BEAM DRIVEN TO A DEPTH OF 14.0 M (45.9 FT) , PROJECTING 1.2 M
000570*30*(3.9 FT) ABOVE GROUND, ENCASED IN A 2.1 M (6.9 FT) LONG
000580*30*INSULATION-FILLED PVC PIPE 45 CM IN DIAMETER SET AT A DEPTH OF 0.9 M
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000590*30*(3.0 FT) PROJECTING 1.2 M (3.9 FT) ABOVE GROUND, SURROUNDED BY A
000600*30*SQUARE CONCRETE SLAB 1.2 M (3.9 FT) ON SIDE FLUSH WITH GROUND.
000610*30*LOCATED 45.4 M (148.9 FT) WEST FROM THE SIXTH BLUE TAXIWAY LIGHT
000620*30*ALONG TAXIWAY 14 (SOUTH OF TAXIWAY 2), 32.3 M (106.0 FT)
000630*30*EAST-NORTHEAST FROM THE APPROXIMATE CENTER OF THE DIRT ROAD, 21.8 M
000640*30*(71.5 FT) SOUTH FROM THE SOUTHEAST CORNER OF THE RUNWAY LIGHTING
000650*30*VAULT AND 21.5 M (70.5 FT) SOUTHEAST FROM THE SOUTHWEST CORNER OF THE
000660*30*RUNWAY LIGHTING VAULT.
000670*30*NOTE--THERE IS AN INVERTED THREADED BOLT AFFIXED TO THE TOP CENTER OF
000680*30*ROUND METAL PLATE.  FOR GPS OCCUPATION, ANTENNA TRIBRACH WAS SCREWED
000690*30*ON THE BOLT AND ANTENNA MEASUREMENT WAS REFERENCED TO TOP OF ROUND
000700*30*METAL PLATE.
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The following several descriptions illustrate how a cluster of related marks should be described. Note that NCMN is not an agency, but a usage, like TIDAL.

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000730*10*6614RTN401058W104433501520M         COWELD                P   LL1438
000740*13*PLATTEVILLE NCMN                                   P  0000
000750*20* /                            A/NGS                   19910515GRH  G
000760*26*07/                               DH N C  NGS
000770*28*PLATTEVILLE NCMN 1981
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000780*30*STATION IS LOCATED ABOUT 9.5 KM (5.9 MI) SOUTHEAST OF PLATTEVILLE, AT
000790*30*THE PLATTEVILLE RADAR SITE, ABOUT 75 M (246.1 FT) NORTHWEST OF THE
000800*30*MAIN BUILDING, IN THE MIDDLE OF THREE 1.7 M (5.6 FT) X 2.7 M
000810*30*(8.9 FT) CONCRETE PADS, IN THE CENTER OF SECTION 36, T 3 N, R 66 W.
000820*30*OWNERSHIP--US DEPARTMENT OF COMMERCE, NATIONAL COMMUNICATIONS AND
000830*30*INFORMATION ADMINISTRATION, NOAA, WPL, REWP 4, 325 BROADWAY, BOULDER,
000840*30*CO 80303.  PHONE IS 303-497-6385 FOR COMBINATION TO GATE LOCK.
000850*30*TO REACH FROM THE JUNCTION OF US HIGHWAY 85 AND STATE HIGHWAY 66 AT
000860*30*THE SOUTH END OF PLATTEVILLE, GO SOUTH ON HIGHWAY 85 FOR 2.05 KM
000870*30*(1.27 MI) TO A CROSSROAD.  TURN LEFT, EAST, ON GRAVEL ROAD (ROAD 28)
000880*30*FOR 7.20 KM (4.47 MI) TO ROAD END AT A THREE-WAY FORK AND A LOCKED
000890*30*GATE ON MIDDLE ROAD.  PASS THROUGH GATE AND GO SOUTHEAST ON GRADED
000900*30*ROAD FOR 1.21 KM (0.75 MI) TO A GRAVEL DRIVEWAY LEFT ABOUT 200 FT
000910*30*(61.0 M) BEFORE REACHING MAIN BUILDING.  TURN LEFT, NORTHEAST, FOR 25
000920*30*M (82.0 FT) TO THE STATION ON THE LEFT.
000930*30*STATION MARK IS SET IN THE TOP OF A 30-CM ROUND CONCRETE POST IN THE
000940*30*MIDDLE OF A 1.2 M (3.9 FT) SQUARE CONCRETE PAD FLUSH WITH THE GROUND.
000950*30*IT IS 26.7 M (87.6 FT) NORTHEAST OF THE ROAD CENTER, 9.6 M (31.5 FT)
000960*30*SOUTHWEST OF A FIBERGLASS WITNESS POST, 12.2 M (40.0 FT)
000970*30*WEST-SOUTHWEST OF A FENCE CORNER, 34.7 M (113.8 FT) WEST-NORTHWEST OF
000980*30*A UTILITY POLE WITH LIGHT, APPROXIMATELY 90 M (295.3 FT) SOUTH OF NGS
000990*30*MARK PLATTEVILLE NCMN RM 1, 86.5 M (283.8 FT) WEST-NORTHWEST OF NGS
001000*30*MARK PLATTEVILLE NCMN RM 2, 62 M (203.4 FT) NORTHEAST OF NGS MARK
001010*30*PLATTEVILLE NCMN RM 3, AND 49.4 M (162.1 FT) NORTHWEST OF PLATTEVILLE
001020*30*NCMN RM 5.


001030*10*8887RTN401058W104433401519M         COWELD                P
001040*13*PLATTEVILLE NCMN RM 1                        DR N 07 X  0005
001050*20*A/NGS                 1981     A/NGS                   19911119EAR  G
001060*26*07/                               DR N C  NGS
001070*28*PLATTEVILLE NCMN NO 1 1981
001080*30*THE STATION IS LOCATED ABOUT 9.5 KM (5.9 MI) SOUTHEAST OF PLATTEVILLE,
001090*30*AT THE PLATTEVILLE RADAR SITE, IN THE CENTER OF SECTION 36, T 3 N, R
001100*30*66 W.  OWNERSHIP--US DEPARTMENT OF COMMERCE, NATIONAL COMMUNICATIONS
001110*30*AND INFORMATION ADMINISTRATION, NOAA, WPL, REWP 4, 325 BROADWAY,
001120*30*BOULDER, CO 80303.  PHONE IS 303-497-6385 FOR COMBINATION TO GATE
001130*30*LOCK.
001140*30*TO REACH FROM THE JUNCTION OF US HIGHWAY 85 AND STATE HIGHWAY 66 AT
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001150*30*THE SOUTH END OF PLATTEVILLE, GO SOUTH ON HIGHWAY 85 FOR 2.05 KM
001160*30*(1.27 MI) TO A CROSSROAD.  TURN LEFT, EAST, ON GRAVEL ROAD (ROAD 28)
001170*30*FOR 7.20 KM (4.47 MI) TO THE ROAD END AT A THREE-WAY FORK AND A
001180*30*LOCKED GATE ON THE MIDDLE ROAD.  PASS THROUGH GATE AND GO SOUTHEAST
001190*30*ON GRADED ROAD FOR 0.50 MI (0.80 KM) TO A GRAVELED CROSSROAD.  TURN
001200*30*LEFT AND GO EAST FOR 90 M (295.3 FT) TO THE STATION ON THE RIGHT
001210*30*INSIDE A METAL FENCE.
001220*30*THE STATION IS AN REFERENCE MARK DISC SET IN THE TOP OF A 30-CM ROUND
001230*30*CONCRETE POST PROJECTING 10 CM, WITH A WOODEN STAND.  LOCATED 91.5 M
001240*30*(300.2 FT) NORTHEAST OF THE ROAD CENTER, 54.9 M (180.1 FT) NORTHEAST
001250*30*OF AN ELECTRIC FENCE, 8.5 M (27.9 FT) SOUTH-SOUTHEAST OF A METAL
001260*30*FENCE, AND 90 M (295.3 FT) NORTH OF NGS MARK PLATTEVILLE NCMN.
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001270*10*8888RTN401058W10443340 1519M         COWELD
001280*13*PLATTEVILLE NCMN RM 2                            C  0000
001290*20*A/NGS                1981     A/NGS                  19911119EAR  G
001300*26*07/                                DR N C  NGS
001310*28*PLATTEVILLE NCMN NO 2 1981
001320*30*THE STATION IS LOCATED ABOUT 9.5 KM (5.9 MI) SOUTHEAST OF PLATTEVILLE,
001330*30*AT THE PLATTEVILLE RADAR SITE, IN THE CENTER OF SECTION 36, T 3 N, R
001340*30*66 W.  OWNERSHIP--US DEPARTMENT OF COMMERCE, NATIONAL COMMUNICATIONS
001350*30*AND INFORMATION ADMINISTRATION, NOAA, WPL, REWP 4, 325 BROADWAY,
001360*30*BOULDER, CO.80303.  CALL 303-497-6385 FOR COMBINATION TO GATE LOCK.
001370*30*TO REACH FROM THE JUNCTION OF US HIGHWAY 85 AND STATE HIGHWAY 66 AT
001380*30*THE SOUTH END OF PLATTEVILLE, GO SOUTH ON HIGHWAY 85 FOR 2.05 KM
001390*30*(1.27 MI) TO A CROSSROAD.  TURN LEFT, EAST, ON GRAVEL ROAD (ROAD 28)
001400*30*FOR 7.20 KM (4.47 MI) TO THE ROAD END AT A THREE-WAY FORK AND A
001410*30*LOCKED GATE ON THE MIDDLE ROAD.  PASS THROUGH GATE AND GO SOUTHEAST
001420*30*ON GRADED ROAD FOR 1.01 KM (0.63 MI) TO A GRAVEL ROAD LEFT JUST
001430*30*BEFORE REACHING MAIN BUILDING.  TURN LEFT FOR 36.6 M (120.1 FT) TO A
001440*30*LIGHT POLE AND TWO NASA TRAILERS.  THE STATION IS ABOUT 55 M
001450*30*(180.4 FT) EAST IN A FENCED FIELD.
001460*30*THE STATION IS A REFERENCE MARK DISK SET IN THE TOP OF A 30 CM ROUND
001470*30*CONCRETE POST PROJECTING 15 CM. LOCATED 55 M (180.4 FT) EAST OF A
001480*30*LIGHT POLE, 22.6 M (74.1 FT) EAST-NORTHEAST OF AN 8-INCH SQUARE WIRE
001490*30*GATE POST UNDER POWER LINES, 17.4 M (57.1 FT) EAST-SOUTHEAST OF AN
001500*30*8-INCH ROUND CORNER FENCE POST, 1.2 M (3.9 FT) SOUTHWEST OF A LONE
001510*30*METAL FENCE POST, 86 M (282.2 FT) EAST-SOUTHEAST OF NGS MARK
001520*30*PLATTEVILLE NCMN, AND 46 M (150.9 FT) EAST-NORTHEAST OF NGS MARK
001530*30*PLATTEVILLE NCMN RM 5.


001540*10*8889RTN401058W1044334 1519M         COWELD
001550*13*PLATTEVILLE NCMN RM 3                            C  0000
001560*20*A/NGS                1981     A/NGS                  19911119EAR  G
001570*26*07/                                DR N C  NGS
001580*28*PLATTEVILLE NCMN NO 3 1981
001590*30*THE STATION IS LOCATED ABOUT 9.5 KM (5.9 MI) SOUTHEAST OF PLATTEVILLE,
001600*30*AT THE PLATTEVILLE RADAR SITE, IN THE CENTER OF SECTION 36,  T 3 N, R
001610*30*66 W.  OWNERSHIP--US DEPARTMENT OF COMMERCE, NATIONAL COMMUNICATIONS
001620*30*AND INFORMATION ADMINISTRATION, NOAA, WPL, REWP 4, 325 BROADWAY,
001630*30*BOULDER, CO 80303.  PHONE IS 303-497-6385 FOR COMBINATION TO GATE
001640*30*LOCK.
001650*30*TO REACH FROM THE JUNCTION OF US HIGHWAY 85 AND STATE HIGHWAY 66 AT
001660*30*THE SOUTH END OF PLATTEVILLE, GO SOUTH ON HIGHWAY 85 FOR 2.05 KM
001670*30*(1.27 MI) TO A CROSSROAD.  TURN LEFT, EAST, ON GRAVEL ROAD (ROAD 28)
001680*30*FOR 7.20 KM (4.47 MI) TO THE ROAD END AT A THREE-WAY FORK AND A
001690*30*LOCKED GATE ON THE MIDDLE ROAD.  PASS THROUGH GATE AND GO SOUTHEAST
001700*30*ON GRADED ROAD FOR 1.01 KM (0.63 MI) TO A GRAVEL ROAD LEFT JUST
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001710*30*BEFORE REACHING MAIN BUILDING AND THE STATION ON THE RIGHT.
001720*30*THE STATION IS A REFERENCE MARK DISK SET IN THE TOP OF A 30-CM
001730*30*CONCRETE POST PROJECTING 5 CM, AND WITH A WOODEN STAND.  LOCATED 53.4
001740*30*M (175.2 FT) SOUTH-SOUTHWEST OF THE ROAD CENTER, 5.8 M (19.0 FT) WEST
001750*30*OF A WIRE FENCE LINE, 1.2 M (3.9 FT) NORTH OF A LONE METAL FENCE
001760*30*POST, 1.05 M (3.44 FT) EAST-SOUTHEAST OF A FIBERGLASS WITNESS POST,
001770*30*AND 62 M (203.4 FT) SOUTHEAST OF NGS MARK PLATTEVILLE NCMN.
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3-15

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001780*10*8890D N401058W104433101522M         COWELD                P
001790*13*PLATTEVILLE NCMN RM 5                           P  0000
001800*20*A/NGS                 1991RSC   /
001820*26*07/                            DH N B  NGS
001820*28*PLATTEVILLE NCMN NO 5 1991
001830*30*STATION IS LOCATED ABOUT 9.5 KM (5.9 MI) SOUTHEAST OF PLATTEVILLE, AT
001840*30*THE NOAA PLATTEVILLE RADAR SITE, ABOUT 75 M (246.1 FT) NORTHWEST OF
001850*30*THE MAIN BUILDING, ON THE EAST SIDE OF A GRADED AREA WITH SEVERAL
001860*30*CONCRETE PADS USED FOR PLATE TECTONICS SURVEY VEHICLES, IN THE CENTER
001870*30*OF SECTION 36, T 3 N, R 66 W.  OWNERSHIP--US DEPARTMENT OF COMMERCE,
001880*30*NATIONAL COMMUNICATIONS AND INFORMATION ADMINISTRATION, NOAA, WPL,
001890*30*REWP 4, 325 BROADWAY, BOULDER, CO 80303.  CALL 303-497-6385 FOR
001900*30*COMBINATION TO LOCKED GATE.
001910*30*TO REACH FROM THE JUNCTION OF US HIGHWAY 85 AND STATE HIGHWAY 66 AT
001920*30*THE SOUTH END OF PLATTEVILLE, GO SOUTH ON HIGHWAY 85 FOR 2.05 KM
001930*30*(1.27 MI) TO A CROSSROAD.  TURN LEFT, WEST, ON GRAVEL ROAD (ROAD 28)
001940*30*FOR 7.20 KM (4.47 MI) TO ROAD END AT THREE-WAY FORK AND A LOCKED GATE
001950*30*ON THE MIDDLE ROAD.  PASS THROUGH GATE, SOUTHEAST, ON GRADED ROAD FOR
001960*30*1.01 KM (0.63 MI) TO A GRAVEL ROAD LEFT JUST BEFORE REACHING THE MAIN
001970*30*BUILDING.  TURN LEFT, NORTHEAST, FOR 25 M (82.0 FT) TO THE STATION ON
001980*30*THE RIGHT.
001990*30*STATION MARK IS SET IN THE TOP OF A 0.5 M (1.6 FT) ROUND CONCRETE POST
002000*30*ENCASED IN A PVC PIPE PROJECTING 1.6 M (5.2 FT) ABOVE GROUND FROM A 1
002010*30*M (3.3 FT) CONCRETE BASE SET 3.4 M (11.2 FT) INTO THE GROUND.  A
002020*30*PERMANENT ROUND TRIBRACH WITH THREADBOLT IS CENTERED ON THE POST.  IT
002030*30*IS 29.6 M (97.1 FT) NORTHEAST OF THE ROAD CENTER, 22.9 M (75.1 FT)
002040*30*NORTH-NORTHEAST OF A TELEPHONE PEDESTAL, 19.5 M (64.0 FT) WEST OF THE
002050*30*WEST CORNER OF A FENCE AROUND AN ELECTRIC SUBSTATION, 15.0 M
002060*30*(49.2 FT) SOUTHEAST OF THE SOUTHEAST CORNER OF ELECTRIC BOX 75, 49.4
002070*30*M (162.1 FT) SOUTHEAST OF NGS MARK PLATTEVILLE NCMN.
002080*AA*
```

If you need more information regarding the writing or use of descriptions, or need clarification of code sets or practices, contact the National Geodetic Information Branch by calling (301) 713-3242, or at the following address:

NOAA
National Geodetic Survey, N/NGS12
1315 East-West Highway
Silver Spring, Maryland
20910-3282

THE FOLLOWING PAGES INCLUDE DETAILED EXAMPLES (FORMAT DIAGRAMS) FOR EACH CHARACTER FIELD AND THE PROPER LOCATION AND LENGTH OF THE FIELD WITHIN A GIVEN RECORD.

DATA SET IDENTIFICATION RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	JOB CODE
11–14	DATA CLASS (GEOD)
15–18	DATA TYPE (DESC)
19–24	ORGANIZATION SYMBOL (See Annex C)
25–44	SUBMITTING ORGANIZATION NAME
45–66	SUBMITTING ORGANIZATION NAME CONTINUED
73–80	Y Y Y Y M M D D FILE CREATION DATE

---

00 PROJECT INFORMATION RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–18	ACCESSION NUMBER
19–22	LINE/PART NUMBER
23–41	BLANK
42–80	BLANK

---

01 PROJECT TITLE RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–45	PROJECT TITLE
46–80	PROJECT TITLE (CONTINUED)

02, *03*, *04* PROJECT TITLE CONTINUATION RECORDS

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–45	PROJECT TITLE CONTINUATION
46–80	PROJECT TITLE CONTINUATION

---

05 COMMENT RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–45	COMMENT
46–80	COMMENT (CONTINUED)

---

10 STATION LOCATION RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–14	SSN
15	D/R CODE
16	RECOVERY TYPE CODE
17–23	H D D M M S S APPROXIMATE LATITUDE (E.G. N382443)
24–31	W D D D M M S S APPROXIMATE LONGITUDE (E.G. W1023452)
32–36	APPROXIMATE HEIGHT
37	HEIGHT UNITS
39–45	30 MINUTE QUAD IDENTIFIER
47–48	STATE
49–68	COUNTY NAME
69–72	APPLICATION CODES
73–78	PID

---

13 STATION IDENTIFICATION RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–46	STATION DESIGNATION
47–50	CONT. DESIGNATION
52–53	UNDERGROUND MARKER TYPE
55	UNDERGROUND MAGNETIC CODE
57–58	UNDERGROUND SETTING CODE
60	TRANSPORTATION CODE
63–66	PACK TIME

---

15 ALIAS RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–50	ALIAS

---

20 MONUMENTED/RECOVERED RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11	SETTING AGENCY GROUP CODE
13–32 (18)	SETTING AGENCY SYMBOL / NAME
33–36	YEAR SET
37–39	CHIEF OF PARTY
42	RECOVERING AGENCY GROUP CODE
44–63 (49)	RECOVERING AGENCY SYMBOL / NAME
64–71	Y Y Y Y M M D D DATE RECOVERED
72–74	CHIEF OF RECOVERING PARTY
77	RECOVERY CONDITION CODE

GEODDESC—DATA-SET-RECORDS (CONT)

26 SETTING RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11 12	SETTING CODE
14–45	SPECIFIC SETTING PHRASE
46 47	MARKER TYPE
49	MAGNETIC CODE
51	VERTICAL STABILITY OVERRIDE CODE
54 59–79	INSCRIBED AGENCY SYMBOL / NAME

---

28 STAMPING RECORD

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11–40	STAMPING
41–60	STAMPING CONTINUED

---

29 ROD/PIPE RECORD (OPTIONAL)

Columns	Field
1–6	SEQUENCE NUMBER
7–10	DATA CODE
11	UNITS CODE (E OR M)
12 13	SETTING CODE
14–17	ROD/PIPE DEPTH
18–21	SLEEVE DEPTH
22	R=RECESS F=FLUSH P=PROJECTING
23 24	PROJECTION OR RECESS OF CASING

GEODDESC—DATA-SET-RECORDS (CONT)

30 TEXT RECORDS

1 – 6	7 – 10	11 – 47
SEQUENCE NUMBER	DATA CODE	DESCRIPTIVE TEXT

48 – 80
DESCRIPTIVE TEXT CONTINUED

DATA SET TERMINATION RECORD

1 – 6	7 – 10	11 – 80
SEQUENCE NUMBER (INC BY 10)	**DATA CODE**	BLANK

ANNEX A

NGS STATE AND COUNTRY CODES

NORTH AMERICAN AND GREENLAND

GREENLAND . . . . GL

CANADA . . . . CD

Provinces and Territories:

Alberta	AB	Newfoundland	NF	Prince Edward Is	PE
British Columbia	BC	Northwest Terr's	NW	Quebec	PQ
Manitoba	MB	Nova Scotia	NS	Saskatchewan	SK
New Brunswick	NB	Ontario	ON	Yukon Territory	YK

UNITED STATES . . . . US

States and District of Columbia:

Alabama	AL	Kentucky	KY	North Dakota	ND
Alaska	AK	Louisiana	LA	Ohio	OH
Arizona	AZ	Maine	ME	Oklahoma	OK
Arkansas	AR	Maryland	MD	Oregon	OR
California	CA	Massachusetts	MA	Pennsylvania	PA
Colorado	CO	Michigan	MI	Rhode Island	RI
Connecticut	CT	Minnesota	MN	**South Carolina**	**SC**
Delaware	DE	Mississippi	MS	South Dakota	SD
Dist of Columbia	DC	Missouri	MO	Tennessee	TN
Florida	FL	Montana	MT	Texas	TX
Georgia	GA	Nebraska	NE	Utah	UT
Hawaii	HI	Nevada	NV	Vermont	VT
Idaho	ID	New Hampshire	NH	Virginia	VA
Illinois	IL	New Jersey	NJ	Washington	WA
Indiana	IN	New Mexico	NM	West Virginia	WV
Iowa	IA	New York	NY	Wisconsin	WI
Kansas	KS	North Carolina	NC	Wyoming	WY

Other Political Units and Territories:

American Samoa	AS	Navassa Island	BQ
Federated States of Micronesia	**FM**	**Northern Mariana Islands**	**CQ**
Guam	GU	Puerto Rico	PR
Johnston Atoll	JQ	Trust Terr of Pacific Islands	TQ
Midway Islands	MQ	**Virgin Islands (US)**	**VQ**
		Wake Island	WQ

BERMUDA . . . . BD

MEXICO . . . . MX

CENTRAL AMERICA AND THE CARIBBEAN AREA

ANGUILLA . . . . AV

HAITI . . . . HA

ANTIGUA AND BARBUDA . . . . . AC	HONDURAS . . . . HO
ARUBA . . . . AA	JAMAICA . . . . JM
BAHAMA ISLANDS . . . . BF	**MARTINIQUE . . . . MR**
BARBADOS . . . . BB	**MONTSERRAT . . . . MH**
BELIZE (British Honduras) . . BH	**NETHERLANDS ANTILLES . . . . . NT**
BRITISH VIRGIN ISLANDS . . . VI	NICARAGUA . . . . NI
CAYMAN ISLANDS . . . . CJ	PANAMA . . . . PN
COLOMBIA . . . . CB	**ST KITTS AND NEVIS . . . . . . SN**
COSTA RICA . . . . CR	**ST LUCIA . . . . ST**
CUBA . . . . CU	**ST MARTIN . . . . SJ**
CURACAO . . . . CP	**ST VINCENT AND GRENADINES. . . VC**
DOMINICA . . . . DO	TRINIDAD AND TOBAGO . . . . . TD
DOMINICAN REPUBLIC . . . . . DR	**TURKS AND CAICOS ISLANDS . . . TK**
EL SALVADOR . . . . ES	
GRENADA . . . . GJ	
GUADELOUPE . . . . GP	
GUATEMALA . . . . GT	
GUYANA . . . . GY	

<u>OTHER COUNTRIES OR AREAS OF INTEREST TO NGS</u>

ANTARCTICA . . . . AY	PARAGUAY . . . . PY
ARGENTINA . . . . AJ	PHILIPPINE ISLANDS . . . . . . RP
BOLIVIA . . . . BL	ROMANIA . . . . RO
BRAZIL . . . . BR	SAINT HELENA ISLANDS . . . . . SH
CENTRAL AFRICAN REPUBLIC . . CF	SAUDI ARABIA . . . . SA
CHILE CI	SOMALIA . . . . SO
ECUADOR . . . . EC	SOUTH AFRICA . . . . SF
EGYPT . . . . EG	SOVIET UNION . . . . UR
ETHIOPIA . . . . ET	SUDAN . . . . SU
FRENCH GUIANA . . . . FG	SURINAM . . . . SR
GERMANY . . . . GM	SWEDEN . . . . SW
ICELAND IC	TANZANIA . . . . TZ
ITALY . . . . IT	UGANDA . . . . UG
JAPAN . . . . JA	UNITED KINGDOM . . . . UK
NORWAY . . . . NO	URUGUAY . . . . UY
	VENEZUELA . . . . VE
	ZAMBIA . . . . ZA

NOTE: After this revision of Annex A, NGS will discontinue publishing hard copy updates. Current NGS STATE AND COUNTRY CODES can be retrieved from the NGS Web Site at: [http://www.ngs.noaa.gov/cgi-bin/get-country.prl].

ANNEX B

STATE PLANE COORDINATES (SPC) ZONE CODES

SPC	ZONE	CODE
AL	E	0101
	W	0102
AK	1	5001
	2	5002
	3	5003
	4	5004
	5	5005
	6	5006
	7	5007
	8	5008
	9	5009
	10	5010
AZ	E	0201
	C	0202
	W	0203
AR	N	0301
	S	0302
CA	1	0401
	2	0402
	3	0403
	4	0404
	5	0405
	6	0406
CO	N	0501
	C	0502
	S	0503
CT		0600
DE		0700
FL	E	0901
	W	0902
	N	0903
GA	E	1001
	W	1002

SPC	ZONE	CODE
HI	1	5101
	2	5102
	3	5103
	4	5104
	5	5105
ID	E	1101
	C	1102
	W	1103
IL	E	1201
	W	1202
IN	E	1301
	W	1302
IA	N	1401
	S	1402
KS	N	1501
	S	1502
KY	N	1601
	S	1602
LA	N	1701
	S	1702
	SH	1703
ME	E	1801
	W	1802
MD		1900
MA	M	2001
	I	2002
MI	N	2111
	C	2112
	S	2113

SPC	ZONE	CODE
MN	N	2201
	C	2202
	S	2203
MS	E	2301
	W	2302
MO	E	2401
	C	2402
	W	2403
MT		2500
NE		2600
NV	E	2701
	C	2702
	W	2703
NH		2800
NJ		2900
NM	E	3001
	C	3002
	W	3003
NY	E	3101
	C	3102
	W	3103
	L	3104
NC		3200
ND	N	3301
	S	3302
OH	N	3401
	S	3402

SPC	ZONE	CODE
OK	N	3501
	S	3502

SPC	ZONE	CODE
TX	N	4201
	NC	4202
	C	4203

SPC	ZONE	CODE
WV	N	4701
	S	4702

OR	N	3601
	S	3602
PA	N	3701
	S	3702
RI		3800
SC		3900
SD	N	4001
	S	4002
TN		4100
	SC	4204
	S	4205
UT	N	4301
	C	4302
	S	4303
VT		4400
VA	N	4501
	S	4502
WA	N	4601
	S	4602
WI	N	4801
	C	4802
	S	4803
WY	E	4901
	EC	4902
	WC	4903
	W	4904
PR &	VI	5200
	AS	5300
	GU	5400

LEGEND:

C - Central Zone
E - Eastern Zone
L - Long Island Zone (NY)
M - Mainland Zone (MA)
N - Northern Zone
NC - North-Central Zone(TX)
SH - Offshore Zone (LA)
S - Southern Zone
SC - South-Central Zone (TX)
W - Western Zone
I - Island (MA)

Note: A blank in the zone columns above indicates that the state has only one state plane coordinate zone.

ANNEX C
CONTRIBUTORS OF GEODETIC CONTROL DATA

This ANNEX contains a list of organizations which have contributed (or are expected to contribute) data resulting from geodetic control established to extend and/or densify the national horizontal and vertical geodetic control networks.

A unique six-character identification **symbol** has been assigned to each organization listed. As far as possible, this symbol is identical to the commonly used abbreviation or acronym of the respective organization. However, to ensure uniqueness, modifications of the commonly used abbreviations and acronyms, as well as arbitrary symbols, had to be assigned in many cases. Organizations not listed in this ANNEX may contact the National Geodetic Survey (see ANNEX K) to have a unique identification symbol assigned.

The respective organizations are grouped under 13 categories, and within each category they are listed in the alphabetic order of their identification symbols. The 13 categories are given in the index below.

CATEGORIES OF CONTRIBUTORS OF GEODETIC CONTROL DATA PAGE

CONVENTIONS USED IN THE FORMATION OF IDENTIFICATION SYMBOLS

a. State, Province, Commonwealth, and Territorial Agencies: The six-character identification symbol of a state, province, commonwealth, or territorial agency consists of the respective two-character state code (see ANNEX A) to which up to four letters (e.g. the initials of the agency's name) may be appended. In general, "S" for "state" and "0" for "of" should be omitted.

b. County Agencies: The six-character identification symbol of a county agency consists of the two-character code denoting the state in which the county is located (see ANNEX A) followed by a hyphen and by a three-digit number which has been assigned to the respective county in Worldwide Geographic Location

Codes prepared by the Office of Finance, General Services Administration (GSA), September 1987. Agencies which do not have access to this publication may contact the National Geodetic Survey (see ANNEX K) to obtain the appropriate county code.

c. City Agencies: The six-character identification symbol of a city agency consists of the two-character code denoting the state in which the city is located (see ANNEX A) followed by a four-digit number which has been assigned to the respective city in Worldwide Geographic Location Codes prepared by the Office of Finance, General Services Administration (GSA), September 1987. Agencies which do not have access to this publication may contact the National Geodetic Survey (see ANNEX K) to obtain the appropriate city code.

NOTE: For the purposes of this ANNEX, agencies of independent cities which are also counties or county-equivalents should be considered to be city (rather than county) agencies and assigned identification symbols accordingly.

NOTE : AGENCY SYMBOLS LISTED HEREIN ARE FOR NGS INTERNAL USE ONLY

NATIONAL AGENCIES

SYMBOL	FULL NAME
******	**
AEC	ATOMIC ENERGY COMMISSION (NOW ERDA)
AMS	US ARMY MAP SERVICE (NOW DMA)
ARUBSD	ARUBA SURVEY DEPARTMENT
ASSUR	AMERICAN SAMOA SURVEY
ATSM	APPALACHIAN NATIONAL SCENIC TRAIL SURVEY MARKER
AVDLAS	ANGUILLA DEPARTMENT OF LANDS AND SURVEYS
BBDLAS	STATE OF BARBADOS DIVISION OF LANDS AND SURVEYS
BLM	US BUREAU OF LAND MANAGEMENT
BOF	US BUREAU OF COMMERCIAL FISHERIES
BOM	US BUREAU OF MINES
BOR	US BUREAU OF RECLAMATION (NOW WPRS)
BPR	US BUREAU OF PUBLIC ROADS
BSDLAS	BAHAMAS DEPARTMENT OF LANDS AND SURVEYS
BV	BRITISH VIRGIN ISLAND
CAB	CIVIL AERONAUTICS BOARD
CGD	CURACAO GEODETIC DEPARTMENT
CGS	US COAST AND GEODETIC SURVEY (NOW NOS)
CHS	CANADIAN HYDROGRAPHIC SERVICE
CIHD	CAYMAN ISLAND HYDROGRAPHIC
CLAS	CAYMAN LANDS AND SURVEYS DEPARTMENT
COD	CENTER FOR ORBIT DETERMINATION
DI	US DEPARTMENT OF INTERIOR
DMA	DEFENSE MAPPING AGENCY (NOW NIMA)
DOD	US DEPARTMENT OF DEFENSE
DOE	DEPARTMENT OF ENERGY
DRN	DOMINICAN REPUBLIC NAVY
DTENAL	ESTUDIOS DEL TERRITORIO NACIONAL DE MEXICO
EMR	ENERGY MINES AND RESOURCES
EPA	ENVIRONMENTAL PROTECTION AGENCY
ES-IGN	EL SALVADOR-INST GEOG NAC
FAA	FEDERAL AVIATION ADMINISTRATION
FHWA	FEDERAL HIGHWAY ADMINISTRATION
GDS	GRENADA DEPARTMENT OF SURVEYS
GSC	GEODETIC SURVEY OF CANADA
GSFC	GODDARD SPACE FLIGHT CENTER
GU	TERRITORY OF GUAM
GUAA	GUAM AIRPORT AUTHORITY
GUGS	GUAM GEODETIC SURVEY
GYANA	GUYANA DIRECTORATE OF OVERSEAS SURVEYS
GYTHD	GUYANA TRANSPORTATION AND HIGHWAYS DEPARTMENT
IAGS	INTER-AMERICAN GEODETIC SURVEY
IBC	INTERNATIONAL BOUNDARY COMMISSION

NATIONAL AGENCIES - CONTINUED

SYMBOL	FULL NAME
******	**
IBWC	INTERNATIONAL BOUNDARY AND WATER COMMISSION
INEGI	INSTITUTO NACIONAL DE ESTADISTICA GI DE MEXICO
ISTS	INTERNATIONAL SATELLITE TRIANGULATION STATION
IWC	INTERNATIONAL WATERWAYS COMMISSION
JSD	JAMAICA SURVEY DEPARTMENT
MCIDR	MILITARY CARTOGRAPHIC INSTITUTE OF THE DOMINICAN REPUBLIC
NASA	NATIONAL AERONAUTICS AND SPACE ADMIN
NBS	NATIONAL BUREAU OF STANDARDS (NOW NIST)
NGS	NATIONAL GEODETIC SURVEY
NIH	NATIONAL INSTITUTES OF HEALTH
NIMA	NATIONAL IMAGERY AND MAPPING AGENCY

NIST	NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
NOAA	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NOS	NATIONAL OCEAN SURVEY (NOW NATIONAL OCEAN SERVICE)
NOSAMC	NOS ATLANTIC MARINE CENTER
NOSOES	NOS OFFICE OF OCEAN AND EARTH SCIENCES (NOW NOSOPS)
NOSOMA	NOS OCEANOGRAPHY AND MARINE ASSESSMENT
NOSOPS	NOS OCEANOGRAPHIC PRODUCTS AND SERVICES DIVISION
NOSPMC	NOS PACIFIC MARINE CENTER
NPS	NATIONAL PARK SERVICE
NRCS	NATURAL RESOURCES CONSERVATION SERVICE
NSL	US NAVY STANDARDS LABORATORY AT POMONA
NWS	NATIONAL WEATHER SERVICE
ONCADH	ONTARIO CANADA DEPARTMENT OF HIGHWAYS
PBPP	OFFICE OF PUBLIC BUILDINGS AND PUBLIC PARKS
PICGS	PHILIPPINE COAST AND GEODETIC SURVEY
SCS	SOIL CONSERVATION SERVICE (NOW NRCS)
SDS	SURINAM DEPARTMENT OF SURVEYS
SKDS	ST KITTS DEPARTMENT OF SURVEYS
SLDS	ST LUCIA DEPARTMENT OF SURVEYS
SMSO	ST MARTIN SURVEYING OFFICE
SVDS	ST VINCENT DEPARTMENT OF SURVEYS
SWEDLS	SWEDISH LAND SURVEY
TDLAS	TRINIDAD DEPARTMENT OF LANDS AND SURVEYS
TLAS	TOBAGO LANDS AND SURVEYS
TNM	TOBAGO NAUTICAL MAPPING
TPC	US ARMY TOPOGRAPHIC COMMAND (NOW DMA)
TQDLM	TRUST TERRITORY OF PACIFIC ISLANDS DIVISION OF LAND MANAGEMENT
TVA	TENNESSEE VALLEY AUTHORITY
UKRE	UNITED KINGDOM ROYAL ENGINEERS
USA	US ARMY
USAF	US AIR FORCE
USAFGS	US AIR FORCE 1381ST GEODETIC SURVEY SQUADRON
USCG	US COAST GUARD
USDA	US DEPARTMENT OF AGRICULTURE
USDOT	US DEPARTMENT OF TRANSPORTATION
USDWC	US DEEP WATERWAY COMMISSION
USE	US ARMY CORPS OF ENGINEERS
USFS	US FOREST SERVICE
USFWA	US FEDERAL WORKS AGENCY
USFWS	US FISH AND WILDLIFE SERVICE

SYMBOL	FULL NAME
******	**
USGLO	US GOVERNMENT LAND OFFICE
USGS	US GEOLOGICAL SURVEY
USGS-E	USGS EASTERN MAPPING CENTER
USGS-M	USGS MID-CONTINENT MAPPING CENTER
USGS-R	USGS ROCKY MOUNTAIN MAPPING CENTER
USGS-W	USGS WESTERN MAPPING CENTER
USIIS	US INDIAN IRRIGATION SERVICE
USLHS	US LIGHTHOUSE SERVICE (NOW USCG)
USLS	US LAKE SURVEY
USMC	US MARINE CORPS
USN	US NAVY
USPS	US POSTAL SERVICE
USSC	US SUPREME COURT
USSES	US SOIL EROSION SERVICE
USTD	US TREASURY DEPARTMENT
USWB	US WEATHER BUREAU (NOW NWS)
VI	VIRGIN ISLANDS (US)

VICS	VIRGIN ISLANDS CADASTRAL SURVEY
WPA	WORKS PROGRESS ADMINISTRATION
WPRS	US WATER AND POWER RESOURCES SERVICE
WSMR	WHITE SANDS MISSILE RANGE
YAP	YAP STATE

INTER-STATE OR INTER-PROVINCE AGENCIES

SYMBOL	FULL NAME
******	**
BPA	BONNEVILLE POWER ADMINISTRATION
CGS+SS	US COAST AND GEODETIC SURVEY AND STATE SURVEY
DEPABC	DELAWARE-PENNSYLVANIA BOUNDARY COMMISSION
IRC	ILLINOIS RIVER COMMISSION
MANHBC	MASSACHUSETTS-NEW HAMPSHIRE BOUNDARY COMMISSION
MDDEBC	MARYLAND-DELAWARE BOUNDARY COMMISSION
MDVABC	MARYLAND-VIRGINIA BOUNDARY COMMISSION
MENHBC	MAINE-NEW HAMPSHIRE BOUNDARY COMMISSION
MORC	MISSOURI RIVER COMMISSION
MRC	MISSISSIPPI RIVER COMMISSION
NCSCSB	NORTH CAROLINA-SOUTH CAROLINA STATE BOUNDARY LINE
NMTXBC	NEW MEXICO AND TEXAS BOUNDARY COMMISSION
OHMI	OHIO-MICHIGAN BOUNDARY COMMISSION
VTNHBC	VERMONT-NEW HAMPSHIRE BOUNDARY COMMISSION

STATE, PROVINCE, COMMONWEALTH, AND TERRITORIAL AGENCIES

SYMBOL	FULL NAME
******	***
AKDAVI	ALASKA DIVISION OF AVIATION
AKDLS	ALASKA DIVISION OF LAND SURVEY
AKDNR	ALASKA DEPARTMENT OF NATURAL RESOURCES
AKDT	ALASKA DEPARTMENT OF TRANSPORTATION
AKHD	ALASKA HIGHWAY DEPARTMENT
AKPWR	ALASKA POWER ADMINISTRATION
ALGS	ALABAMA GEODETIC SURVEY
ALHD	STATE OF ALABAMA HIGHWAY DEPARTMENT
ARGLS	ARKANSAS GEOLOGICAL SURVEY
ARGS	ARKANSAS GEODETIC SURVEY
ARHD	ARKANSAS STATE HIGHWAY DEPARTMENT
AZDT	ARIZONA DEPARTMENT OF TRANSPORTATION
AZHD	ARIZONA HIGHWAY DEPARTMENT (NOW AZDT)
CADC	CALIFORNIA DEPARTMENT OF CONSERVATION
CADF	CALIFORNIA DIVISION OF FORESTRY
CADH	CALIFORNIA DIVISION OF HIGHWAYS (NOW CADT)
CADPW	CALIFORNIA DEPARTMENT OF PUBLIC WORKS
CADT	CALIFORNIA DEPARTMENT OF TRANSPORTATION
CADWR	CALIFORNIA DEPARTMENT OF WATER RESOURCES
CAEC	CALIFORNIA EARTHQUAKE COMMISSION
CAGS	CALIFORNIA GEODETIC SURVEY
CASLC	CALIFORNIA STATE LANDS COMMISSION

CASPC	CALIFORNIA STATE PARKS COMMISSION
CODH	COLORADO STATE DEPARTMENT OF HIGHWAYS
CODOT	COLORADO DEPARTMENT OF TRANSPORTATION
COGS	COLORADO GEODETIC SURVEY
CTCSF	CONNECTICUT COMMISSION OF SHELL FISHERIES
CTDT	CONNECTICUT DEPARTMENT OF TRANSPORTATION
CTGS	CONNECTICUT GEODETIC SURVEY
DCDHT	DC DEPARTMENT OF HIGHWAYS AND TRAFFIC
DEDHT	DELAWARE DEPARTMENT OF HIGHWAYS AND TRANSP
DEGS	DELAWARE GEOLOGICAL SURVEY
FLAA	FLORIDA AVIATION AUTHORITY
FLCSFC	CENTRAL SOUTH FLORIDA FLOOD CONTROL DISTRICT
FLDACS	FLORIDA DEPARTMENT OF AGR AND CONSUMER SERV
FLDEP	FLORIDA DEPARTMENT OF ENVIROMENTAL PROTECTION
FLDNR	FLORIDA DEPARTMENT OF NATURAL RESOURCES (FLDEP)
FLDPW	FLORIDA DEPARTMENT OF PUBLIC WORKS
FLDT	FLORIDA DEPARTMENT OF TRANSPORTATION
FLGS	FLORIDA GEODETIC SURVEY
FLHD	FLORIDA HIGHWAY DEPARTMENT (NOW FLDT)
FLSRD	FLORIDA STATE ROAD DEPARTMENT
GACON	GEORGIA CONSORTIUM
GADT	GEORGIA DEPARTMENT OF TRANSPORTATION
GAGS	GEORGIA GEODETIC SURVEY
GAHD	GEORGIA HIGHWAY DEPARTMENT (NOW GADT)
HI	STATE OF HAWAII
HIDT	HAWAII DEPARTMENT OF TRANSPORTATION
HIGS	HAWAII GEODETIC SURVEY
HITS	HAWAII TERRITORIAL SURVEY

SYMBOL	FULL NAME
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IACC	IOWA CONSERVATION COMMISSION
IADT	IOWA DEPARTMENT OF TRANSPORTATION
IAHD	IOWA HIGHWAY DEPARTMENT
IDDH	IDAHO DEPARTMENT OF HIGHWAYS (NOW IDDT)
IDDT	IDAHO DEPARTMENT OF TRANSPORTATION (NOW IDTD)
IDGS	IDAHO GEODETIC SURVEY
IDPWD	IDAHO DEPARTMENT OF PUBLIC WORKS
IDTD	IDAHO TRANSPORTATION DEPARTMENT
ILDPW	ILLINOIS DEPARTMENT OF PUBLIC WORKS
ILDT	ILLINOIS DEPARTMENT OF TRANSPORTATION
ILDW	ILLINOIS DIVISION OF WATERWAYS
ILGS	ILLINOIS GEODETIC SURVEY
ILHD	ILLINOIS HIGHWAY DEPARTMENT (NOW ILDT)
ILSC	ILLINOIS SANITARY COMMISSION
INDNR	INDIANA DEPARTMENT OF NATURAL RESOURCES
INDOT	INDIANA DEPARTMENT OF TRANSPORTATION
INFCC	INDIANA FLOOD CONTROL AND WATER RES COMM
INGS	INDIANA GEODETIC SURVEY
INHD	INDIANA HIGHWAY DEPARTMENT
IOWAGS	IOWA GEODETIC SURVEY
KSDT	KANSAS DEPARTMENT OF TRANSPORTATION
KSGS	KANSAS GEODETIC SURVEY
KSHC	STATE HIGHWAY COMM OF KANSAS (NOW KSDT)
KSWRB	KANSAS WATER RESOURCES BOARD
KYDT	KENTUCKY DEPARTMENT OF TRANSPORTATION
KYGS	KENTUCKY GEODETIC SURVEY
KYHD	KENTUCKY STATE HIGHWAY DEPARTMENT (NOW KYDT)

LADH	LOUISIANA DEPARTMENT OF HIGHWAYS (NOW LADTD)
LADHGS	LOUISIANA DEPARTMENT OF HIGHWAYS AND CGS
LADPW	LOUISIANA DEPARTMENT OF PUBLIC WORKS
LADTD	LOUISIANA DEPT OF TRANSP AND DEVELOPMENT
LAGS	LOUISIANA GEODETIC SURVEY
LASCC	LOUISIANA STATE CONSERVATION COMMISSION
MADLH	MASSACHUSETTS DEPARTMENT OF LAND AND HARBORS
MADPW	MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS
MAGS	MASSACHUSETTS GEODETIC SURVEY
MAHWY	MASSACHUSETTS HIGHWAY DEPARTMENT
MALCT	MASSACHUSETTS LAND COURT
MDBCSM	MARYLAND BUREAU OF CONTROL SURVEYS AND MAPS
MDDNR	MARYLAND DEPARTMENT OF NATURAL RESOURCES
MDDT	MARYLAND DEPARTMENT OF TRANSPORTATION
MDGS	MARYLAND GEODETIC SURVEY
MDSFC	MARYLAND SHELL FISHERIES COMMISSION
MDSHA	MARYLAND DOT STATE HIGHWAY ADMINISTRATION
MDSRC	MARYLAND STATE ROADS COMMISSION (NOW MDDT)
MEDT	MAINE DEPARTMENT OF TRANSPORTATION
MEGS	MAINE GEODETIC SURVEY
MEHD	MAINE HIGHWAY DEPARTMENT (NOW MEDT)
MEPUC	MAINE PUBLIC UTILITIES COMMISSION

STATE, PROVINCE, COMMONWEALTH, AND TERRITORIAL AGENCIES - CONTINUED

SYMBOL	FULL NAME
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MIDH	MICHIGAN DEPT OF STATE HIGHWAYS AND TRANSP
MIDNR	MICHIGAN DEPARTMENT OF NATURAL RESOURCES
MIDT	MICHIGAN DEPARTMENT OF TRANSPORTATION
MIGS	MICHIGAN GEODETIC SURVEY
MNDNR	MINNESOTA DEPARTMENT OF NATURAL RESOURCES
MNDT	MINNESOTA DEPARTMENT OF TRANSPORTATION
MNGS	MINNESOTA GEODETIC SURVEY
MNHD	MINNESOTA HIGHWAY DEPARTMENT (NOW MNDT)
MODNR	MISSOURI DEPARTMENT OF NATURAL RESOURCES
MOGS	MISSOURI GEODETIC SURVEY
MOHC	MISSOURI STATE HIGHWAY COMMISSION
MOSLSA	MISSOURI STATE LAND SURVEY AUTHORITY
MSDEQ	MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY
MSGS	MISSISSIPPI GEODETIC SURVEY
MSHD	MISSISSIPPI STATE HIGHWAY DEPARTMENT
MTBOR	MONTANA BUREAU OF PUBLIC ROADS
MTDH	MONTANA DEPARTMENT OF HIGHWAYS
MTDOT	MONTANA DEPARTMENT OF TRANSPORTATION
MTGS	MONTANA GEODETIC SURVEY
MTSHC	MONTANA STATE HIGHWAY COMMISSION
NCDF	NORTH CAROLINA DIVISION OF FORESTRY
NCDNR	NORTH CAROLINA DEPT OF NATURAL RESOURCES
NCDOA	NORTH CAROLINA DEPARTMENT OF AGRICULTURE
NCDOT	NORTH CAROLINA DEPT OF TRANS DIV OF HWYS
NCGS	NORTH CAROLINA GEODETIC SURVEY
NCHC	NORTH CAROLINA HIGHWAY COMMISSION (NOW NCDOT)
NCHPWC	NORTH CAROLINA HIGHWAY AND PUBLIC WORKS COMM
NCSHC	NORTH CAROLINA STATE HIGHWAY COMMISSION
NDGS	NORTH DAKOTA GEODETIC SURVEY
NDHD	NORTH DAKOTA HIGHWAY DEPARTMENT
NDWC	NORTH DAKOTA WATER COMMISSION
NEDR	NEBRASKA DEPARTMENT OF ROADS
NEGS	NEBRASKA GEODETIC SURVEY

NEPPD NEBRASKA PUBLIC POWER DISTRICT
NHDOT NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION
NHDPWH NEW HAMPSHIRE DEPT OF PUBLIC WORKS + HWYS
NHGS NEW HAMPSHIRE GEODETIC SURVEY
NHHD NEW HAMPSHIRE HIGHWAY DEPARTMENT
NJBCN NEW JERSEY BOARD OF COMMERCE AND NAVIGATION
NJDCED NEW JERSEY DEPARTMENT OF CONSERVATION AND ECON DEV
NJDEP NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
NJDT NEW JERSEY DEPARTMENT OF TRANSPORTATION
NJGS NEW JERSEY GEODETIC SURVEY
NJHA NEW JERSEY HIGHWAY AUTHORITY
NJSFC NEW JERSEY SHELL FISHERIES COMMISSION
NMGS NEW MEXICO GEODETIC SURVEY
NMHC NEW MEXICO STATE HIGHWAY COMMISSION
NMHD NEW MEXICO STATE HIGHWAY DEPARTMENT
NVBMG NEVADA BUREAU OF MINES AND GEOLOGY
NVDH NEVADA DEPARTMENT OF HIGHWAYS

SYMBOL	FULL NAME
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NVDT	NEVADA DEPARTMENT OF TRANSPORTATION
NVGS	NEVADA GEODETIC SURVEY
NYBE+A	NEW YORK BOARD OF ESTIMATE AND APPORTIONMENT
NYDPW	NEW YORK STATE DEPARTMENT OF PUBLIC WORKS
NYDT	NEW YORK STATE DEPARTMENT OF TRANSPORTATION
NYGS	NEW YORK GEODETIC SURVEY
NYHD	NEW YORK DEPARTMENT OF HIGHWAYS (NOW NYDT)
NYLISP	NEW YORK LONG ISLAND STATE PARK AUTHORITY
NYNPA	NEW YORK NIAGARA POWER AUTHORITY
NYSE+S	NEW YORK STATE ENGINEER AND SURVEYOR
NYSS	NEW YORK STATE SURVEY
OHDNR	OHIO DEPARTMENT OF NATURAL RESOURCES
OHDT	OHIO DEPARTMENT OF TRANSPORTATION
OHGS	OHIO GEODETIC SURVEY
OHHD	OHIO HIGHWAY DEPARTMENT (NOW OHDT)
OKCC	OKLAHOMA CONSERVATION COMMISSION
OKDH	OKLAHOMA DEPARTMENT OF HIGHWAYS
OKDOT	OKLAHOMA DEPARTMENT OF TRANSPORTATION
OKGS	OKLAHOMA GEODETIC SURVEY
ORDT	OREGON DEPARTMENT OF TRANSPORTATION
ORGS	OREGON GEODETIC SURVEY
ORHD	OREGON STATE HIGHWAY DEPARTMENT (NOW ORDT)
ORSLB	OREGON STATE LAND BOARD
ORTAX	OREGON STATE TAX COMMISSION
PADFW	PENNSYLVANIA DEPT OF FORESTS AND WATERS
PADH	PENNSYLVANIA DEPT OF HIGHWAYS (NOW PADT)
PADT	PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
PAGS	PENNSYLVANIA GEODETIC SURVEY
PATUCO	PENNSYLVANIA TURNPIKE COMMISSION
PRPWD	PUERTO RICO PUBLIC WORKS DEPARTMENT
RIBPR	RHODE ISLAND BUREAU OF PUBLIC ROADS
RIDT	RHODE ISLAND DEPARTMENT OF TRANSPORTATION
RIGS	RHODE ISLAND GEODETIC SURVEY
SCCC	SOUTH CAROLINA COASTAL COUNCIL
SCDHPT	SOUTH CAROLINA DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
SCDNR	SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
SCDOT	SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
SCGS	SOUTH CAROLINA GEODETIC SURVEY
SCHD	SOUTH CAROLINA STATE HIGHWAY DEPARTMENT

SCWRC	SOUTH CAROLINA WATER RESOURCE COMMISSION
SDDT	SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION
SDGS	SOUTH DAKOTA GEODETIC SURVEY
SDHD	SOUTH DAKOTA HIGHWAY DEPARTMENT (NOW SDDT)
TNDG	TENNESSEE DIVISION OF GEOLOGY
TNDPW	TENNESSEE DEPARTMENT OF PUBLIC WORKS
TNDT	TENNESSEE DEPARTMENT OF TRANSPORTATION
TNGS	TENNESSEE GEODETIC SURVEY
TNHD	TENNESSEE HIGHWAY DEPARTMENT (NOW TNDT)
TXAC	TEXAS AERONAUTICS COMMISSION
TXDOT	TEXAS DEPARTMENT OF TRANSPORTATION
TXGS	TEXAS GEODETIC SURVEY
TXHD	TEXAS HIGHWAY DEPARTMENT

STATE, PROVINCE, COMMONWEALTH, AND TERRITORIAL AGENCIES - CONTINUED

SYMBOL	FULL NAME
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TXRD	TEXAS RECLAMATION DEPARTMENT
UTDH	UTAH STATE DEPARTMENT OF HIGHWAYS
VACF	VIRGINIA COMMISSION OF FISHERIES
VADH	VIRGINIA DEPARTMENT OF HIGHWAYS
VADHT	VIRGINIA DEPT OF HIGHWAYS AND TRANSPORTATION
VAGS	VIRGINIA GEODETIC SURVEY
VAMR	VIRGINIA MARINE RESOURCES
VTANR	VERMONT AGENCY OF NATURAL RESOURCES
VTAT	VERMONT AGENCY OF TRANSPORTATION
VTDH	VERMONT DEPARTMENT OF HIGHWAYS (NOW VTAT)
VTFS	VERMONT FOREST SERVICE
VTGS	VERMONT GEODETIC SURVEY
VTHP	VERMONT HISTORIC PRESERVATION
VTMP	VERMONT MAPPING PROGRAM
VTSM	STATE OF VERMONT SURVEY MARK
WADECO	WASHINGTON DEPARTMENT OF ECOLOGY
WADNR	WASHINGTON DEPARTMENT OF NATURAL RESOURCES
WADPL	WASHINGTON STATE DEPARTMENT OF PUBLIC LANDS
WADPW	WASHINGTON DEPARTMENT OF PUBLIC WORKS
WADT	WASHINGTON DEPARTMENT OF TRANSPORTATION
WAGS	WASHINGTON GEODETIC SURVEY
WAHC	WASHINGTON STATE HIGHWAY COMMISSION
WATBA	WASHINGTON STATE TOLL BRIDGE AUTHORITY
WIDNR	WISCONSIN DEPARTMENT OF NATURAL RESOURCES
WIDT	WISCONSIN DEPARTMENT OF TRANSPORTATION
WIGS	WISCONSIN GEODETIC SURVEY
WIHD	WISCONSIN HIGHWAY DEPARTMENT (NOW WIDT)
WIPSC	WISCONSIN PUBLIC SERVICE COMMISSION
WIRRC	WISCONSIN RAILROAD COMMISSION
WVGS	WEST VIRGINIA GEODETIC SURVEY
WVHD	WEST VIRGINIA HIGHWAY DEPARTMENT
WYDT	WYOMING DEPARTMENT OF TRANSPORTATION
WYGS	WYOMING GEODETIC SURVEY
WYHD	WYOMING HIGHWAY DEPARTMENT (NOW WYDT)

COUNTY AGENCIES

SYMBOL	FULL NAME
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AK-013	ALEUTIANS EAST BOROUGH
AK-016	ALEUTIANS WEST CENSUS AREA
AK-020	MUNICIPALITY OF ANCHORAGE
AK-050	BETHEL CENSUS AREA
AK-060	BRISTOL BAY BOROUGH
AK-068	DENALI BOROUGH
AK-070	DILLINGHAM CENSUS AREA
AK-090	FAIRBANKS NORTH STAR BOROUGH
AK-100	HAINES BOROUGH
AK-110	JUNEAU BOROUGH
AK-122	KENAI PENINSULA BOROUGH
AK-130	KETCHIKAN GATEWAY BOROUGH
AK-150	KODIAK ISLAND BOROUGH
AK-164	LAKE AND PENINSULA BOROUGH
AK-170	MATANUSKA-SUSITNA BOROUGH
AK-180	NOME CENSUS AREA
AK-185	NORTH SLOPE BOROUGH
AK-188	NORTHWEST ARCTIC BOROUGH
AK-201	PRINCE OF WALES-OUTER KETCHIKAN CENSUS AREA
AK-220	SITKA BOROUGH
AK-232	SKAGWAY-HOONAH-ANGOON CENSUS AREA
AK-240	SOUTHEAST FAIRBANKS CENSUS AREA
AK-261	VALDEZ-CORDOVA CENSUS AREA
AK-270	WADE HAMPTON CENSUS AREA
AK-280	WRANGELL-PETERSBURG CENSUS AREA
AK-282	YAKUTAT BOROUGH
AK-290	YUKON-KOYUKUK CENSUS AREA
AL-053	ESCAMBIA COUNTY ALABAMA
AL-073	JEFFERSON COUNTY ALABAMA
AL-101	MONTGOMERY COUNTY ALABAMA
AL-107	PICKENS COUNTY ALABAMA
AL-119	SUMTER COUNTY ALABAMA
AR-005	BAXTER COUNTY ARKANSAS
AZ-013	MARICOPA COUNTY ARIZONA
AZ-015	MOHAVE COUNTY ARIZONA
AZ-019	PIMA COUNTY ARIZONA
AZ-021	PINAL COUNTY ARIZONA
CA-001	ALAMEDA COUNTY CALIFORNIA
CA-007	BUTTE COUNTY CALIFORNIA
CA-013	CONTRA COSTA COUNTY CALIFORNIA
CA-019	FRESNO COUNTY CALIFORNIA
CA-023	HUMBOLDT COUNTY CALIFORNIA
CA-025	IMPERIAL COUNTY CALIFORNIA
CA-027	INYO COUNTY CALIFORNIA
CA-029	KERN COUNTY CALIFORNIA
CA-031	KINGS COUNTY CALIFORNIA
CA-033	LAKE COUNTY CALIFORNIA
CA-037	LOS ANGELES COUNTY CALIFORNIA
CA-041	MARIN COUNTY CALIFORNIA
CA-043	MARIPOSA COUNTY CALIFORNIA
CA-045	MENDOCINO COUNTY CALIFORNIA

CA-051 MONO COUNTY CALIFORNIA

SYMBOL	FULL NAME
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CA-053	MONTEREY COUNTY CALIFORNIA
CA-055	NAPA COUNTY CALIFORNIA
CA-059	ORANGE COUNTY CALIFORNIA
CA-061	PLACER COUNTY CALIFORNIA
CA-063	PLUMAS COUNTY CALIFORNIA
CA-065	RIVERSIDE COUNTY CALIFORNIA
CA-067	SACRAMENTO COUNTY CALIFORNIA
CA-069	SAN BENITO COUNTY CALIFORNIA
CA-071	SAN BERNARDINO COUNTY CALIFORNIA
CA-073	SAN DIEGO COUNTY CALIFORNIA
CA-075	SAN FRANCISCO COUNTY CALIFORNIA
CA-077	SAN JOAQUIN COUNTY CALIFORNIA
CA-079	SAN LUIS OBISPO COUNTY CALIFORNIA
CA-081	SAN MATEO COUNTY CALIFORNIA
CA-083	SANTA BARBARA COUNTY CALIFORNIA
CA-085	SANTA CLARA COUNTY CALIFORNIA
CA-087	SANTA CRUZ COUNTY CALIFORNIA
CA-089	SHASTA COUNTY CALIFORNIA
CA-091	SIERRA COUNTY CALIFORNIA
CA-093	SISKIYOU COUNTY CALIFORNIA
CA-095	SOLANO COUNTY CALIFORNIA
CA-097	SONOMA COUNTY CALIFORNIA
CA-099	STANISLAUS COUNTY CALIFORNIA
CA-103	TEHAMA COUNTY CALIFORNIA
CA-105	TRINITY COUNTY CALIFORNIA
CA-107	TULARE COUNTY CALIFORNIA
CA-109	TUOLUMNE COUNTY CALIFORNIA
CA-111	VENTURA COUNTY CALIFORNIA
CA-113	YOLO COUNTY CALIFORNIA
CO-001	ADAMS COUNTY COLORADO
CO-005	ARAPAHOE COUNTY COLORADO
CO-013	BOULDER COUNTY COLORADO
CO-017	CHEYENNE COUNTY COLORADO
CO-059	JEFFERSON COUNTY COLORADO
CO-061	KIOWA COUNTY COLORADO
CO-069	LARIMER COUNTY COLORADO
CO-077	MESA COUNTY COLORADO
CO-101	PUEBLO COUNTY COLORADO
CO-123	WELD COUNTY COLORADO
FL-001	ALACHUA COUNTY FLORIDA
FL-005	BAY COUNTY FLORIDA
FL-009	BREVARD COUNTY FLORIDA
FL-011	BROWARD COUNTY FLORIDA
FL-015	CHARLOTTE COUNTY FLORIDA
FL-017	CITRUS COUNTY FLORIDA
FL-025	DADE COUNTY FLORIDA
FL-033	ESCAMBIA COUNTY FLORIDA
FL-053	HERNANDO COUNTY FLORIDA
FL-057	HILLSBOROUGH COUNTY FLORIDA
FL-061	INDIAN RIVER
FL-069	LAKE COUNTY FLORIDA
FL-071	LEE COUNTY FLORIDA

SYMBOL FULL NAME

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FL-081 MANATEE COUNTY FLORIDA
FL-083 MARION COUNTY FLORIDA
FL-085 MARTIN COUNTY FLORIDA
FL-091 OKALOOSA COUNTY FLORIDA
FL-095 ORANGE COUNTY FLORIDA
FL-097 OSCEOLA COUNTY FLORIDA
FL-099 PALM BEACH COUNTY FLORIDA
FL-101 PASCO COUNTY FLORIDA
FL-103 PINELLAS COUNTY FLORIDA
FL-107 PUTNAM COUNTY FLORIDA
FL-109 ST JOHNS COUNTY FLORIDA
FL-111 ST LUCIE COUNTY FLORIDA
FL-113 SANTA ROSA COUNTY FLORIDA
FL-115 SARASOTA COUNTY FLORIDA
FL-131 WALTON COUNTY FLORIDA
GA-067 COBB COUNTY GEORGIA
GA-089 DE KALB COUNTY GEORGIA
GA-095 DOUGHERTY COUNTY GEORGIA
GA-117 FORSYTH COUNTY GEORGIA
GA-121 FULTON COUNTY GEORGIA
GA-135 GWINNETT COUNTY GEORGIA
GA-151 HENRY COUNTY GEORGIA
IA-031 CEDAR COUNTY IOWA
IA-033 CERRO GORDO COUNTY IOWA
IA-035 CHEROKEE COUNTY IOWA
IA-037 CHICKASAW COUNTY IOWA
IA-057 DES MOINES COUNTY IOWA
IA-059 DICKINSON COUNTY IOWA
IA-063 EMMET COUNTY IOWA
IA-065 FAYETTE COUNTY IOWA
IA-077 GUTHRIE COUNTY IOWA
IA-083 HARDIN COUNTY IOWA
IA-105 JONES COUNTY IOWA
IA-113 LINN COUNTY IOWA
IA-119 LYON COUNTY IOWA
IA-125 MARION COUNTY IOWA
IA-147 PALO ALTO COUNTY IOWA
IA-149 PLYMOUTH COUNTY IOWA
IA-159 RINGGOLD COUNTY IOWA
IA-165 SHELBY COUNTY IOWA
IA-167 SIOUX COUNTY IOWA
IA-169 STORY COUNTY IOWA
IA-183 WASHINGTON COUNTY IOWA
ID-011 ADA COUNTY IDAHO
ID-079 SHOSHONE COUNTY IDAHO
IL-031 COOK COUNTY ILLINOIS
IL-043 DU PAGE COUNTY ILLINOIS
IL-051 FAYETTE COUNTY ILLINOIS
IL-103 LEE COUNTY ILLINOIS
IL-125 MADISON COUNTY ILLINOIS
IL-163 ST CLAIR COUNTY ILLINOIS
IL-195 WHITESIDE COUNTY ILLINOIS
IN-003 ALLEN COUNTY INDIANA
IN-039 ELKHART COUNTY INDIANA

SYMBOL FULL NAME
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IN-057 HAMILTON COUNTY INDIANA
IN-059 HANCOCK COUNTY INDIANA
IN-085 KOSCIUSKO COUNTY INDIANA
IN-097 MARION COUNTY INDIANA

IN-127	PORTER COUNTY INDIANA
IN-131	PULASKI COUNTY INDIANA
IN-141	ST JOSEPH COUNTY INDIANA
KS-007	BARBER COUNTY KANSAS
KS-009	BARTON COUNTY KANSAS
KS-167	RUSSELL COUNTY KANSAS
KS-171	SCOTT COUNTY KANSAS
KS-189	STEVENS COUNTY KANSAS
KS-203	WICHITA COUNTY KANSAS
KS-207	WOODSON COUNTY KANSAS
KS-209	WYANDOTTE COUNTY KANSAS
LA-019	CALASIEU PARISH LOUISIANA
LA-033	EAST BATON ROUGE PARISH LOUISIANA
LA-051	JEFFERSON PARISH LOUISIANA
LA-087	ST BERNARD PARISH LOUISIANA
LA-101	ST MARY PARISH LOUISIANA
MD-003	ANNE ARUNDEL COUNTY MARYLAND
MD-005	BALTIMORE COUNTY MARYLAND
MD-013	CARROLL COUNTY MARYLAND
MD-017	CHARLES COUNTY MARYLAND
MD-019	DORCHESTER COUNTY MARYLAND
MD-021	FREDERICK COUNTY MARYLAND
MD-025	HARFORD COUNTY MARYLAND
MD-027	HOWARD COUNTY MARYLAND
MD-037	ST MARYS COUNTY MARYLAND
MD-043	WASHINGTON COUNTY MARYLAND
ME-007	FRANKLIN COUNTY MAINE
MI-003	ALGER COUNTY MICHIGAN
MI-005	ALLEGAN COUNTY MICHIGAN
MI-011	ARENAC COUNTY MICHIGAN
MI-015	BARRY COUNTY MICHIGAN
MI-033	CHIPPEWA COUNTY MICHIGAN
MI-053	GOGEBIC COUNTY MICHIGAN
MI-061	HOUGHTON COUNTY MICHIGAN
MI-063	HURON COUNTY MICHIGAN
MI-075	JACKSON COUNTY MICHIGAN
MI-081	KENT COUNTY MICHIGAN
MI-109	MENOMINEE COUNTY MICHIGAN
MI-125	OAKLAND COUNTY MICHIGAN
MI-161	WASHTENAW COUNTY MICHIGAN
MI-163	WAYNE COUNTY MICHIGAN
MN-019	CARVER COUNTY MINNESOTA
MN-035	CROW WING COUNTY MINNESOTA
MN-037	DAKOTA COUNTY MINNESOTA
MN-041	DOUGLAS COUNTY MINNESOTA
MN-049	GOODHUE COUNTY MINNESOTA
MN-053	HENNEPIN COUNTY MINNESOTA
MN-055	HOUSTON COUNTY MINNESOTA
MN-061	ITASCA COUNTY MINNESOTA

SYMBOL	FULL NAME
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MN-075	LAKE COUNTY MINNESOTA
MN-085	MCLEOD COUNTY MINNESOTA
MN-103	NIC OLLET COUNTY MINNESOTA
MN-109	OLMSTED COUNTY MINNESOTA
MN-123	RAMSEY COUNTY MINNESOTA
MN-131	RICE COUNTY MINNESOTA
MN-137	ST LOUIS COUNTY MINNESOTA
MN-141	SHERBURNE COUNTY MINNESOTA
MN-153	TODD COUNTY MINNESOTA
MN-161	WASECA COUNTY MINNESOTA

MN-163 WASHINGTON COUNTY MINNESOTA
MN-165 WATONWAN COUNTY MINNESOTA
MS-059 JACKSON COUNTY MISSISSIPPI
MS-135 TALLAHATCHIE COUNTY MISSISSIPPI
MS-145 UNION COUNTY MISSISSIPPI
NC-045 CLEVELAND COUNTY NORTH CAROLINA
NC-095 HYDE COUNTY NORTH CAROLINA
NC-129 NEW HANOVER COUNTY NORTH CAROLINA
NC-183 WAKE COUNTY NORTH CAROLINA
ND-057 MERCER COUNTY NORTH DAKOTA
NE-109 LANCASTER COUNTY NEBRASKA
NE-141 PLATTE COUNTY NEBRASKA
NE-167 STANTON COUNTY NEBRASKA
NJ-017 HUDSON COUNTY NEW JERSEY
NJ-035 SOMERSET COUNTY NEW JERSEY
NM-049 SANTA FE COUNTY NEW MEXICO
NV-027 PERSHING COUNTY NEVADA
NV-031 WASHOE COUNTY NEVEDA
NY-005 BOROUGH OF BRONX NEW YORK
NY-023 CORTLAND COUNTY NEW YORK
NY-025 DELAWARE COUNTY NEW YORK
NY-029 ERIE COUNTY NEW YORK
NY-035 FULTON COUNTY NEW YORK
NY-055 MONROE COUNTY NEW YORK
NY-057 MONTGOMERY COUNTY NEW YORK
NY-059 NASSAU COUNTY NEW YORK
NY-065 ONEIDA COUNTY NEW YORK
NY-069 ONTARIO COUNTY NEW YORK
NY-085 BOROUGH OF RICHMOND NEW YORK
NY-091 SARATOGA COUNTY NEW YORK
NY-103 SUFFOLK COUNTY NEW YORK
NY-111 ULSTER COUNTY NEW YORK
NY-119 WESTCHESTER COUNTY NEW YORK
OH-011 AUGLAIZE COUNTY OHIO
OH-013 BELMONT COUNTY OHIO
OH-017 BUTLER COUNTY OHIO
OH-023 CLARK COUNTY OHIO
OH-031 COSHOCTON COUNTY OHIO
OH-035 CUYAHOGA COUNTY OHIO
OH-041 DELAWARE COUNTY OHIO
OH-047 FAYETTE COUNTY OHIO
OH-049 FRANKLIN COUNTY OHIO
OH-051 FULTON COUNTY OHIO

SYMBOL FULL NAME
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OH-055 GEAUGA COUNTY OHIO
OH-057 GREENE COUNTY OHIO
OH-063 HANCOCK COUNTY OHIO
OH-083 KNOX COUNTY OHIO
OH-095 LUCAS COUNTY OHIO
OH-099 MAHONING COUNTY OHIO
OH-107 MERCER COUNTY OHIO
OH-109 MIAMI COUNTY OHIO
OH-113 MONTGOMERY COUNTY OHIO
OH-119 MUSKINGUM COUNTY OHIO
OH-133 PORTAGE COUNTY OHIO
OH-147 SENECA COUNTY OHIO
OH-151 STARK COUNTY OHIO
OH-153 SUMMIT COUNTY OHIO
OH-157 TUSCARAWAS COUNTY OHIO
OH-159 UNION COUNTY OHIO

OK-003 ALFALFA COUNTY OKLAHOMA
OK-133 SEMINOLE COUNTY OKLAHOMA
OR-011 COOS COUNTY OREGON
OR-015 CURRY COUNTY OREGON
OR-017 DESCHUTES COUNTY OREGON
OR-019 DOUGLAS COUNTY OREGON
OR-029 JACKSON COUNTY OREGON
OR-033 JOSEPHINE COUNTY OREGON
OR-035 KLAMATH COUNTY OREGON
OR-039 LANE COUNTY OREGON
OR-043 LINN COUNTY OREGON
OR-047 MARION COUNTY OREGON
OR-049 MORROW COUNTY OREGON
OR-051 MULTNOMAH COUNTY OREGON
OR-053 POLK COUNTY OREGON
OR-067 WASHINGTON COUNTY OREGON
OR-071 YAMHILL COUNTY OREGON
PA-003 ALLEGHENY COUNTY PENNSYLVANIA
PA-029 CHESTER COUNTY PENNSYLVANIA
PA-085 MERCER COUNTY PENNSYLVANIA
PA-091 MONTGOMERY COUNTY PENNSYLVANIA
PA-133 YORK COUNTY PENNSYLVANIA
SC-003 AIKEN COUNTY SOUTH CAROLINA
SC-013 BEAUFORT COUNTY SOUTH CAROLINA
SC-043 GEORGETOWN COUNTY SOUTH CAROLINA
SC-083 SPARTANBURG COUNTY SOUTH CAROLINA
TN-003 BEDFORD COUNTY TENNESSEE
TN-069 HARDEMAN COUNTY TENNESSEE
TX-039 BRAZORIA COUNTY TEXAS
TX-049 BROWN COUNTY TEXAS
TX-057 CALHOUN COUNTY TEXAS
TX-141 EL PASO COUNTY TEXAS
TX-165 GAINES COUNTY TEXAS
TX-177 GONZALES COUNTY TEXAS
TX-195 HANSFORD COUNTY TEXAS
TX-281 LAMPASAS COUNTY TEXAS

SYMBOL FULL NAME
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TX-321 MATAGORDA COUNTY TEXAS
TX-355 NUECES COUNTY TEXAS
UT-027 MILLARD COUNTY UTAH
UT-035 SALT LAKE COUNTY UTAH
UT-041 SEVIER COUNTY UTAH
UT-047 UINTAH COUNTY UTAH
UT-049 UTAH COUNTY UTAH
UT-051 WASATCH COUNTY UTAH
UT-053 WASHINGTON COUNTY UTAH
VA-009 AMHERST COUNTY VIRGINIA
VA-013 ARLINGTON COUNTY VIRGINIA
VA-019 BEDFORD COUNTY VIRGINIA
VA-031 CAMPBELL COUNTY VIRGINIA
VA-059 FAIRFAX COUNTY VIRGINIA
VA-061 FAUQUIER COUNTY VIRGINIA
VA-085 HANOVER COUNTY VIRGINIA
VA-087 HENRICO COUNTY VIRGINIA
VA-095 JAMES CITY COUNTY VIRGINIA
VA-153 PRINCE WILLIAM COUNTY VIRGINIA
VA-199 YORK COUNTY VIRGINIA
WA-001 ADAMS COUNTY WASHINGTON
WA-005 BENTON COUNTY WASHINGTON
WA-009 CLALLAM COUNTY WASHINGTON

WA-011 CLARK COUNTY WASHINGTON
WA-015 COWLITZ COUNTY WASHINGTON
WA-017 DOUGLAS COUNTY WASHINGTON
WA-021 FRANKLIN COUNTY WASHINGTON
WA-025 GRANT COUNTY WASHINGTON
WA-029 ISLAND COUNTY WASHINGTON
WA-033 KING COUNTY WASHINGTON
WA-039 KLICKITAT COUNTY WASHINGTON
WA-041 LEWIS COUNTY WASHINGTON
WA-047 OKANOGAN COUNTY WASHINGTON
WA-049 PACIFIC COUNTY WASHINGTON
WA-053 PIERCE COUNTY WASHINGTON
WA-057 SKAGIT COUNTY WASHINGTON
WA-061 SNOHOMISH COUNTY WASHINGTON
WA-065 STEVENS COUNTY WASHINGTON
WA-077 YAKIMA COUNTY WASHINGTON
WI-003 ASHLAND COUNTY WISCONSIN
WI-007 BAYFIELD COUNTY WISCONSIN
WI-009 BROWN COUNTY WISCONSIN
WI-013 BURNETT COUNTY WISCONSIN
WI-019 CLARK COUNTY WISCONSIN
WI-025 DANE COUNTY WISCONSIN
WI-027 DODGE COUNTY WISCONSIN
WI-031 DOUGLAS COUNTY WISCONSIN
WI-033 DUNN COUNTY WISCONSIN
WI-035 EAU CLAIRE COUNTY WISCONSIN
WI-039 FOND DU LAC COUNTY WISCONSIN

COUNTY AGENCIES - CONTINUED

SYMBOL FULL NAME
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WI-078 MEN0MINEE COUNTY WISCONSIN
WI-095 POLK COUNTY WISCONSIN
WI-099 PRICE COUNTY WISCONSIN
WI-101 RACINE COUNTY WISCONSIN
WI-113 SAWYER COUNTY WISCONSIN
WI-119 TAYLOR COUNTY WISCONSIN
WI-129 WASHBURN COUNTY WISCONSIN
WV-069 OHIO COUNTY WEST VIRGINIA
WV-085 RITCHIE COUNTY WEST VIRGINIA

MUNICIPAL AGENCIES (CITIES)

SYMBOL FULL NAME
****** ***
AK0130 CITY OF ANCHORAGE ALASKA
AK1250 CITY OF KETCHIKAN ALASKA
AL0930 CITY OF DOTHAN ALABAMA
AL1730 CITY OF HUNTSVILLE ALABAMA
AL2130 CITY OF MONTGOMERY ALABAMA
AR2320 CITY OF LITTLE ROCK ARKANSAS
AR3390 CITY OF ROGERS ARKANSAS
AR3880 CITY OF TUPELO ARKANSAS
AR4063 CITY OF WELDON ARKANSAS
AZ0370 CITY OF PHOENIX ARIZONA
AZ0420 CITY OF SCOTTSDALE ARIZONA
AZ0490 CITY OF TEMPE ARIZONA
CA0010 CITY OF ALAMEDA CALIFORNIA
CA0080 CITY OF ANAHEIM CALIFORNIA
CA0340 CITY OF BERKELEY CALIFORNIA
CA0470 CITY OF BUENA PARK CALIFORNIA
CA0480 CITY OF BURBANK CALIFORNIA

CA0537 CITY OF CAMPBELL CALIFORNIA
CA0710 CITY OF CHULA VISTA CALIFORNIA
CA0790 CITY OF COLTON CALIFORNIA
CA0850 CITY OF CORONA CALIFORNIA
CA1182 CITY OF ENCINITAS CALIFORNIA
CA1220 CITY OF EUREKA CALIFORNIA
CA1364 CITY OF FREMONT CALIFORNIA
CA1370 CITY OF FRESNO CALIFORNIA
CA1430 CITY OF GLENDALE CALIFORNIA
CA1450 CITY OF GONZALES CALIFORNIA
CA1520 CITY OF GUSTINE CALIFORNIA
CA1540 CITY OF HANFORD CALIFORNIA
CA1560 CITY OF HAYWARD CALIFORNIA
CA1580 CITY OF HEMET CALIFORNIA
CA1660 CITY OF HUNTINGTON BEACH CALIFORNIA
CA1970 CITY OF LONG BEACH CALIFORNIA
CA1980 CITY OF LOS ANGELES CALIFORNIA
CA2090 CITY OF MARTINEZ CALIFORNIA

SYMBOL	FULL NAME
******	**
CA2280	CITY OF MORGAN HILL CALIFORNIA
CA2290	CITY OF MORROW BAY CALIFORNIA
CA2330	CITY OF NAPA CALIFORNIA
CA2390	CITY OF NEWMAN CALIFORNIA
CA2460	CITY OF NOVATO CALIFORNIA
CA2480	CITY OF OAKLAND CALIFORNIA
CA2550	CITY OF ONTARIO CALIFORNIA
CA2650	CITY OF PALM SPRINGS CALIFORNIA
CA2700	CITY OF PASADENA CALIFORNIA
CA2780	CITY OF PISMO BEACH CALIFORNIA
CA2840	CITY OF PLEASANTON CALIFORNIA
CA2880	CITY OF PORTERVILLE CALIFORNIA
CA2940	CITY OF RED BLUFF CALIFORNIA
CA2970	CITY OF REDONDO BEACH CALIFORNIA
CA2980	CITY OF REDWOOD CITY CALIFORNIA
CA3070	CITY OF RIVERSIDE CALIFORNIA
CA3210	CITY OF SAN BERNARDINO CALIFORNIA
CA3260	CITY OF SAN DIEGO CALIFORNIA
CA3280	CITY OF SAN FERNANDO CALIFORNIA
CA3290	CITY OF SAN FRANCISCO CALIFORNIA
CA3340	CITY OF SAN JOSE CALIFORNIA
CA3370	CITY OF SAN LUIS OBISPO CALIFORNIA
CA3380	CITY OF SAN MARINO CALIFORNIA
CA3390	CITY OF SAN MATEO CALIFORNIA
CA3410	CITY OF SAN RAFAEL CALIFORNIA
CA3420	CITY OF SANTA ANA CALIFORNIA
CA3440	CITY OF SANTA CLARA CALIFORNIA
CA3460	CITY OF SANTA MARIA CALIFORNIA
CA3480	CITY OF SANTA PAULA CALIFORNIA
CA3490	CITY OF SANTA ROSA CALIFORNIA
CA3590	CITY OF SELMA CALIFORNIA
CA3660	CITY OF SONOMA CALIFORNIA
CA3800	CITY OF SUSANVILLE CALIFORNIA
CA3920	CITY OF TULARE CALIFORNIA
CA4020	CITY OF VALLEJO CALIFORNIA
CA4027	CITY OF VENTURA CALIFORNIA
CA4070	CITY OF WALNUT CREEK CALIFORNIA
CA4100	CITY OF WATSONVILLE CALIFORNIA

CO0110	CITY OF AURORA COLORADO
CO0600	CITY AND COUNTY OF DENVER
CO2150	CITY OF ROCKY FORD COLORADO
CT0080	CITY OF BRIDGEPORT CONNECTICUT
CT0237	CITY OF FARMINGTON CONNECTICUT
CT0280	CITY OF HARTFORD CONNECTICUT
CT0360	CITY OF MADISON CONNECTICUT
CT0370	CITY OF MERIDEN CONNECTICUT
CT0380	CITY OF MIDDLETOWN CONNECTICUT
CT0430	CITY OF NEW HAVEN CONNECTICUT
CT0810	CITY OF WATERBURY CONNECTICUT
DC001	CITY OF WASHINGTON DC
FL0290	CITY OF BOCA RATON FLORIDA
FL0570	CITY OF CLEARWATER FLORIDA
FL0780	CITY OF DAYTONA BEACH FLORIDA
FL1420	CITY OF HOLLYWOOD FLORIDA

MUNICIPAL AGENCIES (CITIES) - CONTINUED

SYMBOL	FULL NAME
FL1510	CITY OF JACKSONVILLE FLORIDA
FL1590	CITY OF KISSIMMEE FLORIDA
FL1690	CITY OF LAKELAND FLORIDA
FL2010	CITY OF MIAMI FLORIDA
FL2270	CITY OF OCALA FLORIDA
FL2360	CITY OF ORLANDO FLORIDA
FL2730	CITY OF ST PETERSBURG FLORIDA
FL2940	CITY OF TALLAHASSEE FLORIDA
FL3070	CITY OF VERO BEACH
GA0280	CITY OF ATLANTA GEORGIA
GA0760	CITY OF BRUNSWICK GEORGIA
GA1780	CITY OF DUBLIN GEORGIA
GA3440	CITY OF MARIETTA GEORGIA
GA4910	CITY OF SAVANNAH GEORGIA
HI2400	CITY OF HONOLULU HAWAII
IA2520	CITY OF DYSART IOWA
IA2530	CITY OF EAGLE GROVE IOWA
IA5240	CITY OF MAQUOKETA IOWA
IA7490	CITY OF SAC CITY IOWA
IA8880	CITY OF WEBSTER CITY IOWA
ID0790	CITY OF IDAHO FALLS IDAHO
ID1830	CITY OF TWIN FALLS IDAHO
IL0512	CITY OF BARRINGTON HILLS ILLINOIS
IL0840	CITY OF BLOOMINGTON ILLINOIS
IL1550	CITY OF CHAMPAIGN ILLINOIS
IL1670	CITY OF CHICAGO ILLINOIS
IL2380	CITY OF DIXON ILLINOIS
IL3200	CITY OF FREEBURG ILLINOIS
IL3910	CITY OF HIGHLAND PARK ILLINOIS
IL4710	CITY OF LAWRENCEVILLE ILLINOIS
IL4910	CITY OF LOCKPORT ILLINOIS
IL5360	CITY OF MASON CITY ILLINOIS
IL6850	CITY OF PEORIA ILLINOIS
IL7460	CITY OF ROCKFORD ILLINOIS
IL7640	CITY OF ST CHARLES ILLINOIS
IL9210	CITY OF WESTERN SPRINGS ILLINOIS
IL9450	CITY OF WINNEBAGO ILLINOIS
IN1830	CITY OF GOSHEN INDIANA
IN3480	CITY OF NEW HAVEN INDIANA

KS1950	CITY OF GARDEN CITY KANSAS
KS5400	CITY OF TOPEKA KANSAS
KY2090	CITY OF LOUISVILLE KENTUCKY
LA0040	CITY OF ALEXANDRIA LOUISIANA
LA0230	CITY OF BOSSIER CITY
LA1150	CITY OF JONESBORO LOUISIANA
LA1690	CITY OF NEW ORLEANS LOUISIANA
LA2410	CITY OF WEST MONROE LOUISIANA
MA0035	CITY OF ANDOVER MASSACHUSETTS
MA0120	CITY OF BOSTON MASSACHUSETTS
MA0170	CITY OF CAMBRIDGE MASSACHUSETTS
MA0660	CITY OF MALDEN MASSACHUSETTS
MA1520	CITY OF WORCESTER MASSACHUSETTS
MD0050	CITY OF BALTIMORE MARYLAND
MD0480	CITY OF EASTON MARYLAND

MUNICIPAL AGENCIES (CITIES) - CONTINUED

SYMBOL	FULL NAME
******	**
MD0580	CITY OF FREDERICK MARYLAND
MD0730	CITY OF HAGERSTOWN MARYLAND
MD1380	CITY OF SALISBURY MARYLAND
ME0250	CITY OF BANGOR MAINE
ME6400	CITY OF PORTLAND MAINE
MI0150	CITY OF ANN ARBOR MAINE
MI0310	CITY OF BATTLE CREEK MICHIGAN
MI0490	CITY OF BIRMINGHAM MICHIGAN
MI0700	CITY OF CADILLAC MICHIGAN
MI0890	CITY OF CHARLOTTE MICHIGAN
MI1150	CITY OF CROSWELL MICHIGAN
MI1260	CITY OF DETROIT MICHIGAN
MI1730	CITY OF FLINT MICHIGAN
MI1800	CITY OF FRANKFORT MICHIGAN
MI2010	CITY OF GRAND RAPIDS MICHIGAN
MI2520	CITY OF KALAMAZOO MICHIGAN
MI2990	CITY OF MANTON MICHIGAN
MI3320	CITY OF MONROE MICHIGAN
MI3740	CITY OF OTSEGO MICHIGAN
MI4020	CITY OF PONTIAC MICHIGAN
MI4060	CITY OF PORT HURON
MI4760	CITY OF STURGIS MICHIGAN
MI4905	CITY OF TROY MICHIGAN
MI5310	CITY OF WYANDOTTE MICHIGAN
MN1150	CITY OF CHAMPLIN MINNESOTA
MN1210	CITY OF CHISHOLM MINNESOTA
MN2860	CITY OF GRANITE FALLS MINNESOTA
MN3460	CITY OF HUTCHINSON MINNESOTA
MN4760	CITY OF MINNEAPOLIS MINNESOTA
MN5660	CITY OF PINE CITY MINNESOTA
MO4100	CITY OF JOPLIN MISSOURI
MO7070	CITY OF ST JOSEPH MISSOURI
MO7080	CITY OF ST LOUIS MISSOURI
NC0870	CITY OF CHARLOTTE NORTH CAROLINA
NC1040	CITY OF CONCORD NORTH CAROLINA
NC1460	CITY OF ELIZABETH CITY NORTH CAROLINA
NC1940	CITY OF GREENSBORO NORTH CAROLINA
NC2450	CITY OF KINSTON NORTH CAROLINA
NC3100	CITY OF MONROE NORTH CAROLINA
NC4070	CITY OF SALISBURY NORTH CAROLINA
NH0020	CITY OF BERLIN NEW HAMPSHIRE
NH0070	CITY OF CONCORD NEW HAMPSHIRE
NH0310	CITY OF MANCHESTER NEW HAMPSHIRE
NH0430	CITY OF PORTSMOUTH NEW HAMPSHIRE

NJ0520	CITY OF CAMDEN NEW JERSEY
NJ1775	CITY OF LYNDHURST NEW JERSEY
NJ2130	CITY OF NEWARK NEW JERSEY
NJ2498	CITY OF PARSIPPANY NEW JERSEY
NJ2510	CITY OF PATERSON NEW JERSEY
NJ2570	CITY OF PERTH AMBOY NEW JERSEY
NJ2710	CITY OF PRINCETON NEW JERSEY
NJ3380	CITY OF TRENTON NEW JERSEY
NJ3705	CITY OF WOODBRIDGE NEW JERSEY
NM0030	CITY OF ALBUQUERQUE NEW MEXICO

MUNICIPAL AGENCIES (CITIES) - CONTINUED

SYMBOL	FULL NAME
******	**
NM0170	CITY OF CLAYTON NEW MEXICO
NM0470	CITY OF LAS CRUCES NEW MEXICO
NM0710	CITY OF SANTA FE NEW MEXICO
NV0139	CITY OF MOUNTAIN CITY NEVADA
NV0170	CITY OF RENO NEVADA
NY0750	CITY OF BUFFALO NEW YORK
NY3070	CITY OF LACKAWANNA NEW YORK
NY3340	CITY OF LOCKPORT NEW YORK
NY3940	CITY OF MOUNT VERNON NEW YORK
NY4120	CITY OF NEW ROCHELLE NEW YORK
NY4170	CITY OF NEW YORK NEW YORK
NY4210	CITY OF NIAGARA FALLS NEW YORK
NY5230	CITY OF ROCHESTER NEW YORK
NY5550	CITY OF SCHENECTADY NEW YORK
NY6450	CITY OF WATERTOWN NEW YORK
NY6820	CITY OF YONKERS NEW YORK
OH0070	CITY OF AKRON OHIO
OH1320	CITY OF CANTON OHIO
OH1610	CITY OF CINCINNATI OHIO
OH1680	CITY OF CLEVELAND OHIO
OH1800	CITY OF COLUMBUS OHIO
OH2090	CITY OF DAYTON OHIO
OH3880	CITY OF KENT OHIO
OH3895	CITY OF KETTERING OHIO
OH4730	CITY OF MARIETTA OHIO
OH4820	CITY OF MASSILLON OHIO
OH7200	CITY OF ST CLAIRSVILLE OHIO
OH8070	CITY OF TIFFIN OHIO
OH8120	CITY OF TOLEDO OHIO
OR1225	CITY OF LINCOLN CITY OREGON
OR1260	CITY OF MCMINNVILLE OREGON
OR1310	CITY OF MEDFORD OREGON
OR1500	CITY OF NEWPORT OREGON
OR1510	CITY OF NORTH BEND OREGON
OR1650	CITY OF PORTLAND OREGON
OR1810	CITY OF SALEM OREGON
PA0110	CITY OF ALLENTOWN PENNSYLVANIA
PA1230	CITY OF CHAMBERSBURG PENNSYLVANIA
PA1296	CITY OF CHESTER TOWNSHIP PENNSYLVANIA
PA1335	CITY OF CLAIRTON PENNSYLVANIA
PA2270	CITY OF EASTON PENNSYLVANIA
PA4010	CITY OF JOHNSTOWN PENNSYLVANIA
PA6540	CITY OF PHILADELPHIA PENNSYLVANIA
PA6600	CITY OF PITTSBURGH PENNSYLVANIA
PA8880	CITY OF WASHINGTON PENNSYLVANIA
PA8920	CITY OF WAYNESBORO PENNSYLVANIA
SC0020	CITY OF AIKEN SOUTH CAROLINA
SC0370	CITY OF CAYCE SOUTH CAROLINA
SC1040	CITY OF GREENVILLE SOUTH CAROLINA
SD2450	CITY OF SIOUX FALLS SOUTH DAKOTA

MUNICIPAL AGENCIES (CITIES) - CONTINUED

SYMBOL	FULL NAME
******	**
SD2730	CITY OF VERMILLION SOUTH DAKOTA
SD3070	CITY OF YANKTON SOUTH DAKOTA
TX0260	CITY OF ARLINGTON TEXAS
TX0530	CITY OF BELLAIRE TEXAS
TX1550	CITY OF CORPUS CHRISTI TEXAS
TX1730	CITY OF DALLAS TEXAS
TX2190	CITY OF EL PASO TEXAS
TX2450	CITY OF FORT WORTH TEXAS
TX3280	CITY OF HOUSTON TEXAS
TX4530	CITY OF MESQUITE TEXAS
TX5430	CITY OF PORT ARTHUR TEXAS
TX6090	CITY OF SAN ANTONIO TEXAS
UT1560	CITY OF PROVO UTAH
VA0130	CITY OF BEDFORD VIRGINIA
VA0690	CITY OF CULPEPER VIRGINIA
VA0720	CITY OF DANVILLE VIRGINIA
VA0930	CITY OF FALLS CHURCH VIRGINIA
VA1180	CITY OF HAMPTON VIRGINIA
VA1490	CITY OF LYNCHBURG VIRGINIA
VA1720	CITY OF NEWPORT NEWS VIRGINIA
VA1760	CITY OF NORFOLK VIRGINIA
VA2060	CITY OF RICHMOND VIRGINIA
VA2330	CITY OF STAUNTON VIRGINIA
VA2540	CITY OF VIRGINIA BEACH VIRGINIA
VA2570	CITY OF WARRENTON VIRGINIA
VT0120	CITY OF BURLINGTON VERMONT
VT0155	CITY OF COLCHESTER VERMONT
VT0576	CITY OF ROCKINGHAM VERMONT
VT0686	CITY OF WEATHERSFIELD TOWN VERMONT
WA0109	CITY OF BELLEVUE WASHINGTON
WA0180	CITY OF BREMERTON WASHINGTON
WA1190	CITY OF LONGVIEW WASHINGTON
WA1550	CITY OF OAK HARBOR WASHINGTON
WA1820	CITY OF REDMOND WASHINGTON
WA1850	CITY OF RICHLAND WASHINGTON
WA1960	CITY OF SEATTLE WASHINGTON
WA2110	CITY OF SPOKANE WASHINGTON
WA2230	CITY OF TAKOMA WASHINGTON
WI1470	CITY OF EAU CLAIRE WISCONSIN
WI1760	CITY OF FORT ATKINSON WISCONSIN
WI2320	CITY OF JANESVILLE WISCONSIN
WI3100	CITY OF MILWAUKEE WISCONSIN
WI3810	CITY OF PLYMOUTH WISCONSIN
WI3970	CITY OF RACINE WICONSIN
WI4060	CITY OF RHINELANDER WISCONSIN
WI4330	CITY OF SHEBOYGAN WISCONSIN
WI4730	CITY OF SUPERIOR WISCONSIN
WV0260	CITY OF BLUEFIELD WEST VIRGINIA

C-23

INTER-CITY AND INTER-COUNTY AGENCIES

SYMBOL	FULL NAME
******	**
ACSWM	ADDISON COUNTY SOLID WASTE MANAGEMENT DEPARTMENT
ACWD	ALAMEDA COUNTY WATER DISTRICT
AEWD	ARVIN-EDISON WATER DISTRICT
ATHCE	ATHENS COUNTY ENGINEER

BART	BAY AREA RAPID TRANSIT
BCE	BROWARD COUNTY ENGINEERS
BCED	BOSSIER CITY ENGINEERING DEPARTMENT
BCLID	BURNETTE COUNTY LAND INFORMATION DEPARTMENT
BRICKT	BRICK TOWNSHIP NEW JERSEY
BUTCOE	BUTLER COUNTY ENGINEERS
CCPUD	CHELAN COUNTY PUBLIC UTILITIES DISTRICT
CHERRY	CHERRY HILL TOWNSHIP NEW JERSEY
CID	CENTERVILLE IRRIGATION DISTRICT
CODDOP	CITY OF DAYTON DEPARTMENT OF PLANNING
COOSCS	COOS COUNTY SURVEYOR
COUNTY	COUNTY LINE
CRGS	CLEVELAND REGIONAL GEODETIC SURVEY
CSDOU	COLORADO SPRINGS DEPARTMENT OF UTILITIES
CURRCS	CURRY COUNTY SURVEYOR
DCE	DELAWARE COUNTY ENGINEER
DCENG	DOUGLAS COUNTY ENGINEER
DCGIS	DOUGLAS COUNTY GIS
DCPW	DOUGLAS COUNTY PUBLIC WORKS
DMWW	DENVER MUNICIPAL WATER WORKS
DOUGCS	DOUGLAS COUNTY SURVEYOR
EBDA	EAST BAY SEWAGE DISCHARGE AUTHORITY
EBMUD	EAST BAY MUNICIPAL UTILITIES DISTRICT
FCA	FAIRFIELD COUNTY AUDITOR
FCE	FRANKLIN COUNTY ENGINEERS
FULCOE	FULTON COUNTY ENGINEERS
GCENG	GREENE COUNTY ENGINEER
GCPUD	GRANT COUNTY PUBLIC UTILITIES DISTRICT
HAMTWP	HAMILTON TOWNSHIP NEW JERSEY
HCFC	HARRIS COUNTY TEXAS FLOOD CONTROL DISTRICT
HGCSD	HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT
HHWS	HETCH HETCHY WATER SUPPLY DISTRICT
IAA	INDIANAPOLIS AIRPORT AUTHORITY
IID	IMPERIAL IRRIGATION DISTRICT
IMAGIS	INDIANAPOLIS MAPPING AND GEOGRAPHIC INFRA SYSTEM
JCAD	JEFFERSON COUNTY APPRAISAL DISTRICT
JCMD	JEFFERSON COUNTY MAPPING DEPARTMENT
LACFCD	LOS ANGELES FLOOD CONTROL DISTRICT
LAHRBR	LOS ANGELES HARBOR DEPARTMENT
LAWPC	LOS ANGELES WATER AND POWER COMMISSION
LFUCG	LEXINGTON FAYETTE URBAN COUNTY GOVERNMENT
LVDPW	LAS VEGAS DEPARTMENT OF PUBLIC WORKS
MARTA	METROPOLITAN ATLANTA RAPID TRANSIT AUTHORITY
MCED	MARION COUNTY ENGINEERING DEPARTMENT
MCSO	MARION COUNTY SURVEYOR OFFICE
METAA	METROPOLITAN AIRPORT AUTHORITY
MID	MODESTO IRRIGATION DISTRICT

SYMBOL	FULL NAME
******	**
MRGCD	MIDDLE RIO GRANDE CONSERVATION DISTRICT
MRMSC	MILWAUKEE-RACINE METROPOLITAN SEWAGE COMM
MWAA	METROPOLITAN WASHINGTON AIRPORT AUTHORITY
NJ05ED	BURLINTON COUNTY ENGINEERING DEPARTMENT
NNWW	NEWPORT NEWS WATER WORKS
NOS+WB	NEW ORLEANS SEWERAGE AND WATER BOARD
NYNJPA	NEW YORK/NEW JERSEY PORT AUTHORITY

NYPA	NEW YORK PORT AUTHORITY
OID	OAKDALE IRRIGATION DISTRICT
OKECPA	OKEECHOBEE COUNTY PROPERTY APPRAISERS
OROW	OHIO RIVER ORDINANCE WORKS
PCLIO	POLK COUNTY LAND INFORMATION OFFICE WISCONSIN
PIMACO	PIMA CO DEPT OF TRANSP AND FLOOD CONTROL DIST
PMDPW	PLYMOUTH MA DEPARTMENT OF PUBLIC WORKS
PTHT	PARSIPPANY TROY HILLS TOWNSHIP
RCFC	RIVERSIDE COUNTY FLOOD CONTROL
RCOS	RIVERSIDE COUNTY SURVEYOR
RIRD	RYER ISLAND RECLAMATION DISTRICT
RTSD	REGIONAL TRANSIT DISTRICT
SCCS	SANTA CLARA COUNTY SURVEYOR
SDWD	SAN DIEGO WATER DISTRICT
SEWRPC	SE WISCONSIN REGIONAL PLANNING COMMISSION
SFLWMD	SOUTH FLORIDA WATER MANAGEMENT DISTRICT
SFWD	SAN FRANCISCO WATER DEPARTMENT
SJID	SAN JOAQUIN IRRIGATION DISTRICT
SJRWMD	ST JOHNS RIVER WATER MANAGEMENT DISTRICT
SLCPS	SALT LAKE CITY PUBLIC SERVICES
SRPE	SAVANNAH RIVER PLANT ENGINEER
SRVWUA	SALT RIVER VALLEY WATER USERS ASSOCIATION
SVIP	SACRAMENTO VALLEY IRRIGATION PROJECT
SWFWMD	SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
TID	TURLOCK IRRIGATION DISTRICT
TLAKE	TULARE LAKE IRRIGATION DISTRICT
TLC	TALLAHASSEE-LEON COUNTY
TWWP	THE WASHINGTON WATER POWER COMPANY
UPPERA	UPPER ALLEN TOWNSHIP PENNSYLVANIA
WACRM	WASHINGTON COUNTY REFERENCE MARK
WMATA	WASHINGTON METROPOLITAN AREA TRANSIT AUTH
WSSC	WASHINGTON SUBURBAN SANITARY COMMISSION

C-25

RAILROADS

SYMBOL	FULL NAME
******	***
ACYRR	AKRON CANTON AND YOUNGSTOWN RAILROAD
AGSRR	ALABAMA GREAT SOUTHERN RAILROAD
ATNRR	ALABAMA TENNESSEE AND NORTHERN RAILROAD
ATSFRR	ATCHISON TOPEKA AND SANTA FE RAILROAD
B+ARR	BOSTON AND ALBANY RAILROAD
BARR	BANGOR AND AROOSTOOK RAILROAD
BLERR	BESSEMER AND LAKE ERIE RAILROAD
BMRR	BOSTON AND MAINE RAILROAD
BNRR	BURLINGTON NORTHERN RAILROAD
BORR	BALTIMORE AND OHIO RAILROAD
BRPRR	BUFFALO ROCHESTER PITTSBURG RAILROAD

CBQRR	CHICAGO BURLINGTON AND QUINCY RAILROAD
CHWRR	CHESAPEAKE AND WESTERN RAILROAD
CIMRR	CHICAGO AND ILLINOIS MIDLAND RAILROAD
CLGRR	COLUMBUS AND GREENVILLE RAILROAD
CMPPRR	CHICAGO MILWAUKEE ST PAUL AND PACIFIC RR
CNJRR	CENTRAL OF NEW JERSEY RAILROAD
CNWRR	CHICAGO AND NORTH WESTERN RAILROAD
CORR	CHESAPEAKE AND OHIO RAILROAD
CPRR	CANADIAN PACIFIC RAILROAD
CRNRR	CAROLINA AND NORTHWESTERN RAILROAD
CVRR	CENTRAL VERMONT RAILROAD
DHRR	DELAWARE AND HUDSON RAILROAD
DLWRR	DELAWARE LACKAWANNA AND WESTERN RAILROAD
DMIRRR	DULUTH MISSABE AND IRON RANGE RAILROAD
DMRR	DETROIT AND MACKINAW RAILROAD
DRGWRR	DENVER AND RIO GRANDE WESTERN RAILROAD
DTSRR	DETROIT AND TOLEDO SHORE LINE RAILROAD
DWPRR	DULUTH-WINNIPEG AND PACIFIC RAILROAD
ELRR	ERIE LACKAWANNA RAILROAD
ERIERR	ERIE RAILROAD
FECRR	FLORIDA EAST COAST RAILROAD
FWDRR	FORT WORTH AND DENVER CITY RAILWAY
GCSFRC	GULF COLORADO AND SANTE FE RAILWAY COMPANY
GMORR	GULF MOBILE AND OHIO RAILROAD
GNRR	GREAT NORTHERN RAILROAD
GSFRR	GEORGIA SOUTHERN AND FLORIDA RAILWAY
GTWRR	GRAND TRUNK WESTERN RAILROAD
GWRR	GREAT WESTERN RAILROAD
HRR	HUDSON RAILROAD
ICRR	ILLINOIS CENTRAL RAILROAD
INTRR	INTERSTATE RAILROAD
KCSRR	KANSAS CITY SOUTHERN RAILROAD
LARR	LOUISIANA AND ARKANSAS RAILROAD
LIRR	LONG ISLAND RAILROAD
LNRR	LOUISVILLE AND NASHVILLE RAILROAD
LVRR	LEHIGH VALLEY RAILROAD
MCRR	MICHIGAN CENTRAL RAILROAD
MKTRR	MISSOURI KANSAS TEXAS RAILROAD
MPRR	MISSOURI PACIFIC RAILROAD
NCRR	NASHVILLE CHATTANOOGA AND ST LOUIS RAILROAD
NPRR	NORTHERN PACIFIC RAILROAD
NSRR	NORFOLK SOUTHERN RAILROAD

RAILROADS - CONTINUED

SYMBOL	FULL NAME
******	**
NWPRR	NORTHWESTERN PACIFIC RAILROAD
NWRR	NORFOLK AND WESTERN RAILROAD
NYCRR	NEW YORK CENTRAL RAILROAD
NYNH+H	NEW YORK NEW HAVEN AND HARTFORD RAILROAD
NYSLRR	NEW YORK CHICAGO AND ST LOUIS RAILROAD
NYSWRR	NEW YORK SUSQUEHANNA AND WESTERN RAILROAD
PCRR	PENN CENTRAL RAILROAD
PLERR	PITTSBURGH AND LAKE ERIE RAILROAD
PMRR	PERE MARQUETTE RAILROAD
PRR	PENNSYLVANIA RAILROAD
PSFRR	PANHANDLE AND SANTA FE RAILWAY COMPANY
RDGRR	READING RAILROAD
RIRR	CHICAGO ROCK ISLAND AND PACIFIC RAILROAD
RRR	RUTLAND RAILROAD
SCLRR	SEABOARD COAST LINE RAILROAD
SDARR	SAN DIEGO AND ARIZONA EASTERN RAILWAY COMPANY

SLSFRR	ST LOUIS SAN FRANCISCO RAILROAD
SLSWRR	ST LOUIS SOUTHWESTERN RAILROAD
SNRR	SACRAMENTO NORTHERN RAILROAD
SOORR	SOO LINE RAILROAD
SOURR	SOUTHERN RAILROAD
SPRR	SOUTHERN PACIFIC RAILROAD
TMRR	TEXAS MEXICAN RAILROAD
TNRR	TEXAS AND NORTHERN RAILROAD
TPRR	TEXAS AND PACIFIC RAILWAY
TPWRR	TOLEDO PEORIA AND WESTERN RAILROAD
UPRR	UNION PACIFIC RAILROAD
VARR	VIRGINIA RAILWAY
VTRR	VERMONT RAILROAD
WARR	WESTERN OF ALABAMA RAILROAD
WLERR	WHEELING AND LAKE ERIE RAILROAD
WMRR	WESTERN MARYLAND RAILROAD
WPRR	WESTERN PACIFIC RAILROAD
Y+MVRR	YAZOO AND MISSISSIPPI VALLEY RAILROAD
YVRR	YOSEMITE VALLEY RAILROAD

UTILITY AND NATURAL RESOURCE COMPANIES

SYMBOL	FULL NAME
******	**
AEP	AMERICAN ELECTRIC POWER
AGASEL	ASSOCIATED GAS AND ELECTRIC COMPANY
ALPCO	ALABAMA POWER COMPANY
AMOCO	AMOCO OIL COMPANY
AOCO	ASSOCIATED OIL COMPANY
APC	APPALACHIAN POWER COMPANY
ARFUEL	AR FUEL OIL COMPANY
ARLAGC	AR-LA GAS COMPANY
ASC	ALYSEKA SERVICE COMPANY
ATRECO	ATLANTIC REFINING COMPANY
BOCO	BELRIDGE OIL COMPANY

UTILITY AND NATURAL RESOURCE COMPANIES - CONTINUED

SYMBOL	FULL NAME
******	**
CHOCO	CHEVRON OIL COMPANY
CITGO	CITIES SERVICE COMPANY
CONED	CONSOLIDATED EDISON POWER COMPANY
CONOCO	CONTINENTAL OIL COMPANY
CONSP	CONSUMER POWER COMPANY OF MICHIGAN
CREOL	CREOLE PETROLEUM COMPANY
CSPC	COLUMBUS SOUTHERN POWER COMPANY
CTP+L	CONNECTICUT POWER AND LIGHT COMPANY
CSPC	COLUMBUS SOUTHERN POWER COMPANY
CVPS	CENTRAL VERMONT PUBLIC SERVICE CORPORATION
DECO	DETROIT EDISON COMPANY
DUKE	DUKE POWER COMPANY
DWD	DENVER WATER DEPARTMENT
EASTUT	EASTON UTILITIES
FLPCO	FLORIDA POWER COMPANY
GAPC	GEORGIA POWER COMPANY
GPCC	GENERAL PETROLEUM CORPORATION OF CALIFORNIA
GULF	GULF REFINING COMPANY
HLPCO	HOUSTON LIGHTING AND POWER COMPANY
HOCO	HONOLULU OIL COMPANY
HUMBLE	HUMBLE OIL AND REFINING COMPANY
IMECO	INDIANA-MICHIGAN ELECTRIC COMPANY

LONESR	LONE STAR GAS COMPANY
LPCO	LAKEHEAD PIPELINE COMPANY
MINPCO	MICHIGAN NORTHERN POWER COMPANY
MOBIL	MOBIL OIL CORPORATION
MSP+L	MISSISSIPPI POWER AND LIGHT COMPANY
MWDSC	METROPOLITAN WATER DISTRICT OF SO CALIFORNIA
MWPLC	MICHIGAN-WISCONSIN PIPELINE COMPANY
NGPCA	NATURAL GAS PIPELINE COMPANY OF AMERICA
NJP+L	NEW JERSEY POWER AND LIGHT COMPANY
OHOCO	OHIO OIL COMPANY
OHPCO	OHIO POWER COMPANY
PEPCO	POTOMAC EDISON POWER COMPANY
PG+E	PACIFIC GAS AND ELECTRIC COMPANY
PHELCO	PHILADELPHIA ELECTRIC COMPANY
PHILIP	PHILLIPS PETROLEUM COMPANY
PP+L	PACIFIC POWER AND LIGHT COMPANY
PSCOCO	PUBLIC SERVICE COMPANY OF COLORADO
PSEG	PUBLIC SERVICE ELECTRIC AND GAS CO OF NEW JERSEY
PWPCO	PENNSYLVANIA WATER AND POWER COMPANY
ROCO	RICHFIELD OIL COMPANY
RPCO	REPUBLIC PRODUCTION COMPANY
SCE+G	SOUTH CAROLINA ELECTRIC AND GAS COMPANY
SCECO	SOUTHERN CALIFORNIA EDISON COMPANY
SCPA	SOUTH CAROLINA POWER AUTHORITY
SDG+E	SAN DIEGO GAS AND ELECTRIC COMPANY
SHELL	SHELL OIL COMPANY
SOCO	STANDARD OIL COMPANY
SOGCO	SIGNAL OIL AND GAS COMPANY
SOHIO	SOHIO PETROLEUM COMPANY
STOGC	STANOLIND OIL AND GAS COMPANY
SUBWC	SUBURBAN WATER COMPANY CALIFORNIA

UTILITY AND NATURAL RESOURCE COMPANIES - CONTINUED

SYMBOL	FULL NAME
******	***
SUNOCO	SUN OIL COMPANY
SUPOCO	SUPERIOR OIL COMPANY
TENNEC	TENNESSEE GAS AND PIPELINE COMPANY
TEXACO	TEXACO INCORPORATED
TWOCO	TIDEWATER OIL COMPANY
UNOLA	UNION TEXAS PETROLEUM
UOCO	UNION OIL COMPANY
VEPCO	VIRGINIA ELECTRIC POWER COMPANY
VOCO	VALVOLINE OIL COMPANY

SURVEYING, ENGINEERING, AND CONSTRUCTION INDUSTRY

SYMBOL	FULL NAME
******	***
AAS	ATLANTIC AERIAL SURVEYS (NOW ATLTEC)
AASCO	ATLANTIS AERIAL SURVEY COMPANY
ABRAMS	ABRAMS AERIAL SURVEYS
ABW	ABW MAPPING AND CONSULTING
ACFPS	ACF PRECISION SURVEYS INCORPORATED
ADRGS	ADR GEODETIC SERVICES
AEROS	AERO SERVICE CORPORATION
AHI	ATWELL HICKS INC
AIRLAN	AIR LAND SURVEYS INCORPORATED
AIRSUR	AIR SURVEY CORPORATION
AISS	A I SILANDER AND SON
ALBDOU	ALBANY-DOUGHERTY
ALLENG	ALLEN ENGINEERING INCORPORATED

ALSTER	ALSTER AND ASSOCIATES ENGINEERS
AME	AERO-METRIC ENGINEERING INC
AMGEOD	AMERICAN GEODETIC SURVEY
ANDREG	ANDREGG INCORPORATED
ARCO	ATLANTIC RICHFIELD COMPANY
ASCPC	AMERICAN SURVEYING CONSULTANTS PC
ASHTEC	ASHTECH INCORPORATED
ATEAM	A TEAM PROFESSIONAL ASSOCIATES INCORPORATED
ATLAE	ATLANTA AIRPORT ENGINEERS
ATLTEC	ATLANTIC TECHNOLOGIES
AYLENO	AYRES LEWIS NORRIS INCORPORATED
AYRES	AYRES ASSOCIATES
B+OINC	BARBER AND OYLER, INCORPORATED
BAKER	M BAKER JR INC
BANNER	BANNERMAN SURVEYORS INCORPORATED
BARTON	BARTON AERIAL TECHNOLOGIES INCORPORATED
BDE	BASKERVILLE DONOVAN INCORPORATED
BELL	BELL SURVEYING INCORPORATED
BENDIX	BENDIX CORPORATION
BESCH	BESCH CONSULTING INCORPORATED
BESTOR	BESTOR ENGINEERS INC
BFEC	BENDIX FIELD ENGINEERING CORPORATION
BFM	BFM CORPORATION
BGAS	BRUCE AND GUNN AERIAL SURVEYS

SYMBOL	FULL NAME
******	**
BMMS	BOUTELLE MACFARLANE MEYER AND SELEE
BOHAN	BOHANNAN-HUSTON INCORPORATED
BOLAND	PAUL BOLAND-ST LUCIA PRIVATE SURVEYOR
BRADY	BRADY LAND SURVEYING INC
BRWE	BROCK AND WEYMOUTH ENGINEERS
BSC	BSC GROUP-SURVEYING AND MAPPING INC
BUN-Y	BURK + ASSOCIATES INC AND N-Y ASSOCIATES INC
BWDCO	BERKELEY WATERFRONT DEVELOPMENT COMPANY
CANDA	CERVANTES AND ASSOCIATES
CARAS	CARIBBEAN AERIAL SURVEYS INCORPORATED
CAS	CONTINENTAL AERIAL SURVEY INCORPORATED
CASSON	CASSON ENGINEERING COMPANY
CEJA	C E JOHNSON AND ASSOCIATES INC
CE+S	CALDWELL ENGINEERING AND SURVEYING
CFM	C F MERRIAM SURVEYOR
CHAMBA	CHAMBLIN AND ASSOCIATES
CHANCE	JE CHANCE AND ASSOCIATES
CHIAS	CHICAGO AERIAL SURVEY
CHIPPR	CHIPPERFIELD NAVIGATION SERVICES
CH2M	CH2M HILL INCORPORATED
CL	CLIFFORD LEISURE CIVIL ENGINEER
CMCO	CHARLES MAIN COMPANY
COLE	DAVID COLE PLS
COLGOV	COLBURN AND GOVE CONSULTING ENGINEERS
CONE+S	CONCORD ENGINEERING AND SURVEYING INCORPORATED
CONTE	CONTINENTAL ENGINEER
CONTRA	CONTRACT SURVEYING LIMITED
CPSSI	CPS SURVEYS INCORPORATED
CRAFT	ALLAN CRAFT SUR-CON INCORPORATED
CREDAN	CREEGAN AND D ANGELO
CRIM	CENTRO DE RECAUDACION DE INGRESOS MUNICIPALES
CSMCI	C S MARINE CONSTRUCTORS INCORPORATED
CTMAIN	CT MAIN INCORPORATED
CTMALE	C T MALE ASSOCIATES
CULTEP	CULPEPPER AND TERPENIN

DADETR	DADE-TRIM INCORPORATED
DAGSUR	DAGGETT SURVEYING INCORPORATED
DARA	D A RATEKIN AND ASSOCIATES
DCJOHN	D C JOHNSON AND ASSOCIATES INCORPORATED
DEC	DAHLING ENGINEERING COMPANY
DECKER	R L DECKER
DELTA	DELTA ENGINEERS INC
DENI	DENI ASSOCIATES INCORPORATED
DEWDAV	DEWBERRY DAVIS
DMW	DAFT MCCUNE WALKER INCORPORATED
DTM	DONALD T MCQUILLAN
DUDA	DUDA LANDS INCORPORATED
DUGGER	JACK DUGGER
DUNLAP	DUNLAP ASSOCIATES
EDA	EARL DUDLEY ASSOCIATES INCORPORATED
EESCC	E E STULLER CONSTRUCTION COMPANY

SYMBOL	FULL NAME
******	***
EGENG	EVANS-GRAVES ENGINEERS INC
EGPSSC	EAGLE GPS SURVEYING CORPORATION
ENGDA	ENGINEERING DEVELOPMENT ASSOCIATES
EQUINO	EQUINOX INCORPORATED SURVEYING AND MAPPING
ERLAND	ERLANDSEN AND ASSOCIATES
ESP	ENGINEERING SURVEYING AND PLANNING INC
EVANS	DAVID EVANS AND ASSOCIATES INCORPORATED
EWB	E W BRAASCH CONSULTING ENGINEER
FAMC	FALCON AIR MAPS COMPANY
FAS	FAIRCHILD AERIAL SURVEYS
FE	FRASER ENGINEERING
F+HINC	FLORENCE + HUTCHESON INCORPORATED
FORBAC	FORD BACON AND DAVIS INCORPORATED
FORSGN	FORSGREN AND ASSOCIATES
GAI	GERKINWOOD AND ASSOCIATES INCORPORATED
GBLI	GORDON B LEWIS INC
GCIOMI	GILBERT COMMONWEALTH INCORPORATE OF MICHIGAN
GCS	GEODETIC CONSULTING SERVICES
GCYI	G C Y INCORPORATED
GENES	GENESIS SURVEYING INCORPORATED (NOW GENGRP)
GENGRP	GENESIS GROUP INCORPORATED SE
GEOBAS	GEOBASE CONTROL INCORPORATED
GEOHYD	GEO-HYDRO INCORPORATED
GEOMET	GEOMETRICS GPS INCORPORATED
GEONEX	GEONEX ITECH INCORPORATED
GEOONE	GEOONE INCORPORATED
GEORES	GEO RESEARCH INCORPORATED
GEOSER	GEODETIC SERVICES INCORPORATED
GGSUR	G AND G SURVEYING AND CONSULTING
GHA	G HENKENHOFF AND ASSOCIATES
GLCOOP	GARY L COOPER
GLORI	GLO RETRACEMENT INCORPORATED
GREENW	RONALD GREENWELL AND ASSOCIATES
GREOMA	GREENHORNE-OMARA
GRWAS	GRW AERIAL SURVEY
GSIGPS	GEOPHYSICAL SERVICE INCORPORATED
GWMSI	GEORGE W MUERY AND SON INCORPORATED
HALSEY	W H HALSEY CIVIL ENGINEERS INC
HARMS	JOHN E HARMS JR AND ASSOCIATES INCORPORATED
HARTMN	HARTMANN ASSOCIATES INCORPORATED
HDA	HORTON DENNIS ASSOCIATES
HEIDT	HEIDT AND ASSOCIATES INCORPORATED
HGSERV	HAMILTON GEODETIC SERVICES

HHAA   HELMER HUGHS AND ASSOCIATES
HIGHC   HIGH COUNTRY ENGINEERING
HLS   HUNTER LAND SURVEYING COMPANY
HOBBS   HOBBS AND ASSOCIATES
HOFFMA HOFFMAN AND COMPANY
HOLDEN HOLDEN GPS

SYMBOL	FULL NAME
******	**
HOLLIN	HOLLINGSWORTH AND ASSOCIATES
HTB	HEALY TIBBITS BUILDERS
HUBBLE	HUBBLE ENGINEERING INCORPORATED
HYCAS	HYCON AERIAL SURVEY
IAMAP	INTERNATIONAL AERIAL MAPPING
IGS	INTERNATIONAL GEODYNAMICS SERVICE
ISBELL	ISBELL CONSTRUCTION COMPANY
ITECHI	INTERNATIONAL TECHNOLOGY INCORPORATED
JAHA	JAMES H HARRIS AND ASSOCIATES
JBB	J B BLYDENBURGH SURVEYOR
JKPLS	JEFF KERN PROFESSIONAL LAND SURVEYOR
JOHFRA	JOHNSON-FRANK
JOHNSN	JOHNSON ENGINEERING INCORPORATED
KAISER	KAISER INDUSTRIES CORPORATION
KEISCH	KEITH AND SCHNARS - LAKELAND
KIMLEY	KIMLEY-HORN AND ASSOCIATES INCORPORATED
KONSKI	KONSKI ENGINEERS
LAFAVE	A LAFAVE LAND SURVEYOR
LAWNOA	LAWSON NOBLE AND ASSOCIATES
LBFH	LINDAHL BROWNING FERRARF HELLSTROM
LDA	LEWIS DICKERSON AND ASSOCIATES CONS ENG
LEAS	LIMBAUGH ENGINEERING AND AERIAL SURVEY INC
LEGER	LEGER SURVEYS INC
LENZ	H F LENZ COMPANY
LEVITT	ITT LEVITT CORPORATION
LIETZ	THE LIETZ COMPANY
LINDSY	F M LINDSEY AND ASSOCIATES
LITTL	A E LITTLE RLS
LITTLE	OWEN LITTLE AND ASSOCIATES
LOWE	LOWE ENGINEERS
MADHOP	MADDOX AND HOPKINS SURVEYORS
MAI	MEYER AND ASSOCIATES INCORPORATED
MARCHE	MARCHESE AND SONS
MARLOW	HARRY W MARLOW INCORPORATED
MASDIX	MASON AND DIXON
MATOTA	WILLIAM MATOTAN AND ASSOCIATES
MCCENG	MCCLELLAND ENGINEERS
MCCRON	J R MCCRONE JR INCORPORATED
MCGRIF	P C MCGRIFF COMPANY
MCTUER	MCCARTER AND TULLER INCORPORATED
MELGEE	MELVIN GEE AND ASSOCIATES
MENSHA	MENASHA CORPORATION
MERCER	JOHN D MERCER AND ASSOCIATES INCORPORATED
MERRIC	MERRICK AND COMPANY
METRIC	METRIC SURVEYS
MGA	MOORE GARDNER AND ASSOCIATES
MGSINC	MINISTER AND GLAESER SURVEYING INCORPORATED
MHAS	MARK HURD AERIAL SURVEYS
MIDGA	MID GEORGIA SURVEYORS

SURVEYING, ENGINEERING, AND CONSTRUCTION INDUSTRY - CONTINUED

SYMBOL	FULL NAME
******	**
MJH	MITCHELL JONES AND HARDEN INCORPORATED
MKWS	M K WELCH SURVEYS
MLI	MILLER AND LUX INC
MME	MYERS-MACOMBER ENGINEERS
MPHI	MORRIS P HEBERT INCORPORATED
MPS	MACNAMEE PORTER AND SEELEY
MSAM	MOUNTAIN SURVEYING AND MAPPING INCORPORATED
MSE	MSE CORPORATION
MSI	MEASUREMENT SCIENCE INCORPORATED
MSM	MEURER SERAFINI AND MEURER INCORPORATED (NOW MSAM)
NAVSER	NAVIGATION SERVICES INCORPORATED
NEDIVS	NORTHEAST DIVERSIFIED SERVICES INCORPORATED
NEILAN	THE NEILAN ENGINEERS INCORPORATED
NFORK	NORTH FORK SURVEYING
NVGPS	NORTH VALLEYS GPS SERVICES
OCEGPS	OCEONICS INCORPORATED
OHM	ORCHARD HILTZ AND MCCLIMENT INCORPORATED
OMAN	OMAN CONSTRUCTION COMPANY
OMEGA	OMEGA ENGINEERING SERVICES
PAS	PARK AERIAL SURVEYS INCORPORATED
PASENG	PENFIELD AND SMITH ENGINEERS
PATRIC	PATRICK ENGINEERING INCORPORATED
PGEG	PETTY GEOPHYSICAL AND ENGINEERING COMPANY
PHELPS	B E PHELPS INCORPORATED
PIEDAS	PIEDMONT AERIAL SURVEYS
PLSO	PROFESSIONAL LAND SURVEYORS OF OHIO
PMC	PERRY C MCGRIFF COMPANY
PMGS	PHOTOGRAMMETRIC GEODETIC SURVEY
PORTER	NORMAN PORTER ASSOCIATES
PRENAS	PROFESSIONAL ENGINEERING ASSOCIATES INCORPORATED
PROENG	PROFESSIONAL ENGINEERING CONSULTANTS INCORPORATED
PS	POSITIONING SERVICES
R+MCON	R + M CONSULTANTS INCORPORATED
RAYONI	ITT RAYONIER INCORPORATED
RBAGB	R BRADFORD AND G BEAM
RDA	RINKER DETWILER AND ASSOCIATES
RICE	RICE ASSOCIATES PC
RSA	ROUSE-SIRINE ASSOCIATES
RUSH	RU-SH GPS CONSULTANTS AND LAND SURVEYORS
SAWENG	SAWTOOTH ENGINEERING
SBAS	SIDNEY B BOWNE AND SON
SBI	SHERWOOD BROTHERS INCORPORATED
SCAN	SCANLON AND ASSOCIATES
SCSC	SO CAROLINA SANTEE COOPER PS AUTHORITY
SEC	SCHNEIDER ENGINEERING CORPORATION
SECI	SMITH ENGINEERING CONSULTANTS INCORPORATED
SECO	SOUTHERN ENGINEERING COMPANY
SELLS	CHAS H SELLS INCORPORATED CONSULTING ENGINEERS
SPAN	SPAN INTERNATIONAL INCORPORATED

SYMBOL	FULL NAME
******	**
SPEAR	JAY SPEARMAN CONSULTING ENGINEERS
STEINA	STEINMAN AND ASSOCIATES
STUNTZ	STUNTZNER ENGINEERING AND FORESTRY
SUNRIS	SUNRISE GEODETIC

SURCON	SURVCON INCORPORATED
SURSAT	SURVSAT
SURTEC	SUR-TECH INCORPORATED
SWECO	STONE WEBSTER ENGINEERING CORPORATION
TCIRR	TENNESSEE COAL IRON AND RAILROAD COMPANY
TE	THOMPSON ENGINEERING
THOMAS	THOMAS ENGINEERING AND SURVEYING COMPANY
TNH	TRYCK NYMAN AND HAYES
TOTTEN	CARL TOTTEN ASSOCIATES
TOWILL	TOWILL INCORPORATED
TPP	T P PARKER AND SON
TRIBBL	TRIBBLE AND RICHARDSON
TRINAV	TRIMBLE NAVIGATION LIMITED
TSI	TOBIN SURVEYS INCORPORATED (NOW TOBIN)
TURNER	A E TURNER ARCHITECT
TVGA	TVGA ENGINEERING SURVEYING PC
TWT	TAYLOR WISEMAN AND TAYLOR CONSULTING ENGINEERS
URS	URS COMPANY
USKCE	UNWIN-SCHEBAN-KORYNTA CONS ENG
VFM	VERNON F MEYER AND ASSOCIATES INCORPORATED
VJV	V J VANLINT CONSULTING ENGINEER
VOGI	VOGI IVERS AND ASSOCIATES
WAA	WALKER AND ASSOCIATES INCORPORATED
WADTRI	WADE-TRIM INCORPORATED
WALASS	WALLACE AND ASSOCIATES
WARD	E J WARD
WAWHI	WALKER AND WHITEFORD INCORPORATED
WBCC	WARREN BROTHERS CONSTRUCTION COMPANY
WESGEO	WESTERN GEOPHYSICAL COMPANY OF AMERICA
WEVACO	WEST-VACO CORPORATION
WEYCO	WEYERHAEUSER COMPANY
WFTA	W F TURNEY AND ASSOCIATES
WHGAI	WILLIAM H GORDON ASSOCIATES INCORPORATED
WHPCO	W H PORTER AND COMPANY INCORPORATED
WIMPOL	WIMPOL INCORPORATED
WOOLPT	WOOLPERT CONSULTANTS
WRA	WHIGMAN AND REQUARDT ASSOCIATES
WSA	WILLIAMS AND STACKHOUSE ASSOCIATES
XYZGPS	THE XYZS OF GPS INCORPORATED
YOUNG	GEORGE F YOUNG INCORPORATED
ZENA	ZENA COMPANY (ZEISS-JENA DISTR UNITED STATES)

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EDUCATIONAL INSTITUTIONS

SYMBOL	FULL NAME
******	***
AUBURN	AUBURN UNIVERSITY
BMS	BOSTON MUSEUM OF SCIENCE
BNL	BROOKHAVEN NATIONAL LABORATORY
BSCOL	BISMARCK STATE COLLEGE
CBI	CONRAD BLUCHER INSTITUTE FOR SURVEY AND SCIENCE
CLEMU	CLEMSON UNIVERSITY
CORUNI	CORNELL UNIVERSITY
CU	COLUMBIA UNIVERSITY
FSNSCH	FARMINGTON STATE NORMAL SCHOOL
GATECH	GEORGIA INSTITUTE OF TECHNOLOGY
IASUNI	IOWA STATE UNIVERSITY

INU	INDIANA UNIVERSITY
JPL	JET PROPULSION LABORATORY
KSU	KANSAS STATE UNIVERSITY
LAFCO	LAFAYETTE COLLEGE
LAHSCH	LOS ALTOS HIGH SCHOOL
LASLAB	LOS ALAMOS SCIENTIFIC LABORATORIES
LASU	LOUISIANA STATE UNIVERSITY
LAWRRI	LOUISIANA WATER RESOURCE RESEARCH INSTITUTE
LEHIGH	LEHIGH UNIVERSITY
MERCU	MERCER UNIVERSITY
MISCOL	MICHIGAN STATE COLLEGE
MIT	MASSACHUSETTS INSTITUTE OF TECHNOLOGY
MITU	MICHIGAN TECHNICAL UNIVERSITY
MSSU	MISSISSIPPI STATE UNIVERSITY
MSU	UNIVERSITY OF MISSISSIPPI
MUNIV	MARQUETTE UNIVERSITY
NDSU	NORTH DAKOTA STATE UNIVERSITY
ODU	OLD DOMINION UNIVERSITY
ORTI	OREGON TECHNICAL INSTITUTE
PEABMA	PEABODY MUSEUM AWATOVI
PMAE	PEABODY MUSEUM OF ARCHEOLOGY AND ETHNOLOGY
SCEC	SOUTHERN CALIFORNIA EARTHQUAKE CENTER
SCRIPP	SCRIPPS INSTITUTE OF OCEANOGRAPHY
SCT	SOUTHERN COLLEGE OF TECHNOLOGY
SUNIV	STANFORD UNIVERSITY
TCU	TEXAS CHRISTIAN UNIVERSITY
TUM	TECHNICAL UNIVERSITY OF MUNICH GERMANY
UALR	UNIVERSITY OF ARKANSAS AT LITTLE ROCK
UC	UNIVERSITY OF CALIFORNIA
UDE	UNIVERSITY OF DELAWARE
UFL	UNIVERSITY OF FLORIDA
UGA	UNIVERSITY OF GEORGIA
UHI	UNIVERSITY OF HAWAII
UID	UNIVERSITY OF IDAHO
ULAVAL	UNIVERSITY LAVAL QUEBEC
UMPQU	UMPQUA COMMUNITY COLLEGE
UNAVCO	UNIVERSITY NAVSTAR CONSORTIUM
UNC	UNIVERSITY OF NORTH CAROLINA
UNM	UNIVERSITY OF NEW MEXICO

SYMBOL	FULL NAME
******	**
UNO	UNIVERSITY OF NEW ORLEANS
USC	UNIVERSITY OF SOUTHERN CALIFORNIA
UTU	UNIVERSITY OF UTAH
UTX	UNIVERSITY OF TEXAS
UVA	UNIVERSITY OF VIRGINIA
UVC	UNIVERSITY OF VIRGINIA CONSERVANCY
UVT	UNIVERSITY OF VERMONT
UWI	UNIVERSITY OF WISCONSIN
WILCO	WILLIAMS COLLEGE AT WILLIAMSTOWN MASSACHUSETTS
WVUNI	WEST VIRGINIA UNIVERSITY

PROFESSIONAL AND AMATEUR ASSOCIATIONS

SYMBOL	FULL NAME
******	**

BSA	BOY SCOUTS OF AMERIC
ECM	ENGINEERS CLUB OF MEMPHIS
ILRLSA	ILLINOIS REGISTERED LAND SURVEYORS ASSOCIATION
KSSS	KANSAS SOCIETY OF SURVEYORS
NVALS	NEVADA ASSOCIATION OF LAND SURVEYORS
PLSO	PROFESSIONAL LAND SURVEYORS OF OHIO INCORPORATED
SCSRLS	SOUTH CAROLINA SOCIETY OF REGISTERED LAND SURVEYORS
SWNMS	SOUTHWEST NEW MEXICO SURVEYORS
USPSQD	UNITED STATES POWER SQUADRON
WALSA	WASHINGTON LAND SURVEYORS ASSOCIATION

MISCELLANEOUS COMMERCIAL ORGANIZATIONS AND PRIVATE FIRMS

SYMBOL	FULL NAME
******	***
AKGEO	ALASKAN GEOPHYSICAL
AKLPCO	ALASKA LUMBER AND PULP COMPANY
ATCO	ASSOCIATED TRACTION COMPANY
ATT	AMERICAN TELEPHONE AND TELEGRAPH COMPANY
BGCO	BROWN GEOPHYSICAL COMPANY
BOECOM	BOEING COMPANY
BULE	BULE AND ASSOCIATES
BW	BRADFORD WASHBURN
BWCO	BONO-WILLIAMS COMPANY
CARRIB	CARRIBBEAN SURVEYS
CCCC	CARBIDE AND CARBON CHEMICALS CORPORATION
CCICO	CLEVELAND CLIFFS IRON COMPANY
CLA	CROZER LAND ASSOCIATION
CPFC	CHAMPION PAPER AND FIBER COMPANY
CPI	CINCINNATI PRECISION INSTRUMENT COMPANY
CRAIG	CRAIG BULTHUIS AND STELMAR
CROSET	CROSSETT LUMBER COMPANY
DBA	DBA SYSTEMS INCORPORATED

MISCELLANEOUS COMMERCIAL ORGANIZATIONS AND PRIVATE FIRMS - CONTINUED

SYMBOL	FULL NAME
******	***
DFWIAP	DALLAS-FORT WORTH INTERNATIONAL AIRPORT
DOWCO	DOW CHEMICAL COMPANY
DSI	DESIGN SCIENCES INCORPORATED
DVLCO	DOLLY VARDEN LUMBER COMPANY
ENVENG	ENVIRONMENTAL ENGINEERING INCORPORATED
FMCO	FORD MOTOR COMPANY
GCC	GLOGORA COAL COMPANY
GE	GENERAL ELECTRIC CORPORATION
GEON	GEONAUTICS INCORPORATED
GPI	GREENMAN PEDERSEN INCORPORATED
GPSSER	GPS SERVICES INCORPORATED
GRDC	GULF RESEARCH AND DEVELOPMENT COMPANY
GWA	GERKEN WOOD AND ASSOCIATES INCORPORATED
HAPT	HUGHES AIRPORT
HMB	HANNON MEEKS AND BAGWELL
HMCO	HANNA MINING COMPANY
ISSINC	INSTRUMENT SALES AND SERVICES INCORPORATED
KETCH	KETCHIKAN PULP COMPANY
LAICO	LOS ANGELES INVESTMENT COMPANY
LDGO	LAMONT DOHERTY GEOLOGICAL OBSERVATORY
LEICA	LEICA INCORPORATED

MACCO	MACCO CORPORATION
MCAM	MOLYBDENUM CORPORATION OF AMERICA
MCLCO	MICHIGAN-CALIFORNIA LUMBER COMPANY
MLGW	MEMPHIS LIGHT GAS AND WATER
MSI	MEASUREMENT SCIENCE INCORPORATED
NAAV	NORTH AMERICAN AVIATION
NJZINC	NEW JERSEY ZINC COMPANY
NWHYDR	NORTHWEST HYDRAULIC CONSULTANTS
PACTT	PACIFIC TELEPHONE AND TELEGRAPH COMPANY
PANAM	PAN AMERICAN AIRLINES
PCC	PEABODY COAL COMPANY
PECO	POHLY EXPLORATION COMPANY
PHILCM	PHILLIPS CHEMICAL COMPANY
PPCC	PACIFIC PORTLAND CEMENT CORPORATION
PSOMAS	PSOMAS AND ASSOCIATES
PVE	PALOS VERDES ESTATES
REGIS	ST REGIS PAPER COMPANY
RRLC	RED RIVER LUMBER COMPANY
SANDIA	SANDIA CORPORATION
SLDC	SAINT LAWRENCE DEVELOPMENT CORPORATION
SSC	SEISMOGRAPH SERVICE CORPORATION
STATEL	STANFORD TELECOM
SWBELL	SOUTH WESTERN BELL TELEPHONE COMPANY
TLDYNE	TELEDYNE INCORPORATED
VAILCO	VAIL COMPANY
VITRO	VITRO CORPORATION (NOW VITSER)
VITSER	VITRO SERVICES CORPORATION
WE	WESTERN ELECTRIC COMPANY
WHITE	WHITE PIGMENT COMPANY

NON-SPECIFIC DESIGNATORS

SYMBOL	FULL NAME
******	***
LOCENG	LOCAL ENGINEER (INDIVIDUAL OR FIRM)
LOCSUR	LOCAL SURVEYOR (INDIVIDUAL OR FIRM)
UNK	UNKNOWN PERSON OR FIRM

NOTE: After this revision of Annex C, NGS will discontinue publishing hard copy updates. Current codes for CONTRIBUTORS OF GEODETIC CONTROL DATA can be retrieved from the NGS Web Site at: [http://www.ngs.noaa.gov/cgi-bin/get-contrib.prl].

ANNEX D

GUIDELINES FOR GEODETIC CONTROL POINT DESIGNATIONS

A geodetic control point is a monumented or otherwise marked, survey point, established for the purpose of providing geodetic reference for mapping and charting activities and for a wide variety of engineering and scientific applications. A control point is normally identified by a number, an alphanumeric symbol, or a concise, intelligible name which is usually stamped on the disk marker. In principle, the designation by which a control point is identified should closely resemble the stamping that appears on the respective marker. However, extraneous information is frequently present which should not be included as part of the designation. In every case, the designation assigned to a control point for processing purposes must be identical to the designation that appears in the heading of the station description.

These guidelines have been established to provide consistent control point designations and facilitate automated processing of the data. Implementation of these guidelines may sometimes result in two or more control points having the same designation. In such cases it will be necessary to refer to other information in the description to completely identify the control point. Sample formats for the various designations are given in this annex.

GUIDELINES

1. A control point designation must not exceed 40 alphanumeric characters, including all imbedded blanks. When necessary, abbreviate and/or edit an existing designation to conform to this limit.

2. The year the mark was set is considered extraneous information and is not to be carried as part of a control point designation. For marks whose designations have not been altered when they were reset, the word RESET must be appended to the original designations. This also holds true for control points which have been reset more than once. In such cases the year given in the "year set" field will be used to distinguish the marks.

Monument	Stamped	Designation
USGS BM Disk	TT 8 RESET 1965	TT 8 RESET
CGS BM Disk	LAKE WASHINGTON RESET 1970	LAKE WASHINGTON RESET
CGS Tri Sta Disk	BRADY 1951	BRADY
CGS BM Disk	ONEAL 1 1954	ONEAL 1
CGS BM Disk	DE KALB 1934	DEKALB
NCGS Trav Sta Disk	MC CALL 1968	MCCALL
CGS Tri Sta Disk	DODGE 2 1969	DODGE 2
CGS Tri Sta Disk	SPIT 1953 1983	SPIT RESET
USGS Survey Disk	PRIM TRAV STA NO 185 1915	PTS 185

3. The acronym or abbreviation of the agency or organization whose name is precast or sometimes stamped in the survey marker is considered extraneous information and should not be included in the control point designation.

Monument	Stamped	Designation

FLGS BM Disk	203 RESET 1950	203 RESET
FLGS BM Disk	203 RESET 1967	203 RESET
FLGS BM Disk	203 RESET 1967 MAY	203 RESET MAY
USGS BM Disk	2903	2903
MORC Gaging Sta	GAGING STA	GAGING STA
RIRR Disk	RV 16	RV 16
USGS Chis Square		WO 23 RM=148 RM
USGS Survey Disk	WO 23 1933	WO 23
USGS Survey Disk	WO 23 1933 RESET 1962	WO 23 RESET
PP+L Survey Disk	P 11 PPL RESET 1976	P 11 RESET

4. The following special characters are the only ones allowed in a control point designation. They are the blank ( ), plus (+), minus or hyphen (-), equals (=), slash (/), and decimal point (.). When used, these special characters must not be separated from adjacent characters by any blanks. Commas and parentheses are not allowed within a designation.

4.1 Most alpha and numeric character groupings in a designation should be separated by a single blank ( ). Some exceptions are allowed, see the set of Abbreviations and Formats.

Monument	Stamped	Designation
USGS Survey Disk	TT17B	TT 17 B
USGS Survey Disk	TT-17B	TT 17 B
USGS Survey Disk	TT-1 7B	TT 1 7 B

4.2 A plus sign (+) is permitted within a designation when the control point was previously used for stationing in alignment surveys. In these cases the plus sign (+) must be immediately preceded and followed by a digit, not a blank.

Monument	Stamped	Designation
AZDT Disk	STATION 11+14	ROUTE 244 STA 11+14
Highway Disk	2623 + 00	I95 STA 2623+00

4.3 The minus or hyphen (-) is allowed only when indicating a negative elevation stamped on a mark. An elevation stamped on a mark is used as the designation only when there is no other means to identify the mark. When a minus or hyphen (-) is used, it must be the first character of the designation and must be immediately followed by a digit.

Monument	Stamped	Designation
USGS Nail (Tag)	-227.10 5-23-55	-227.10
CGS BM Disk	-193.097 F 70 1928	F 70
USGS BM Disk	ELEV -7.325 FT	-7.325

4.4 The equal sign (=) is used as a separator for control points which carry multiple stamped designations. The designations involved should be concatenated with the equal sign. The combined designation length must not exceed the 40-character limit and the designation preceding the equal sign should be the designation used by the originating agency.

Monument	Stamped		Designation
USGS Chis Square			WO 23 RM=148 RM
CADH Survey Disk	CH 1174	297+00 (A)	CH 1174=297+00 A
Unk Survey Disk	STA. NO. 3	MI. 182.5	STA 3=MI 182.5
CGS Ref Mark Disk	LEE NO 1 1932	R 13	LEE RM 1=R 13
CGS Tri Sta Disk	68.399 B 22	ATKINSON 1918	ATKINSON=B 22
USGS Cap	U 276 1942	VA 45 1917	45=U 276

NOTE: In situations where there are multiple designations that either do not appear stamped on the mark or are too long to be accommodated by the 40-character designation, the secondary designation may be given as a separate data item and carried as an alias in the appropriate field.

4.5 A slash (/) may be used to indicate a numerical fraction.

Monument	Stamped	Designation
USGLO Survey Disk	T1N R3E S35 S36 1/4 1943	T1N R3E SECS 35 36 1/4 COR

4.6 A period (.) may not appear imbedded in or adjacent to a grouping of alpha characters, but may be used as a decimal point if imbedded in (but not adjacent to) a grouping of numeric characters.

Monument	Stamped	Designation
MADPW Survey Disk	ELEV. B.M. NO. F 40	F 40
CGS Ref Mark Disk	W. BASE NO 4 1965	CHARLESTON W BASE RM 4
CADWR Survey Disk	MI. 0.9 1967	AMERICAN CANAL MI 0.9
CGS Tri Sta Disk	PALMER N.E. BASE	PALMER NE BASE
CGS BM Disk	MT. MORRIS 1941	MT MORRIS

5. Nonspecific descriptive terms are not to be treated as "double designations" and are not to be carried as aliases.

Published as	Stamped	Designation
BENCH MARK 2		2
114.3, Chis Square		114.3
C 1, Bolt		C 1

6. The characters "BM", "BENCH MARK", and "PBM", even when stamped on a disk, are not to be included in a designation unless the control point has no other stamping (e.g., BM USGS) or the characters "BM" do not represent the words "BENCH MARK."

7. The elevation stamped on the disk marker on the monument is not to be carried as a part of the respective designation. The exception is when the elevation is the only means of identifying the survey mark.

Monument	Stamped	Designation

CGS BM Disk	H 325 230.695FT	H 325
MORC Disk	140B ELEV 95.3 FT	140 B
USGS BM Disk	-9.825 FT	-9.825
BOR Survey Disk	ELEV. 101.6	101.6

8. The characters "NO" or "No.", when used as an abbreviation for the word "number", should not be included in the designation, even when they are stamped in the disk.

Monument	Stamped	Designation
CGS Ref Mark Disk	MONROE NO 1 1944	MONROE RM 1
CGS BM Disk	BENCH MARK No. 6	6

9. The designation for a reference mark disk should be formed by appending the symbols RM 1, RM 2, ..., RM 13, etc. to the name of the horizontal control point for reference marks stamped NO 1, NO 2, ..., NO 13, etc., respectively.

Monument	Stamped	Designation
CGS Ref Mark Disk	CHARLOTTE NO. 1 1945	CHARLOTTE RM 1
CGS Ref Mark Disk	BOULDER 1935 NO 6 1968	BOULDER RM 6
CGS Ref Mark Disk	CHICO 1948 NO 3 RESET 1971	CHICO RM 3 RESET

10. The designation for an azimuth mark disk is formed by appending the characters "AZ MK" to the name of the respective horizontal control point. In the case of multiple azimuth marks, the numbers "2", "3", etc. are added for azimuth marks stamped NO 2, NO 3, etc.

Monument	Stamped	Designation
CGS Az Mark Disk	CHARLOTTE 1934	CHARLOTTE AZ MK
CGS Az Mark Disk	BOULDER 1935 NO. 3	BOULDER AZ MK 3
CGS Az Mark Disk	NORWASH AZI 1932	NORWASH AZ MK
CGS Az Mark Disk	PARK AZ RESET 1965	PARK AZ MK RESET

11. A temporary bench mark (TBM) must carry the letters "TBM" as the first three characters of the designation.

Monument	Stamped	Designation
Spike		TBM 1 A
Sidewalk		TBM 14

12. The National Ocean Service (NOS) has instituted a standard system of designations for all tidal and water level stations operated by NOS. The system provides for the unique identification of all disks, staffs, etc., located at such stations (e.g., see Formats in this annex).

Tidal and water level bench mark designations must conform to standard designations adopted by the National Ocean Service. For information concerning specific tide gage bench marks, etc., communicate with:

User Services Section, N/OES232
National Ocean Service, NOAA
1305 East-West Highway
Silver Spring, MD 20910
Telephone: 1-301-713-2877

Whenever the need arises for a guideline to deal with a situation not covered herein, the user is encouraged to communicate with the following appropriate technical offices in NGS:

Horizontal Network Branch, N/CG12
National Geodetic Survey, NOAA
1315 East-West Highway
Silver Spring, MD 20910
Telephone: 1-301-713-3176

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
1315 East-West Highway
Silver Spring, MD 20910
Telephone: 1-301-713-3191

Space and Physical Geodesy Branch, N/CG14
National Geodetic Survey, NOAA
1315 East-West Highway
Silver Spring, MD 20910
Telephone: 1-301-713-3205

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ABBREVIATIONS

A list of standard abbreviations has been adopted for use in designating geodetic control points. These abbreviations are for terms that commonly occur in designations and are the only accepted forms of abbreviation. This list may be extended as the need arises.

Geodetic control point abbreviations	
A POINT	A PT
ACADEMY	ACAD
ADMINISTRATION	ADM
AGENCY	AGY
AGRICULTURE	AGRI
AHEAD	AHD
AIRCRAFT	ARCFT
AIRPORT	APT
AIRWAY	AWY
AIR FORCE BASE	AFB
ALLEGHENY	ALGHNY
AMBASSADOR	AMB
AMENDED	AMD
AMENDED MONUMENT (AM)	AMD MON
AMERICAN	AMER
ANGLE	ANG
ANGLE POINT (AP)	ANG PT
ANTENNA	ANT
APPALACHIAN	APLCN
APPROXIMATELY	APPROX

ASSOCIATION	ASSOC
ASTRONOMICAL	ASTRO
ASYLUM	ASY
ATLANTIC	AT
AUTHORITY	AUTH
AUXILIARY	AUX
AUXILIARY MEANDER CORNER (AMC)	AUX MDR COR
AVENUE	AVE

Notes:

1. Abbreviations listed with () are used by the Bureau of Land Management.
2. The cardinal directions (E, S, W, N, NE, SE, SW, and NW) are to be abbreviated only when they are not the first word of the designation.

Geodetic control point abbreviations (Continued)

AVIATION	AVN
AZIMUTH	AZ
BACK	BCK
BANK	BK
BANKING	BKG
BAPTIST	BAP
BATTERY	BTRY
BEACON	BCN
BEARING	BRG
BEARING OBJECT (BO)	BRG OBJ
BEARING TREE (BT)	BRG TREE
BELFRY	BFRY
BETWEEN	BET
BOULEVARD	BLVD
BOUNDARY	BDRY
BREAKWATER	BRKWTR
BRICK	BR
BROADCASTING	BCSTG
BROTHER	BRO
BROTHERS	BROS
BUILDING	BLDG
BUREAU	BUR
CAPITOL	CAP
CATHEDRAL	CATHL
CATHOLIC	CATH
CEMETERY	CEM
CENTER (C)	CEN
CENTERLINE	CL
CERAMIC	CERAM
CHEMICAL	CHEM
CHIMNEY	CHIM
CHURCH	CH
CLOCK	CLK

CLOSING CORNER (CC)	CC
COLLEGE	COLL
COMMERCE	COM
COMMERCIAL	COML
COMMISSION	COMM
COMPANY	CO
COMPRESS	COMP
CONCENTRATION	CONCN
CONCEPTION	CON
CONCRETE	CONC
CONGREGATIONAL	CONG

Geodetic control point abbreviations (Continued)

CONSOLIDATED	CONSOL
CONSTRUCTION	CONSTR
CONTINENTAL	CONTL
CONTROL	CTRL
COOPERATIVE	COOP
CORNER	COR
CORPORATION	CORP
CORRECTIONAL	CORR
COUNTRY	CTRY
COUNTY	CNTY
COURTHOUSE	CTHSE
CUPOLA	CUP
DAYBEACON	DBCN
DEFENSE	DEF
DEPARTMENT	DEPT
DISTRIBUTOR	DISTR
DIVISION	DIV
DOMESTIC	DOM
DORMITORY	DORM
DRAWBRIDGE	DBRIDGE
EAST	E
ECCENTRIC	ECC
EDUCATION	EDUC
ELECTRIC	ELEC
ELEMENTARY	ELEM
ELEVATION	ELEV
ELEVATED	ELEVD
ELEVATOR	ELEVR
ENGINEERING	ENG
ENGRAVING	ENGR
ENTRANCE	ENTR
EPISCOPAL	EPIS
EQUIPMENT	EQPT
EVANGELICAL	EVAN
EXCHANGE	EXCH
EXPERIMENTAL	EXPTL
FEDERAL	FED
FINIAL	FIN
FIRST	1ST

FLAGPOLE	FP
FLAGSTAFF	FS
FOURTH	4TH
FRONT RANGE	FRGE
FURNITURE	FURN

Geodetic control point abbreviations (Continued)

GABLE	GAB
GENERAL	GEN
GEODETIC	GEOD
GEOGRAPHIC	GEOG
GEOLOGICAL	GEOL
GOVERNMENT	GOVT
GROWERS	GROS
HARBOR	HBR
HARDWARE	HDWE
HEADQUARTERS	HQ
HEIGHTS	HTS
HIGHWAY	HWY
HISTORICAL	HIST
HOSPITAL	HOSP
HOUSE	HSE
HYDRO	HYD
IMMACULATE	IMM
IMPLEMENT	IMPL
IMPORT	IMP
INCINERATOR	INCIN
INCORPORATED	INC
INDEPENDENT	IND
INDUSTRIAL	INDL
INDUSTRY	INDY
INFIRMARY	INFIRM
INSTITUTE	INST
INSTITUTION	INSTN
INSURANCE	INS
INTERNATIONAL	INTL
INTERSTATE	INTST
INTERSECT	INT
INVESTMENT	INVT
IRRIGATION	IRRIG
ISLAND	IS
JUNCTION	JCT
LABORATORY	LAB
LANDING	LDG
LATITUDE	LAT
LATTER DAY SAINTS	LDS
LEATHER	LEA
LEFT	LT **

**The abbreviations R, T, LT, and RT must be adjacent to at least one numeric character.

Geodetic control point abbreviations (Continued)

LIGHT	LT
LIGHTHOUSE	LH
LOCAL	LCL
LOCATION	LOC
LOCATION MONUMENT (LM)	LOC MON
LOOKOUT	LO
LOOKOUT HOUSE	LOH
LOOKOUT TOWER	LOT
LONGITUDE	LON
LUMBER	LUM
LUTHERAN	LUTH
MACHINERY	MACH
MAGAZINE	MAGZ
MAGNETIC	MAG
MAINTENANCE	MAINT
MANUFACTURED	MFD
MANUFACTURING	MFG
MARK	MK
MARKET	MKT
MAST	MST
MEANDER	MDR
MEANDER CORNER (MC)	MDR COR
MERCHANDISE	MDSE
MERCANTILE	MERC
METHODIST	METH
METROPOLITAN	MET
MICROWAVE	MV
MILE or MILES	MI
MILEPOST	MP
MILITARY	MIL
MILLING	MILL
MONUMENT	MON
MOUNT	MT
MOUNTAIN	MTN
MUNICIPAL	MUN
MUSEUM	MUS
NATIONAL	NAT
NAVIGATION	NAV
NEAR	NR
NORTH	N
NORTHEAST	NE
NORTHWEST	NW
OBJECT	OBJ
OBSERVATION	OBS

Geodetic control point abbreviations (Continued)

OBSERVATORY	OBSY
OBSTRUCTION	OBSTR
OFFICE	OFF
ORDNANCE	ORD
ORGANIZATION	ORG
ORTHODOX	ORTH
PEAK	PK
PENINSULA	PEN
PETROLEUM	PET
PINNACLE	PCLE
PLANT	PLT
POINT	PT
POINT A	PTA
POINT OF CURVE	POC
POINT OF INTERSECTION	PI
POINT OF TANGENT	POT
POLICE	POL
POWER	PWR
POWERHOUSE	PHSE
PRESBYTERIAN	PRESB
PRIMARY	PRIM
PRIMARY TRAVERSE STATION	PTS
PRINTING	PTG
PROCESS	PRCS
PRODUCING	PRODG
PRODUCT	PROD
PROPERTIES	PROP
PROTESTANT	PROT
PUBLIC	PUB
PUBLISHING	PUBG
QUARTER	QTR
RADIO	RAD
RAILROAD	RR
RAILWAY	RWY
RANGE	RGE
RANGE (Township)	R **
REAR RANGE	RRGE
REFERENCE	REF
REFERENCE MARK	RM
REFERENCE MONUMENT (RM)	REF MON
REFERENCE POINT	RP

**The abbreviations R, T, LT, and RT must be adjacent to at least one numeric character.

Geodetic control point abbreviations (Continued)

REFINING	REFG

REFORMED	REFM
REFRIGERATING	REFRIG
RESET	RST
RIGHT	RT **
RIGHT OF WAY	ROW
ROAD	RD
ROMAN	ROM
ROUTE	RTE
RUNWAY	RNWY
SAINT	ST
SANITARY	SANIT
SANITORIUM	SAN
SAVINGS	SVGS
SCHOOL	SCH
SCHOOLHOUSE	SCHSE
SCIENTIFIC	SCI
SECOND	2ND
SECTION	SEC
SECTIONS	SECS
SEMINARY	SEM
SERVICE	SERV
SOCIETY	SOC
SOUTH	S
SOUTHEAST	SE
SOUTHWEST	SW
SPECIAL	SPL
SPECIAL MEANDER CORNER (SMC)	SPL MDR COR
SPIRE	SP
SQUARE	SQ
STACK	STK
STANDARD	STD
STANDARD CORNER (SC)	SC
STANDPIPE	SPIPE
STATION	STA
STEEPLE	STPE
STORAGE	STGE
STREET	STR
SUBURBAN	SUBR
SUPERINTENDENT	SUPT
TANK	TK

**The abbreviations R, T, LT, and RT must be adjacent to at least one numeric character.

TANGENT	TAN
TANGENT OFFSET	TOS
TECHNICAL	TECH
TELEGRAPH	TELG
TELEPHONE	TEL
TELEVISION	TV
TEMP POINT A	TP A

TERMINAL	TERM
TERRITORY	TERR
THEOLOGICAL	THEO
THIRD	3RD
TOWER	TWR
TOWNSHIP	TWP
TOWNSHIP (Tier)	T **
TRACT	TR
TRANSCONTINENTAL	TRANSCON
TRANSMISSION	TRANSM
TRANSPORTATION	TRANSP
TRAVERSE	TRAV
TRAVERSE STATION	TS
TRIANGLE	TRI
TURNPIKE	TPK
UNITARIAN	UNIT
UNIVERSITY	UNIV
VACUUM	VAC
VERTEX	VTX
VILLAGE	VIL
WATER	WT
WEST	W
WAREHOUSE	WHSE
WINDMILL	WMILL
WITNESS CORNER (WC)	WC
WITNESS POST (WP), wood	WP
WITNESS POST, metal	MWP
WITNESS POST, fiberglass	FWP

**The abbreviations R, T, LT, and RT must be adjacent to at least one numeric character.

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FORMATS

Only NGS employees and agents may set brass disks and aluminum flanges precast with NGS logo. Such marks must be stamped with designations supplied by the agency. Each geodetic control point designation should be unique among all the designations located within a defined region.

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Geodetic control points

FORMAT: NAME SPECIAL

1. NAME

A. The following method is generally used for naming vertical control points (bench marks). The first mark established in a state is designated "A", then "B" and so on through the alphabet, except the letters "I" and "O" which are not used because they are too easily confused with the numbers "1" and "0". The next series of marks is identified as "A 1", "B 1", etc.; then "A 2", "B 2", etc., and so on through the alphabet. In some cases, more than one letter is used to distinguish between bench marks that have accidentally been given the same name in the same state.

B. The following method is generally used for naming a horizontal control point (triangulation or traverse). The name should serve not only to identify the station but to suggest the local geographic location or feature. The name should be used only once within a county and preferably a given state. Therefore, use sufficient variety to avoid duplication. A short name is desirable, but if a longer name is required to properly serve the purpose, it should be used. In those cases where a well known geographical feature in the vicinity is used, or the name of a local landowner, the name should be spelled correctly.

2. SPECIAL USE

A. These terms are used with vertical control points to distinguish between names used more than once in a state or to indicate disturbance of the original bench mark (e.g., "RESET").

B. These terms are used with horizontal control points to explain a local use or disturbance to the original mark or its designation.

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Examples:

Geodetic control points

NAME		SPECIAL
Station	Number	Use
A		
L	690	
L	690	RESET
YY	1150	
C	1244	X
LEON		
LEON		ECC
LEON		RESET
LEON	RM 1	
LEON	RM 2	
LEON	AZ MK	
LEON	AZ MK	RESET
LEON	AZ MK	PTA
LEON	AZ MK 2	
LEON 2		
LEON 2	RM 3	
LEON 2	RM 4	
LEON 2	AZ MK	
LEON 2	AZ MK 2	

Tide station bench marks

FORMAT: LOCATION OBJECT SPECIAL

---

1. LOCATION Code and Station

   A. The location has two parts, the first part, the CODE, is a 3-digit State code given for each geographical region.
   B. The second part of the location, the STATION NUMBER, is an unique 4-digit number assigned to a particular tide station within a given geographical area.

2. OBJECT Identification

   A. The MARK USE gives information on the nature of the object which was used.
   B. The PUBLICATION NAME is used to give the proper identification of the object. In most cases, this field should be based on the stamping. If there is no stamping, use the name given in the tidal publication. In either case, this field is subject to the guidelines given in this Annex.

3. SPECIAL Use

   This term is used to explain a local use or disturbance to the original mark.

   NOTE: If other types of marks are used in tidal surveys, see other format rules for their primary designations; and add aliases according to the following examples:

Mark type	DS (Triangulation Station Mark)
Stamping	BREACH 1963
Primary designation	BREACH

Alias	866 5552 TIDAL

Mark type	DB (Bench Mark Disk)
Stamping	V 163 RESET 1984
Primary designation	V 163 RESET
Alias	872 9871 TIDAL

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Examples

Tide station bench marks set before or about 1976

LOCATION		OBJECT		SPECIAL
Code State	Station No.	Mark use	Identification Publication name	Use
866	1684	TIDAL	HB 1	
857	4680	TIDAL	BASIC	
872	0030	TIDAL	37	RESET
944	0886	TIDAL	USE 5	

Tide station bench marks set after about 1976

LOCATION		OBJECT		SPECIAL
Code State	Station No.	Identification Publication name	Mark use	Use
872	0051	D	TIDAL	
872	9554	C	TIDAL	RESET

Staffs or electric tape gage (ETG) reading marks at tide or water-level stations

---

FORMAT: TEMPORAL LOCATION OBJECT SPECIAL

---

1. TEMPORAL Reference

   The Temporal Reference is identified by setting the term "TBM" in front of the location.

2. LOCATION Code and Station

   A. The location has two parts, the first, the CODE, is either a 3-digit STATE number code for a State or a 3-digit CUTTER code for defining a part of a lake or channel.
   B. The second part of the location, the STATION NUMBER, is an unique 4-digit number assigned to a particular tide or water level station within a given geographical area.

3. OBJECT Identification

   The Object Identification gives information on the nature of the object that was used.

4. SPECIAL Use
   These terms are used to indicate the graduation of the tide or water level staff on which the level rod was placed.

Examples

Staffs located at tide stations

TEMPORAL	LOCATION		OBJECT	SPECIAL
Reference	Code State	Station No.	Identification	Use
TBM	872	2029	STAFF	6 FT

Electric (or "zero electric") tape gage reading marks at tide stations

TEMPORAL	LOCATION		OBJECT	SPECIAL
Reference	Code State	Station No.	Identification	Use
TBM	872	9678	ETG READ MK	

Staffs located at water level stations

TEMPORAL	LOCATION		OBJECT	SPECIAL
Reference	Code Cutter	Station No.	Identification	Use
TBM	906	3000	STAFF	6 FT

Electric tape gage (ETG) reading marks at water level stations

TEMPORAL	LOCATION		OBJECT	SPECIAL
Reference	Code Cutter	Station No.	Identification	Use
TBM	907	5099	ETG READ MK	

Water level station bench marks

FORMAT: LOCATION OBJECT SPECIAL

---

1. LOCATION Code and Station

   A. The first part of the location is the 3-digit code for defining a part of a lake or channel within the CUTTER Code System.
   B. The second part of the location, the STATION NUMBER, is a unique 4-digit number assigned to the water level station within a given geographical area.

2. OBJECT Identification

   In most cases, this field should be based on the stamping. If there is no stamping, use the name given in the water level publication. In either case, this field is subject to the guidelines given in this annex.

3. SPECIAL Use

   These character strings are used to explain some local use or disturbance to the original mark.

   NOTE: If other types of marks are used in water level surveys, see other format rules for their primary designation and add an alias according to the following example:

Mark type	F	(flange-encased rod)
Stamping	C 234 1980	(on logo cap)
Primary designation	C 234	
Alias	906 3087	

Examples

Water level station bench marks set before or about 1976

LOCATION	OBJECT	SPECIAL

Code Cutter	Station No	Identification	Use
907	5098	ROAD A	
907	5098	ROAD A	RESET

Water level station bench marks set after about 1976

LOCATION		OBJECT	SPECIAL
Code Cutter	Station No.	Identification	Use
907	5085	F	
907	5085	F	RESET

Airport runways

FORMAT: ALIGNMENT OBJECT LOCATION SPECIAL

1. ALIGNMENT Survey Name

Use the proper NAME of the town, city, or a geographic location within the area for the airport.

2. OBJECT Identification

   Enter the type of alignment object, in this case it is the airport RUNWAY.

3. LOCATION Station (Runway Number) and Tangent Offset (TOS)

   A. The location has two parts, the first part is called the runway number and should be a 2-digit numerical value. These two digits are taken from the first two digits of the 3-digit runway (measured from north) azimuth, i.e., 01, 13, 22, or 34 which were taken from the azimuths of 010, 130, 220, and 340 respectively.

   B. The second part of the location, the tangent offset (TOS), is the location of the control point in question with respect to the center of the alignment, that is, the distance (in meters/feet) either left or right.

4. SPECIAL Use

   Terms such as A PT, ECC, HUB, PTA, RESET, and TP A are used to explain a local use or disturbance to the original mark.

Examples

Airport runways

ALIGNMENT	OBJECT	LOCATION		SPECIAL
Survey name	Identification	Station	TOS	Use
KENNEWICK AIRPORT				
KENNEWICK AIRPORT				ECC
KENNEWICK AIRPORT				RESET
KENNEWICK APT AZ MK				
KENNEWICK APT	RUNWAY	00	OFFSET	HUB
KENNEWICK APT	RUNWAY	36	CL	
KENNEWICK APT	RNWY	02	CL	
KENNEWICK APT	RNWY	20	CL	

D-23
Political boundaries

FORMAT: ALIGNMENT OBJECT DESIGNATE POLITICAL SPECIAL

---

1. ALIGNMENT Survey

   The term BOUNDARY is used when two or more participants are in common or adjacent to an alignment.

2. OBJECT Identification

   Enter the type of alignment object, such as name, station, miles, mileposts, monuments, reference points, etc.

3. DESIGNATE Reference

   The designate reference is used to identify the unique number, letters, or symbols that describe the control point.

4. POLITICAL Participants

   A. All participants in common or adjacent to the alignment boundary are listed in alphabetical order.
   B. The political participants to be selected and entered first will be by the following order: international, federal, reservations, state, county, municipal, and private.
   C. The selection order will provide the correct entries for the country/state and county fields used within the NGS data base.

5. SPECIAL Use

   Terms such as A PT, ECC, HUB, PTA, RESET, and TP A are used to explain a local use or disturbance to the original mark.

Examples

Political boundaries

ALIGNMENT	OBJECT	DESIGNATE	POLITICAL	SPECIAL
Survey	Identification	Reference	Participants	Use
BOUNDARY	MONUMENT	84 A	MX US	RESET
BOUNDARY	MILEPOST	360	ND SD	
BOUNDARY	TRAVERSE STATION	110 A	CD US	ECC
BOUNDARY	ARC STONE	14	DE PA	RESET
BOUNDARY	CORNER STONE	2	MD PA	
BOUNDARY	TANGENT STONE	1	DE MD	
BOUNDARY	INTERSECT STONE	OFFSET	DE PA	
BOUNDARY	POINT	24	CD US	
BOUNDARY	REFERENCE POINT	22	AZ CA	

D-24

Highways and roads

FORMAT: ALIGNMENT OBJECT LOCATION SPECIAL

---

1. ALIGNMENT Survey Name

   A. Use the term Ixxx for all Interstate highways.
   B. Use the term HIGHWAY for all Federal highways.
   C. Use the term ROUTE for all State highways.
   D. Use the term ROAD for all county roads.
   E. Use the municipality name for all local streets, avenues, boulevards, pikes, roads, etc.

2. OBJECT Identification

   A. Enter the type of alignment object, such as the name and station, miles, mileposts, monuments, reference points, etc.
   B. Or enter the proper name of the alignment, such as the name of the city street.

3. LOCATION Station and Tangent Offset

   A. The location uses two parts, the first part is called the stationing. This part should be, for most cases, a numeric value.

B. The second part of the location, the tangent offset (TOS), is the location of the point in question with respect to the center of the alignment, that is, the distance (in meters/feet) either left or right.

4. SPECIAL Use

Terms such as A PT, ECC, HUB, PTA, RESET, and TP A are used to explain a local use or disturbance to the original mark.

Examples
Highways and roads

ALIGNMENT	OBJECT	LOCATION		SPECIAL
Survey name	Identification	Station	TOS	Use
I495	MILEPOST	99.387		ECC
HIGHWAY 50	STATION	1234+00	CL	
ROUTE 355	STATION MARK	233+16	50LT	
ROUTE 193	REFERENCE POINT	21+00	POC	
ROAD 2786	MILEPOST	37.3		RESET
ROCKVILLE	MAPLE AVE STA	1+32	39RT	
ROCKVILLE	MAPLE AVE STA	2+50	POT	
PASCO	MAIN STREET	PI 9		

Railroads, canals and rivers

FORMAT: ALIGNMENT OBJECT LOCATION SPECIAL

---

1. ALIGNMENT Survey

A. The terms RAILROAD or RAILWAY for alignments which follow these right-of-ways.
B. Use the characters CANAL or REACH for those man made waterways.
C. Use the characters RIVER for all natural waterways.

2. OBJECT Identification

Enter the type of alignment object, such as name, station, miles, mileposts, monuments, reference points, etc.

3. LOCATION Station and Tangent Offset

A. The location uses two parts, the first part is called the stationing. This part should be, for most cases, a numeric value.

B. The second part of the location, the tangent offset (TOS), is the location of the point in question with respect to the center of the alignment, that is, the distance (in meters/feet) either left or right.

4. SPECIAL Use

Terms such as A PT, ECC, HUB, PTA, RESET, and TP A are used to explain a local use or disturbance to the original mark.

Examples

Railroads, canals and rivers

ALIGNMENT	OBJECT	LOCATION		SPECIAL
Survey	Identification	Station	TOS	Use
RAILROAD	MILEPOST	347.8	CL	RESET
RAILWAY	MILEPOST	216.455	OFFSET	
REACH	1	22+00	400LT	ECC
REACH	1	PI 2		
REACH	3	295+00	400LT	
RIVER	SNAKE MILEPOST	37.3		

D-26
Landmarks

FORMAT: LOCATION OWNERSHIP OBJECT SPECIAL

---

1. LOCATION

    A. The general area in which the landmark is located should be used, such as the nearest city, town, or local geographic area.
    B. However, some landmarks by the nature of their name alone will be enough to give a general location, e.g. STATUE OF LIBERTY (New York), SEARS TOWER (Chicago), and SEATTLE SPACE NEEDLE (Seattle).

2. OWNERSHIP

    A. The ownership should be the proper name of the existing owner at the time the landmark was positioned. Later recovery information will reflect the changes of ownership.
    B. If the ownership is a political group, such as a state or county, do not include the name of the state or county.

3. OBJECT Identification
For a landmark, enter a general name in order to identify it.

4. SPECIAL Target
The special target is used to uniquely identify the exact object sighted as the landmark.

Examples
Landmarks

LOCATION	OWNERSHIP	OBJECT	SPECIAL
		Identification	Target

ASHLAND	MUNICIPAL	AIRPORT	BEACON
BETHESDA	GREEK ORTHODOX	CHURCH	CROSS
CARSON CITY	STATE POLICE	RADIO STATION	MAST
FRANKLIN	COUNTY	HOSPITAL	FLAGPOLE
KEY WEST	FORT MONROE	BATTERY	RED LIGHT
LAS VEGAS		TV STATION KLAS	MAST
LOVELOCK		RADIO STATION KOB 893	MAST
NEW YORK	PORT AUTHORITY	BUILDING	FLAGPOLE
PASCO	COUNTY	COURTHOUSE	DOME
POTOMAC	ST MARKS CATHOLIC	CHURCH	SPIRE
ROCKVILLE	HUGHES AIRCRAFT	BUILDING	APEX
ROCKVILLE	MUNICIPAL	GAS TANK	FINIAL
ROCKVILLE	MUNICIPAL	WATER TANK	BALL
ROCKVILLE	MUNICIPAL	STANDPIPE	FINIAL
SALEM	1ST METHODIST	CHURCH	WEST SPIRE
SALEM	STATE	HOSPITAL CLOCK	APEX
WINNEMUCCA		RADIO STATION KWNA	MAST

D-27
Township and range control point information

FORMAT: TOWNSHIP RANGE SECTION LOCATION

Department of Interior, Bureau of Land Management disks are always marked by stamping them so as to be read looking north while standing on the south side. This relationship gives the viewer a pictorial or graphical representation of the physical relationship of the existing subdivision of the land under survey.

The south and east boundaries of each township, for the most part, are the controlling sides, whereas north and west township boundaries will close onto the controlling standard parallel to the north and the guide meridian to the west of it respectively.

1. TOWNSHIP

   A. One Township #
      Indicate the Township containing the identified survey monument.
   B. Two Townships ## (read from south to north)
      (1) List southernmost FIRST (one with lowest latitude)
      (2) List northernmost SECOND (one with higher latitude)

2. RANGE

   A. One Range #
      Indicate the Range containing the identified survey monument.
   B. Two Ranges ## (read from west to east)
      (1) List Range on the left FIRST (western most)
      (2) List Range on the right SECOND (eastern most)

3. SECTION

   A. Arrange and list all sections to be included, in a string of increasing section numbers.
   B. For Township surveys which are incomplete, show the identification (see part 4) as a Cardinal Corner of the "One" lowest section where the subdivision survey has been completed.

4. LOCATION - Identification of a Subdivision Survey Point

A.	Standard Corner	S C
B.	Closing Corner	C C
C.	Meander Corner	M C
D.	Quarter-Section Corner	1/4 COR
E.	Location Monument	L M
F.	Angle Point	A P
G.	Witness Corner	W C
H.	Cardinal Corner	***
I.	Identification as Found	NIR S180 MP31

***Use Lowest Section Number Completed.


```
  |    |    |    |    |   |                            |
  |  4TH STD PARALLEL NORTH (96 miles)                 |
  + -- + -- + -- + -- + -- +---------------------------+------
N |    |    |    |    |    |      |      |      |      |
O |    F    S    3    4   5|      |      |      | T16N |6
R |    I    E    R    T   T|      |      |      | R24E |T
T |    R    C    D    H   H|      |      |      |      |H
H |    S    O              |------|------|------|------|
  |    T    N    |    |   G|      |      |      |      |G
  |         D    |    |   U|      |      |      | T15N |U
  |    |         |    |   I|      |      |      | R24E |I
P |    |    |    |    |   D|      |      |      |      |D
R |                       E|------|------+******+------|E
I |                        |      |      *      *      |
N |                       M|      |      * T14N * T14N |M
C |                       E|      |      * R23E * R24E |E
I |                       R|      |      *      *      |R
P |                       I|------|------+******+------|I
A |                       D|      |      |      |      |D
L |                       I| T13N | T13N | T13N | T13N |I
  |    |    |    |    |   A| R21E | R22E | R23E | R24E |A
  |    |    |    |    |   N|      |      |      |      |N
M + -- + -- + -- + -- + -- +---------------------------+------
E |  3RD STD PARALLEL NORTH (72 miles)                 |
R |                        |                           |
I |
D + -- + -- + --
I |  SECOND STD PARALLEL NORTH (48 miles)
A |
N |
  + -- + -- + --
  |  FIRST STD PARALLEL NORTH (24 miles)
  |
  |
  + -- + -- BASE LINE
  |\
S | \ (INITIAL POINT)
O |
U |
T |  FIRST STD PARALLEL SOUTH (24 miles)
H + -- + -- + --
  |
```

Figure D.1 - Layout of Standard Parallels and Guide Meridians.

```
                                     D-29
T15N R22E |                T15N R23E                | T15N R24E
    36    |  31  |  32  |  33  |  34  |  35  |  36  |    3
          |      |      |      |      |      |      |
--------- +******+******+******+******+******+******+ ----------
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
     1    *   6  |   5  |   4  |   3  |   2  |   1  *    6
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
       -- +------+------+------+------+------+------+ --
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
    12    *   7  |   8  |   9  |  10  |  11  |  12  *    7
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
       -- +------+------+------+------+------+------+ --
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
    13    *  18  |  17  |  16  |  15  |  14  |  13  *   18
          *      |      |             |      |      *
T14N      *      |      |    T14N     |      |      *      T14N
R22E   -- +------+------+--- R23E ----+------+------+ --   R24E
          *      |      |             |      |      *
          *      |      |      |      |      |      *
    24    *  19  |  20  |  21  |  22  |  23  |  24  *   19
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
       -- +------+------+------+------+------+------+ --
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
    25    *  30  |  29  |  28  |  27  |  26  |  25  *   30
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
       -- +------+------+------+------+------+------+ --
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
    36    *  31  |  32  |  33  |  34  |  35  |  36  *   31
          *      |      |      |      |      |      *
          *      |      |      |      |      |      *
----------+******+******+******+******+******+******+-----------
          |      |      |      |      |       |     |
     1    |   6      5      4      3      2      1  |    6
T13N R22E |                T13N R23E                | T13N R24E
```

Figure D.2 - T14N R23E SECS (1 - 36) as shown in Figure D.1.

```
                T14N R23E

 SEC 33  |        SEC 34          |  SEC 35
         |                        |
--------(A)---------(B)---------(C)--------
         |                        |
 SEC 4   |        SEC 3           |  SEC 2

                T13N R23E


                T13N R23E

 SEC 33  |        SEC 34          |  SEC 35
         |                        |
 -----+-(D)---------(E)-------+-(F)---- 3RD STD PARALLEL NORTH
     (X)                     (Y)
SEC 4  |        SEC 3         |  SEC 2

             T12N R23E
```

Figure D.3 - Designations for East/West Boundary Corners.

Examples

	TOWNSHIP	RANGE	SECTION	LOCATION
A	T13 14N	R23E	SECS 3 4 33 34	
B	T13 14N	R23E	SECS 3 34	1/4 COR
C	T13 14N	R23E	SECS 2 3 34 35	
D	T13N	R23E	SECS 33 34	SC
or D	T13N	R23E	SEC 33	SE COR
E	T13N	R23E	SEC 34	1/4 COR
F	T13N	R23E	SECS 34 35	SC
or F	T13N	R23E	SEC 34	SE COR
X	T12N	R23E	SECS 3 4	CC
Y	T12N	R23E	SECS 2 3	CC


```
                    T17N R24E              |           T17N R25SE
                                     S 36  |  S 31
--- 4TH STD PARALLEL NORTH  ------+---(L)----
                                 (Y)
                             S 1  |  S 6
```

```
                        --(K)-
                    S 12 |  S 7
                        --(J)-
    T16N R24E               |              T16N R25E
                ---------(I)---------
    T15N R24E               |              T15N R25E
                ---------(H)---------
    T14N R24E               |              T14N R25E
                ---------(G)---------
                    S 1  |  S 6
                        --(F)-
                    S 12 |  S 7
                        --(E)-
                    S 13 |  S 18
    T13N R24E           --(D)-             T13N R25E
                    S 24 |  S 19
                        --(C)-
                    S 25 |  S 30
                        --(B)-
                    S 36 |  S 31
--- 3RD STD PARALLEL NORTH ---+--(A)---------
                    (X)
                S 1  |  S 6
    T12N R24E      -(W)-                   T12N R25E
                      |
```

Figure D-4 - Designations for North/South Boundary Corners.

Examples

	TOWNSHIP	RANGE	SECTION	LOCATION
W	T12N	R24 25E	SECS 1 6 7 12	
X	T12N	R24 25E	SECS 1 6	CC
A	T13N	R24 25E	SECS 31 36	SC
B	T13N	R24 25E	SECS 25 30 31 36	
C	T13N	R24 25E	SECS 19 24 25 30	
D	T13N	R24 25E	SECS 13 18 19 24	
E	T13N	R24 25E	SECS 7 12 13 18	
F	T13N	R24 25E	SECS 1 6 7 12	
G	T13 14N	R24 25E	SECS 1 6 31 36	
H	T14 15N	R24 25E	SECS 1 6 31 36	
I	T15 16N	R24 25E	SECS 1 6 31 36	
J	T16N	R24 25E	SECS 7 12 13 18	
K	T16N	R24 25E	SECS 1 6 7 12	
Y	T16N	R24 25E	SECS 1 6	CC
L	T17N	R24 25E	SECS 31 36	SC

ANNEX E

STATION ORDER-AND-TYPE (OT) CODES

This ANNEX contains lists of the various types of horizontal control points with the corresponding two-character Order-and-Type (OT) Codes. These codes are used to classify every horizontal control point according to the general order of accuracy of the main-scheme network of which it is a part and according to the surveying method by which the point is positioned. The use of the OT Codes is explained in Chapter 2, pages 2-35 thru 2-38.

The first character (i.e., the "order code") of the OT Code indicates the order of accuracy of the main-scheme network of which the horizontal control point in question is a part or to which it is connected. It also indicates whether the horizontal control point is permanently marked and recoverable (e.g., a monumented station or a landmark) or not permanently marked and hence nonrecoverable (e.g., an auxiliary point):

ORDER CODES OF RECOVERABLE POINTS:

A - Order A Interferometric Positioning
B - Order B Interferometric Positioning
0 - Trans-Continental Traverse (TCT)
1 - lst-Order Survey Scheme
2 - 2nd-Order (Class I and Class II) Survey Scheme
3 - 3rd-Order (Class I and Class II) Survey Scheme
4 - Lower-Than-3rd-Order Survey Scheme and Supplemental Unmonumented Recoverable Landmarks (see p. E-4)

ORDER CODES OF NONRECOVERABLE POINTS:

5 - lst-Order Survey Scheme
6 - 2nd-Order (Class I and Class II) Survey Scheme
7 - 3rd-Order (Class I and Class II) Survey Scheme
8 - Lower-Than-3rd-Order Survey Scheme

The second code (i.e., the "type code") of the OT Code indicates the type of the (primary) surveying method by which the horizontal control point is positioned. It also shows whether the horizontal control point in question is a main-scheme station (i.e., one which is essential to the survey scheme) or a supplemental station (i.e., one which is incidental to the survey scheme):

TYPE CODES OF MAIN-SCHEME STATIONS:

1 - Positioned Primarily by Triangulation (or by Intersection)
2 - Positioned Primarily by Trilateration
3 - Positioned Primarily by Traverse
A - Positioned Primarily by Interferometric Satellite Relative Positioning

TYPE CODES OF SUPPLEMENTAL STATIONS:

4 - Positioned Primarily by Triangulation
5 - Positioned Primarily by Trilateration
6 - Positioned Primarily by Traverse
7 - Positioned by Intersection (Note: 1 if Main-Scheme Station)
8 - Positioned by Resection

B - Positioned Primarily by Interferometric Satellite Relative Positioning

<u>ORDER-AND-TYPE (OT) CODES OF RECOVERABLE HORIZONTAL CONTROL POINTS</u> - monumented (or otherwise permanently marked) stations, published as indicated.

SURVEY PROCEDURES	STATION TYPE	OT	PUBLISHED
MONUMENTED STATIONS POSITIONED BY GPS			
GPS Procedures	Main-Scheme	AA	AA-Order
GPS Procedures	Main-Scheme	BA	B-Order
GPS Procedures	Supplemental	BB	B-Order
STATIONS OF THE TRANS-CONTINENTAL TRAVERSE (TCT)			
TCT Procedures	Main-Scheme *	03	lst-Order
TCT Procedures	Supplemental **	06	lst-Order
MONUMENTED STATIONS POSITIONED PRIMARILY BY TRIANGULATION			
lst-Order	Main-Scheme	11	lst-Order
lst-Order	Supplemental	14	2nd-Order
2nd-Order (Class I or II)	Main-Scheme	21	2nd-Order
2nd-Order (Class I or II)	Supplemental	24	3rd-Order
3rd-Order (Class I or II)	All Stations	31	3rd-Order
Lower-Than-3rd-Order	All Stations	41	Low-Order
MONUMENTED STATIONS POSITIONED PRIMARILY BY TRILATERATION			
lst-Order	Main-Scheme	12	lst-Order
lst-Order	Supplemental	15	2nd-Order
2nd-Order (Class I or II)	Main-Scheme	22	2nd-Order
2nd-Order (Class I or II)	Supplemental	25	2nd-Order
3rd-Order (Class I or II)	All Stations	32	3rd-Order
Lower-Than-3rd-Order	All Stations	42	Low-Order
MONUMENTED STATIONS POSITIONED PRIMARILY BY TRAVERSE			
lst-Order	Main-Scheme	13	lst-Order
lst-Order	Supplemental	16	2nd-Order
2nd-Order (Class I or II)	Main-Scheme	23	2nd-Order
2nd-Order (Class I or II)	Supplemental	26	2nd-Order
3rd-Order (Class I or II)	All Stations	33	3rd-Order
Lower-Than-3rd-Order	All Stations	43	Low-Order

---

* Main-Scheme Station - one which is essential to the survey scheme.
** Supplemental Station - one which is incidental to the survey scheme.

SURVEY PROCEDURES	STATION TYPE	OT	PUBLISHED
MONUMENTED STATIONS POSITIONED BY INTERSECTION			
lst-Order	Main-Scheme	11	lst-Order
lst-Order	Supplemental	17	2nd-Order
2nd-Order (Class I or II)	Main-Scheme	21	2nd-Order
2nd-Order (Class I or II)	Supplemental	27	3rd-Order
3rd-Order (Class I or II)	All Stations	37	3rd-Order
Lower-Than-3rd-Order	All Stations	47	Low-Order

MONUMENTED STATIONS POSITIONED BY RESECTION

lst-Order	All Stations	18	2nd-Order
2nd-Order (Class I or II)	All Stations	28	2nd-Order
3rd-Order (Class I or II)	All Stations	38	3rd-Order
Lower-Than-3rd-Order	All Stations	48	Low-Order

ORDER-AND-TYPE (OT) CODES OF NONRECOVERABLE HORIZONTAL CONTROL POINTS -temporary or auxilliary points, not permanently marked, which must be carried in the files for network integrity purposes. These horizontal control points will not be published.

SURVEY PROCEDURES	STATION TYPE	OT
*************************	************	**

STATIONS OF THE TRANS-CONTINENTAL TRAVERSE (TCT) - must be monumented.

UNMARKED STATIONS POSITIONED PRIMARILY BY TRIANGULATION

lst-Order	Main-Scheme*	51
lst-Order	Supplemental**	54
2nd-Order (Class I or II)	Main-Scheme	61
2nd-Order (Class I or II)	Supplemental	64
3rd-Order (Class I or II)	All Stations	71
Lower-Than-3rd-Order	All Stations	81

UNMARKED STATIONS POSITIONED PRIMARILY BY TRILATERATION

1st-Order	Main-Scheme	52
1st-Order	Supplemental	55
2nd-Order (Class I or II)	Main-Scheme	62
2nd-Order (Class I or II)	Supplemental	65
3rd-Order (Class I or II)	All Stations	72
Lower-Than-3rd-Order	All Stations	82

---

* Main-Scheme Station - one which is essential to the survey scheme.
** Supplemental Station - one which is incidental to the survey scheme.

SURVEY PROCEDURES	STATION TYPE	OT
*************************	************	**

UNMARKED STATIONS POSITIONED PRIMARILY BY TRAVERSE

1st-Order	Main-Scheme	53
1st-Order	Supplemental	56
2nd-Order (Class I or II)	Main-Scheme	63
2nd-Order (Class I or II)	Supplemental	66
3rd-Order (Class I or II)	All Stations	73
Lower-Than-3rd-Order	All Stations	83

UNMARKED STATIONS POSITIONED BY INTERSECTION

lst-Order	Main-Scheme	51
lst-Order	Supplemental	57
2nd-Order (Class I or II)	Main-Scheme	61
2nd-Order (Class I or II)	Supplemental	67
3rd-Order (Class I or II)	All Stations	77
Lower-Than-3rd-Order	All Stations	87

UNMARKED STATIONS POSITIONED BY RESECTION			
lst-Order	All Stations	58	
2nd-Order (Class I or II)	All Stations	68	
3rd-Order (Class I or II)	All Stations	78	
Lower-Than-3rd-Order	All Stations	88	

ORDER-AND-TYPE (OT) CODES OF UNMONUMENTED RECOVERABLE LANDMARKS - normally positioned as supplemental low-accuracy control points, possibly used as main-scheme triangulation stations (e.g., a well-defined church spire used as the unoccupied center of a central-point figure in a triangulation network), published as indicated.

SURVEY PROCEDURES	STATION TYPE	OT	PUBLISHED
LANDMARKS USED AS MAIN-SCHEME TRIANGULATION STATIONS			
lst-Order	Main-Scheme	11	lst-Order
2nd-Order (Class I or II)	Main-Scheme	21	2nd-Order
3rd-Order (Class I or II)	Main-Scheme	31	3rd-Order
Lower-Than-3rd-Order	Main-Scheme	41	Low-Order
LANDMARKS POSITIONED AS SUPPLEMENTAL CONTROL POINTS			
Any-Order Traverse	Supplemental	43	Low-Order
Any-Order Intersection	Supplemental	47	Low-Order
Any-Order Resection	Supplemental	48	Low-Order

ANNEX F

NGS SURVEY EQUIPMENT CODES

000-099 - Gravity Instruments and Satellite Systems
100-199 - Theodolites and Transits
200-299 - Leveling Instruments
300-399 - Leveling Rods and Staffs
400-499 - Steel and Invar Tapes
500-599 - Lightwave Distance-Measuring Equipment
600-699 - Infrared Distance-Measuring Equipment
700-799 - Microwave Distance-Measuring Equipment
800-899 - Total Station-Measuring Equipment
900-999 - Other Miscellaneous Surveying Equipment

The purpose of the National Geodetic Survey (NGS) Survey Equipment Code is to provide a three-digit identifier for each item of survey equipment commonly used in connection with horizontal and vertical control surveys in the United States. The code has been devised in such a manner that the first digit of the three-digit identifier would indicate a specific category of survey equipment. Accordingly, there are ten broad survey equipment categories, the first of which (000-099) is reserved for gravity instruments and satellite systems, and the last (900-999) is reserved for miscellaneous survey equipment which does not fit into any of the specific categories. The ten survey equipment categories are listed above.

Within each category, specific items and/or classes of survey equipment have been grouped into subcategories and assigned unique three-digit code numbers. The grouping of survey equipment into subcategories is intended to reflect the level of accuracy attained in common usage of the specific items or classes of survey equipment in question and not necessarily their intrinsic or potential accuracy. In each category and subcategory, a code is provided for items of survey equipment which do not appear among the items listed or which are not specifically identified. The respective lists of survey equipment are not all-inclusive, and series of numbers have been skipped in each category and/or subcategory to allow for additions.

CODE	MANUFACTURER	INSTRUMENT MODEL OR TYPE
****	************	************************

000-099 - GRAVITY INSTRUMENTS AND SATELLITE SYSTEMS
4

000	Unspecified	Unknown Instrument or System

<u>001-009 - Reserved for Absolute Gravity Devices</u>

<u>010-029 - Gravimeters</u>

010	Unspecified	Gravimeter
011	Frost	Frost Gravimeter
012	North American	North American Gravimeter
013	LaCoste-Romberg	Early Models
014	LaCoste-Romberg	G-Meter
015	LaCoste-Romberg	D-Meter
016	Worden	Unspecified
017	Worden	Uncompensated Model
018	Worden	Temperature-Compensated Model
019	Scintrex	CG-2

<u>030-049 - Doppler Satellite Tracking Systems</u>

030	Unspecified	Doppler Satellite Tracking System
031	Magnavox	Geoceiver or Geoceiver II
032	JMR	JMR-1
033	ITT	ITT 5500
034	Magnavox	MX-702A
035	APL	Tranet
036	Canadian Marconi	CMA 722A
037	Canadian Marconi	CMA 722B
038	Magnavox	MX-1502

<u>050-099 - GPS Satellite Tracking Systems</u>

050	Unspecified	GPS Satellite Tracking System
051	Western Atlas Intl.	Macrometer[R] V1000
052	Western Atlas Intl.	Macrometer™ II
053	Texas Instruments, Inc.	TI-4100 (GESAR Software)
054	Texas Instruments, Inc.	TI-4100 (TI EPROM Software)
055	Trimble Navigation, Ltd.	4000 series
056	Leica-Wild-Magnavox	WM101/WM102/GPS-System 200
057	ISTAC, Inc.	Model 2002™
058	EDO Canada, Ltd.	EDO JMR GeoTrak
059	Motorola, Inc.	Eagle series
060	Norstar Instruments, Ltd.	Norstar 1000
061	SERCEL Inc.- USA	TR5S, NR101, NR104
062	Western Atlas Intl.	MINI-MAC™

<u>050-099 - GPS Satellite Tracking Systems - Continued</u>

063	Ashtech, Inc.	XII series
064	Allen Osborne Assoc., Inc.	Rogue series
065	NovAtel Commun., Ltd.	NovAtel GPSCard™
066	Topcon America Corp.	GP-R1, GP-R1D
067	Del Norte Technology, Inc.	1008,1012
068	Magellan	NAV5000 PRO

100-199 - THEODOLITES AND TRANSITS
4

100	Unspecified	Theodolite or Transit

101-119 - Instruments of Geodetic Astronomy

101	Various	Zenith Telescope
102	Various	Meridian Telescope, Transit, or Circle
103	Various	Bamberg-Type Astronomic Transit
104	Wild	T-4
105	Kern	DKM3-A
106	Gigas-Askania	TPR
107	Zeiss/Jena	Theo-Q02

120-139 - First-Order (Geodetic) Theodolites

120	Unspecified	0."1, 0."2, 0."5 Direct-Reading Theodolite
121	Various	Ramsden-Type 30, 24, 12-inch Theodolite
122	Various	USC&GS Parkhurst
123	Wild	T-3
124	Kern	DKM3
125	CTS/Vickers	Geodetic Tavistock
126	Hilger-Watts	Microptic No. 3

140-159 - Second-Order (Universal) Theodolites

140	Unspecified	1", 2", 5" Direct-Reading Theodolite
141	Various	USC&GS 7-inch Repeating Theodolite
142	Wild	T-2 or T-2E
143	Kern	DKM2 or DKM2-A
144	CTS/Vickers	V-400 Series
145	Hilger-Watts	Microptic No. 2
146	Dietzgen/Askania	A2 or A2E
147	Zeiss/Oberkochen	Th2
148	Zeiss/Jena	Theo-010 or Theo-OlOA
149	Nikon	NT-3 or NT-5
150	Sokkisha	TM-lA
151	Geotec	TH-01

CODE	MANUFACTURER	INSTRUMENT MODEL OR TYPE
****	************	************************

160-169 - Third-Order (Construction) Theodolites

160	Unspecified	Construction Theodolite or Transit
161	Various	10" Direct-Reading Theodolite or Transit
162	Various	20" Direct-Reading Theodolite or Transit
163	Various	30" Direct-Reading Theodolite or Transit
164	Various	1' Direct-Reading Theodolite or Transit

170-179 - 30' or Coarser Angulation Devices

170	Unspecified	30' or Coarser Angulation Device
171	Various	30' or Coarser Theodolite or Transit
172	Various	30' or Coarser Compass Device

173	Various	30' or Coarser Protractor

180-199 - Gyroscopic Theodolites

180	Unspecified	Gyro-Theodolite

200-299 - LEVELING INSTRUMENTS
4

200	Unspecified	Leveling Instrument

210-249 - Precise (Geodetic) Levels

210	Unspecified	Precise Level

211-230 - Precise Spirit (Bubble-Vial) Levels

211	Various	USC&GS Fischer
212	USC&GS	Stampfer-Type (1877-1899)
213	Buff & Berger	Van Orden or Mendenhall
214	Various	Kern-Type (US Engineers)
215	Zeiss	Ni-III or Ni-A
216	Zeiss/Jena	Ni-004
217	Wild	N-3
218	Kern	NK3-M
219	Breithaupt	NABON
220	Fennel	Precise Level
221	Hilger-Watts	Precise Level
222	CTS/Vickers	Geodetic Level
223	Sokkisha	PL-5
224	Keuffel & Esser	Precise Level

CODE	MANUFACTURER	INSTRUMENT MODEL OR TYPE
****	************	************************

231-249 - Precise Compensator (Self-Aligning) Levels

231	Zeiss/Oberkochen	Nil
232	Zeiss/Oberkochen	Ni2
233	Zeiss/Jena	Ni-002
234	Zeiss/Jena	Ni-007
235	Wild	NA-2 or NAK-2
236	Salmoiraghi	5190
237	MOM	Ni-A31
238	Sokkisha	B-1
239	Kern	GK2-A
240	Topcon	AT-D2
241	Zeiss	Ni-005A
242	Leica/Wild	NA2000 or NA2002 Digital Level
243	Leica/Wild	NA3000 Digital Level
244	**TOPCON**	**DL101 Digital Level**
245	**TOPCON**	**DL102 Digital Level**
246	ZEISS	DINI10

250-289 - Engineer's (Universal) Levels

250	Unspecified	Engineer's Level

251-270 - Engineer's Spirit (Bubble-Vial) Levels

251	Various	18-inch Dumpy-Type Level
252	Various	18-inch Wye-Type Level
253	Zeiss	Ni-II or Ni-B
254	Zeiss/Jena	Ni-030
255	Wild	N-2 or NK-2
256	Kern	NK3
257	Kern	NK2
258	Kern	GK23
259	Breithaupt	NAKRE
260	Fennel	Engineer's Level
261	Hilger-Watts	Engineer's Level
262	CTS/Vickers	Engineer's Level
263	Salmoiraghi	5160 Series
264	Nikon	S2
265	Sokkisha	TTL-5 or TTL-6
266	Geotec	L-11 or L-21

271-289 - Engineer's Compensator (Self-Aligning) Levels

271	Zeiss/Oberkochen	Ni22
272	Zeiss/Jena	Ni-025
273	Kern	GKl-A
274	Breithaupt	AUTOM or AUCIR
275	Fennel	AUING
276	Hilger-Watts	AUTOSET
277	Salmoiraghi	5173, 5175, or 5180
278	Ertel	INA
279	Nikon	AE Series
280	Sokkisha	B-2
281	Geotec	AL-2 or AL-23
282	Sokkisha	C-1

CODE	MANUFACTURER	INSTRUMENT MODEL OR TYPE
****	************	************************

290-299 - Builder's (Construction) Levels

290	Unspecified	Builder's Level
291	Various	Builder's Dumpy-Type Spirit Level
292	Various	Builder's Tilting Spirit Level
293	Various	Builder's Compensator Level

300-399 - LEVELING RODS AND STAFFS
4

300	Unspecified	Leveling Rod or Staff

310-349 - Precise (Geodetic) Metal-Scale Rods

310	Unspecified	Precise Metal-Scale Rod
311	USC&GS	USC&GS Pre-Invar Rods
312	USC&GS	Invar (Introduced in 1916)
313	Zeiss/Oberkochen	Invar
314	Zeiss/Jena	Invar
315	Wild	Invar
316	Kern	Invar
317	Breithaupt	Invar
318	Fennel	Invar
319	Hilger-Watts	Invar
320	CTS/Vickers	Nilex
321	Salmoiraghi	Invar

322	Keuffel & Esser	Invar
323	Gurley	Invar
324	Renick	Invar (Checkerboard)
325	USGS	Invar (Metal-Frame)
340	Nedo	Invar
341	Nestler	Invar

350-389 - Engineer's Wooden Rods and Staffs

350	Unspecified	Engineer's Wooden Rod or Staff
351	Various	US Engineers 12-foot Rigid Rod
352	Various	US Geological Survey 12-foot Rigid Rod

390-395 - Builder's Rods and Staffs

390	**Unspecified**	**Builder's Rod or Staff**
391	**Various**	**Philadelphia Rod**
392	**Various**	**Chicago Rod**
393	**Various**	**California Rod**
394	**Various**	**12-foot Folding Rod**
395	**Leica/Wild**	**3-piece Fiberglass (Bar-Code) Rod**

396-399 - Precise (Geodetic) Metal-Scale, Bar-Code Rods

396	**Leica/Wild**	**Invar (Bar-Code) Rod**
397	**Zeiss**	**Invar (Bar-Code) Rod**
398	**Topcon**	**Invar (Bar-Code) Rod**

400-499 - STEEL AND INVAR TAPES
4

400	Unspecified	Steel or Invar Tape

420-439 - Calibrated Invar Tapes

420	Unspecified	Calibrated Invar Tape
421	Various	25-meter Calibrated Invar Tape
422	Various	50-meter Calibrated Invar Tape
423	Various	100-foot Calibrated Invar Tape

440-459 - Calibrated Steel Tapes

440	Unspecified	Calibrated Steel Tape
441	Various	30-meter Calibrated Steel Tape
442	Various	100-foot Calibrated Steel Tape
443	Various	300-foot Calibrated Steel Tape

460-479 - Uncalibrated Steel Tapes

460	Unspecified	Uncalibrated Steel Tape or Ruler
461	Various	30-meter Uncalibrated Steel Tape
462	Various	100-foot Uncalibrated Steel Tape
463	Various	300-foot Uncalibrated Steel Tape

500-599 - LIGHTWAVE DISTANCE-MEASURING EQUIPMENT
4

500	Unspecified	Lightwave Electro-Optical DME

501	AGA	Geodimeter Model 1
502	AGA	Geodimeter Model 2 or 2A
503	AGA	Geodimeter Model 3
504	AGA	Geodimeter Model 4A, 4B, or 4D
505	AGA	Geodimeter Model 4L or 4L 10A
506	AGA	Geodimeter Model 6
507	AGA	Geodimeter Model 6A
508	AGA	Geodimeter Model 6B
509	AGA	Geodimeter Model 6BL
510	AGA	Geodimeter Model 7T
511	AGA	Geodimeter Model 700 or 710
512	AGA	Geodimeter Model 76 or 78
513	AGA	Geodimeter Model 8
531	Keuffel & Esser	LSE Ranger I, II, or III
532	Keuffel & Esser	LSE Ranger IV
533	Keuffel & Esser	LSE Ranger V
534	Keuffel & Esser	LSE Rangemaster
535	Keuffel & Esser	Rangemaster II
536	Keuffel & Esser	Uniranger

CODE	MANUFACTURER	INSTRUMENT MODEL OR TYPE
****	************	************************
	500-599 - LIGHTWAVE DISTANCE-MEASURING EQUIPMENT - CONTINUED 4	
541	Spectra-Physics	Geodolite 3G
542	Spectra-Physics	Transitlite LT-3
551	Kern	ME-3000 Mekometer
561	Cubic Percision	Rangemaster III
562	Cubic Percision	Ranger V-A
571	Leitz	Red 2L
	600-699 - INFRARED DISTANCE-MEASURING EQUIPMENT 4	
600	Unspecified	Infrared Electro-Optical DME
601	AGA	Geodimeter Model 12 or 12A
602	AGA	Geodimeter Model 78,110,114,116
603	AGA	Geodimeter Model 210 or 220
604	AGA	Geodimeter Model 120 or 216
605	AGA	Geodimeter Model 6000
606	AGA	Geodimeter Model 14 or 14A
607	AGA	Geodimeter Model 112 or 122
611	Plessey	Tellurometer CD-6
612	Plessey	Tellurometer MA-100
613	Plessey	Tellurometer MA-200
616	Lietz	Red Mini 2
617	Lietz	Red 2A
621	Wild	Distomat DI-3 Series
622	Wild	Distomat DI-10 Series
623	Wild	Distomat DI-4L
624	Wild	Distomat DI-5 or DI-5S
625	Wild	DI 1000 or 1000L
626	Wild	DI 2000
627	Wild	DI 3000 (time-pulse)
628	Leica/Wild	DI 2002
629	Leica/Wild	DI 1600
631	Kern	DM-500
632	Kern	DM-1000 or DM-2000
633	Kern	DM 104 or DM 150

634	Kern	DM 503 or DM 550
635	Kern	DM 504
641	Zeiss/Oberkochen	SM 11 or RegElta 14
642	Zeiss/Oberkochen	Eldi Series
643	Zeiss/Oberkochen	SM 4
651	Keuffel & Esser	LSE Microranger or Microranger II
652	Keuffel & Esser	LSE Autoranger
661	Hewlett-Packard	3800A or 3800B
662	Hewlett-Packard	3805 or 3810
663	Hewlett-Packard	3808A
667	Pentax	MD-14 or MD-20
671	Cubic Precision	Cubitape DM-60
672	Cubic Precision	HDM-70

CODE	MANUFACTURER	INSTRUMENT MODEL OR TYPE
****	************	************************
	600-699 - INFRARED DISTANCE-MEASURING EQUIPMENT - CONTINUED 4	
673	Cubic Precision	DM-80 or DM-81
674	Cubic Precision	AutoRanger II
675	Cubic Precision	Beetle 500 or 500S
676	Cubic Precision	Beetle 1000 or l000S
681	Carrol & Reed	Akkuranger Mark I
685	Topcon	DM-C2
686	Topcon	DM-A2 or DM-A3
687	Topcon	DM-S2 or DM-S3
688	Topcon	GTS-2R
693	Nikon	ND 20 or ND 21 or ND 26
694	Nikon	ND 30 or ND 31
	700-799 - MICROWAVE DISTANCE-MEASURING EQUIPMENT 4	
700	Unspecified	Microwave Electro-Magnetic DME
701	Plessey	Tellurometer MRA-1
702	Plessey	Tellurometer MRA-2
703	Plessey	Tellurometer MRA-3
704	Plessey	Tellurometer MRA-4
705	Plessey	Tellurometer MRA-5
709	Plessey	Tellurometer CA-1000
731	Wild	Distomat DI-50
732	Wild	Distomat DI-60
741	Cubic	Electrotape DM-20
751	Fairchild	Microchain
	800-899 - TOTAL STATION-MEASURING EQUIPMENT 4	
800	Unspecified	Total Station
	801-860 - Self Contained Instruments	
801	Leitz	SDM3F or SDM3FR
802	Leitz	SET 2
803	Leitz	SET 3
804	Leitz	SET 4
810	Nikon	NTD-4
811	Nikon	NTD-2S
812	Nikon	DTM1

813	Nikon	DTM5
816	Geotronics AB	Geodimeter 142
817	AGA	Geodimeter 140
821	Pentax	PX20D
822	Pentax	PX10D
823	Pentax	PX06D
824	Pentax	PTS-10

CODE	MANUFACTURER	INSTRUMENT MODEL OR TYPE
****	************	************************

801-860 - Self Contained Instruments - Continued

825	Pentax	PTS-1110
826	Pentax	PTS-1105
830	Topcon	GTS or GTS-2R
831	Topcon	GTS-3B or GTS-3C
832	Topcon	ET-1 or ET-2
833	Topcon	GTS-4A or GTS-4B
840	Wild	TC1600
841	Wild	TC2000
842	Leica/Wild	TC2002
850	Zeiss	ELTA 3
851	Zeiss	ELTA 4
856	Hewlett-Packard	3820A

861-899 - Modular Instruments

861	Kern	E1/DM504
862	Kern	E2/DM504
871	Leitz	DT2/Red Mini 2
872	Leitz	DT2/Red 2A or Red 2L
881	Wild	T1000
882	Wild	T1600
883	Wild	T2000 or T2000S
884	Wild	T2002
885	Leica/Wild	T3000

900-999 - OTHER MISCELLANEOUS SURVEYING EQUIPMENT
4

900	Unspecified	Miscellaneous Surveying Equipment

ANNEX G

ELLIPSOID HEIGHT ORDER-AND-CLASS (OC) CODES

This annex contains ellipsoid height Order and Class (OC) codes. These two-digit codes are used to classify each ellipsoid height value observed and adjusted at horizontal control points.

The first character of the OC code indicates the order and the second character the class, in accordance with the following draft standards for classifying ellipsoid height determinations:

OC Code	Classification	b = Maximum Height Difference Accuracy
11	First Order, Class I	0.5
12	First Order, Class II	0.7
21	Second Order, Class I	1.0
22	Second Order, Class II	1.3
31	Third Order, Class I	2.0
32	Third Order, Class II	3.0
41	Fourth Order, Class I	6.0
42	Fourth Order, Class II	15.0
51	Fifth Order, Class I	30.0
52	Fifth Order, Class II	60.0

The ellipsoid height difference accuracy **(b)** is computed from a minimally constrained, correctly weighted, least squares adjustment by the formula:

b = s / sqrt(d)

where: **d** = horizontal distance in kilometers between control points.
s = propagated standard deviation of ellipsoid height difference in millimeters between control points obtained from the least squares adjustment.

The following table lists the standard errors of ellipsoid height differences at various distances:

Standard Error (mm)

OC Code

Distance (km)	11	12	21	22	31	32	41	42	51	52
1	.5	.7	1.0	1.3	2	3	6	15	30	60
5	1.1	1.6	2.2	2.9	4.5	6.7	13	34	67	134
10	1.6	2.2	3.2	4.1	6.3	9.5	19	47	95	190
25	2.5	3.5	5.0	6.5	10	15	30	75	150	300
50	3.5	4.9	7.1	9.2	14	21	42	106	212	424
75	4.3	6.1	8.7	11	17	26	52	130	260	520
100	5.0	7.0	10	13	20	30	60	150	300	600

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ANNEX I

SUMMARY OF CODES USED IN GEODETIC SURVEY POINT DESCRIPTIONS

This annex contains lists of codes that are used in the preparation of station descriptions and recovery notes pertaining to geodetic control points. The use of these codes is explained in Chapter 3, entitled GEODETIC SURVEY POINT DESCRIPTIVE (GEOD DESC) DATA.

DR CODE - used to identify the descriptive data by type.

ENTRY	DEFINITION
D	An original description of a newly set mark.
R	Everything else (includes recovered, not recovered, destroyed, and the first report to NGS of a pre-existing mark not in the NGS data base).

RECOVERY TYPE CODE (optional) - used to classify recovery descriptions relative to existing information residing in the agency data base.

ENTRY	DEFINITION
F	A full recovery description of a survey point which you think is not included in the NGS Data Base.
M	A recovery description which does not contain a complete textual description of the mark, but **may** contain updates or modifications to the most current description. This is used when a mark is **destroyed or not recovered**, or when the text of the previous description of this mark in the NGS data base requires no update (i.e., the text is in accord with current practice, and the situation at the mark has not changed).
T	A complete re-description of a mark which is included in the NGS data base.

SPECIAL APPLICATIONS CODE - used to represent certain specialized information about the control point.

ENTRY	DEFINITION
F	Fault monitoring site
N	Site not suitable for receiving satellite signals
O	Other (see descriptive text)
P	Site determined suitable for receiving satellite signals in connection with geodetic surveys
T	Tidal station

SETTING CODE - used to complement all MARKER TYPE CODES **except** Landmark stations.

SHALLOW SETTINGS (LESS THAN 10 FT DEEP)	DEFAULT STABILITY CODE
00 - setting not listed - see description	D
01 - unspecified shallow	D

02 - driven into the ground	D
03 - imbedded in the ground	D
04 - surrounded by a mass of concrete	D
05 - set into the top of an irregular mass of concrete	D
07 - set into the top of a round concrete monument	C
08 - set into the top of a square concrete monument	C
set into the top of a prefabricated concrete post ...	
09 - ... imbedded in the ground	D
10 - ... surrounded by a mass of concrete	D
11 - ... imbedded in a mass of concrete	C
set into a prefabricated concrete block ...	
12 - ... imbedded in the ground	D
13 - ... surrounded by a mass of concrete	D
14 - ... imbedded in a mass of concrete	C
15 - a metal rod driven into the ground	D
16 - a metal rod with base plate buried/screwed into the ground	C
set into the top of a metal pipe ...	
17 - ... driven into the ground	D
18 - ... imbedded in the ground	D
19 - ... surrounded by a mass of concrete	D
20 - ... imbedded in a mass of concrete	C
set in concrete at the center of a clay tile pipe ...	
21 - ... fastened to a wooden pile driven into marsh	D
22 - ... imbedded in the ground	D
23 - ... surrounded by a mass of concrete	D
24 - ... imbedded in a mass of concrete	C

SETTINGS IN STRUCTURES

30 - light structures (other than listed below)	D
31 - pavements (street, sidewalk, curb, apron, etc.)	D
32 - retaining walls, etc.= concrete ledge	C
33 - piles and poles (e.g. spike in utility pole)	D
34 - footings/foundation walls of small/medium structures	C
35 - mat foundations, etc. = concrete slab	C
36 - massive structures (other than listed below)	B
37 - massive retaining walls	B
38 - abutments and piers of large bridges	B
39 - tunnels	B
40 - massive structures with deep foundations	A
41 - large structures with foundations on bedrock	A

UNSLEEVED DEEP SETTINGS (10 FT. +)

45 - unspecified depth	C
46 - copper-clad steel rod	B
47 - galvanized steel pipe	B
48 - galvanized steel rod	B
49 - stainless steel rod	B
50 - aluminum alloy rod	B

SLEEVED DEEP SETTINGS (10 FT. +)	DEFAULT STABILITY CODE
55 - unspecified pipe/rod in sleeve	B
56 - copper-clad steel rod in sleeve	B
57 - galvanized steel pipe in sleeve	**B**
58 - galvanized steel rod in sleeve	**B**
59 - stainless steel rod in sleeve	**B**
60 - aluminum alloy rod in sleeve	**B**

SETTINGS IN ROCKS OR BOULDERS

65 -	unspecified rock	B
66 -	in rock outcrop	A
67 -	**set into a drill hole in rock outcrop**	A
68 -	... and marked by a chiseled cross	A
69 -	... and marked by a chiseled triangle	A
70 -	... and marked by a chiseled circle	A
71 -	... and marked by a chiseled square	A
73 -	in a rock ledge	A
74 -	**set into a drill hole in a rock ledge**	A
75 -	... at the intersection of two chiseled lines	A
76 -	... and marked by a chiseled triangle	A
77 -	... and marked by a chiseled circle	A
78 -	... and marked by a chiseled square	A
80 -	in a boulder	C
81 -	**set into a drill hole in a boulder**	C
82 -	... and marked by a chiseled cross	C
83 -	... and marked by a chiseled triangle	C
84 -	... and marked by a chiseled circle	C
85 -	... and marked by a chiseled square	C
87 -	in a partially exposed boulder	C
88 -	**set into a drill hole in a partially exposed boulder**	C
89 -	... and marked by a chiseled cross	C
90 -	... and marked by a chiseled triangle	C
91 -	... and marked by a chiseled circle	C
92 -	... and marked by a chiseled square	C
93 -	in bedrock	A
94 -	set in a drill hole in bedrock	A
	set into a mass of concrete ...	
95 -	... in a depression in rock outcrop	A
96 -	... in a depression in a rock ledge	A
97 -	... in a depression in a boulder	C
98 -	... in a depression in a partially exposed boulder	C
99 -	... in a depression in the bedrock	A

MARKER TYPE CODES - **(Not for Landmark stations)**

A - aluminum marker **(other than a disk)**

B - bolt

C - cap-and-bolt pair

DA - astro pier

DB - bench mark disk

DD - survey disk

E - earthenware pot

F - flange-encased rod

G - glass bottle

H - drill hole

I - metal rod

J - earthenware jug

DE - traverse station disk

DG - gravity station disk

DH - horizontal control disk

DJ - tidal station disk

DK - gravity reference mark disk

DM - magnetic station disk

DO - unspecified disk type (see text)

DP - base line pier disk

DQ - calibration base line disk

DR - reference mark disk

DS - triangulation station disk

DT - topographic station disk

DU - boundary marker disk

DV - vertical control disk

DW - NOS hydrographic survey disk

DZ - azimuth mark disk

K - clay tile pipe

L - gravity plug

M - ammo shell casing

N - nail

O - chiseled circle

P - pipe cap

Q - chiseled square

R - rivet

S - spike

T - chiseled triangle

U - concrete post

V - stone monument

W - unmonumented

X - chiseled cross

Y - drill hole in brick

Z - see description

MARKER TYPE CODES (Landmark stations)

Landmarks Not Listed:

00 - see description

Natural Objects:

01 - lone tree
02 - conspicuous rock
03 - mountain peak
04 - rock pinnacle
05 - rock awash

Waterfront Landmarks and Visual Aids to Navigation:

11 - piling
12 - dolphin
13 - lighthouse
14 - navigation light
15 - range marker

Tanks and Towers:

51 - tank
52 - standpipe tank
53 - elevated tank
54 - water tower
55 - tower
56 - skeleton tower
57 - lookout tower
58 - control tower

Miscellaneous Landmarks:

61 - pole
62 - flagpole
63 - stack
64 - silo
65 - grain elevator
66 - windmill

16 - daybeacon
17 - flag tower
18 - signal mast

Aeronautical and Electronic Aids to Navigation:

21 - airport beacon
22 - airway beacon
23 - VOR antenna
24 - RBN antenna
25 - radar antenna
26 - spherical radome
27 - radio range mast
28 - LORAN mast

Broadcast and Communications Facilities:

41 - antenna mast
42 - radio/TV mast
43 - radio/TV tower
44 - microwave mast
45 - microwave tower

67 - oil derrick
68 - commercial sign
69 - regulatory sign
70 - monument
71 - boundary monument
72 - cairn
73 - lookout house
74 - large cross
75 - belfry

Features of a Building:

81 - gable
82 - finial
83 - flagstaff
84 - lightning rod
85 - chimney
86 - cupola
87 - dome
88 - observatory dome
89 - spire
90 - church spire
91 - church cross
92 - antenna
93 - microwave antenna
94 - rooftop ventilator
95 - rooftop blockhouse

MAGNETIC CODE - used to indicate the magnetic property of the mark or monument.

A - steel rod adjacent to monument
B - bar magnet imbedded in monument
H - bar magnet set in drill hole
I - marker is a steel rod
M - marker equipped with bar magnet
N - no magnetic material
O - other - see description
P - marker is a steel pipe
R - steel rod imbedded in monument
S - steel spike imbedded in monument
T - steel spike adjacent to monument

TRANSPORTATION CODE - used to indicate the mode of transportation used (or to be used) to reach the station or to reach the location where packing begins, if packing to the station site is required.

A - light airplane
B - boat
C - car (or station wagon)
F - float airplane
H - helicopter
O - other (see descriptive text)
P - light truck (pickup, carryall, etc.)
T - truck (larger than 3/4 ton)
W - tracked vehicle (Weasel, Snowcat, etc.)
X - four-wheel drive vehicle

AGENCY CODE - used to indicate the type of survey organization which established or recovered the geodetic control point.

A - National Agencies
B - Inter-State or Inter-Province Agencies
C - State, Province, Commonwealth, and Territorial Agencies
D - County Agencies
E - Municipal Agencies (Cities)
F - Inter-City and Inter-County Agencies
G - Railroads
H - Utility and Natural Resource Companies
I - Surveying, Engineering, and Construction Industry
J - Educational Institutions
K - Professional and Amateur Associations
L - Miscellaneous Commercial or Private Firms
M - Non-Specific Designators

CONDITION CODE - used to indicate the condition of the monument or mark each time the geodetic control point is recovered.

G - Good
N - Not Recovered, Not Found
O - Other (See descriptive text)
P - Poor, Disturbed, Mutilated, Requires Maintenance
X - Destroyed (See Note Below)

STABILITY CODE - may be entered in the *26* coded record to override the software default codes in the descriptions for publication.

CODE	DEFINITION
A	Monuments expected to hold their elevations very well.
B	Monuments which generally hold their elevations fairly well.
C	Monuments which may be affected by surface ground movements.
D	Monuments of questionable or unknown vertical stability.

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ANNEX J

NGS GPS ANTENNA CODES

GPS ANTENNA CODE	MANUFACTURER, MODEL/NAME OF ANTENNA	MODEL#/PART#
****************	***	************
AOA D/M+crB	ALLEN OSBORNE ASSOC., DORNE MARGOLIN B	
ASH 700228.A	ASHTECH, L1/L2	700228A
ASH 700228.B	ASHTECH, L1/L2	700228B
ASH 700228.C	ASHTECH, L1/L2, NO LEVEL	700228C
ASH 700228.D	ASHTECH, L1/L2, REV. B 'L-SHAPED NOTCHES'	700228D
ASH 700228.E	ASHTECH, L1/L2, REV. B 'L-SHAPED NOTCHES'	700228E
ASH 700700.A	ASHTECH, MARINE L1/L2	700700 (A)
ASH 700700.B	ASHTECH, MARINE L1/L2	700700 (B)
ASH 700700.C	ASHTECH, MARINE L1/L2	700700 (C)
ASH 700718.A	ASHTECH, GEODETIC III ANTENNA	700718A
ASH 700718.B	ASHTECH, GEODETIC III ANTENNA	700718B
ASH 700829.2	ASHTECH, GEODETIC III ANTENNA, USCG VERSION	700829 2
ASH 700829.3	ASHTECH, GEODETIC III ANTENNA, USCG VERSION	700829 3
ASH 700829.A	ASHTECH, GEODETIC III ANTENNA, USCG VERSION	700829A
ASH 700829.A1	ASHTECH, GEODETIC III ANTENNA, USCG VERSION	700829A1
ASH 700936.A-rd	ASHTECH, CHOKE RING ANTENNA - NO RADOME	700936A
ASH 700936.B-rd	ASHTECH, CHOKE RING ANTENNA - NO RADOME	700936B
ASH 700936.C-rd	ASHTECH, CHOKE RING ANTENNA - NO RADOME	700936C
ASH 700936.D-rd	ASHTECH, CHOKE RING ANTENNA - NO RADOME	700936D
ASH 700936.A	ASHTECH, CHOKE RING ANTENNA	700936A
ASH 700936.B	ASHTECH, CHOKE RING ANTENNA	700936B
ASH 700936.C	ASHTECH, CHOKE RING ANTENNA	700936C
ASH 700936.D	ASHTECH, CHOKE RING ANTENNA	700936D
GEO 2200	GEOTRACER,	2200
JPL D/M+crR	JET PROPULSION LAB., DORNE MARGOLIN R	
JPL D/M+crT	JET PROPULSION LAB., DORNE MARGOLIN T	
LEI SR299.I	LEICA, SR299 RECEIVER WITH INTERNAL ANTENNA	
LEI SR299.X-gp	LEICA, (AT202) EXTERNAL WITHOUT GP	WILD AT202
LEI SR299.X+gp	LEICA, (AT202) EXTERNAL WITH GP	WILD AT202
LEI SR399.I	LEICA, SR399 RECEIVER WITH INTERNAL ANTENNA	
LEI SR399.X-gp	LEICA, (AT302) EXTERNAL WITHOUT GP	WILD AT302
LEI SR399.X+gp	LEICA, (AT302) EXTERNAL WITH GP	WILD AT302
LEI AT303+rd	LEICA, CHOKE RING ANTENNA - WITH RADOME	LEICA AT303
LEI AT303-rd	LEICA, CHOKE RING ANTENNA - NO RADOME	LEICA AT303
MAC 4647942	MACROMETRICS, MACROMETER CROSSED DIPOLES	
TOP 72110	TOPCON,	72110
TRM	MICROPULSE, M-PULSE L1/L2 SURVEY	
TRM 14532.00	TRIMBLE, 4000SST/SSE L1/L2 GEODETIC	14532-00
TRM 14532.10	TRIMBLE, 4000SSE KIN L1/L2 - NO GP	14532-10
TRM 22020.00	TRIMBLE, COMPACT L1/L2	22020-00
TRM 22020.00-gp	TRIMBLE, COMPACT L1/L2 - NO GP	22020-00
TRM 27947.00-gp	TRIMBLE, RUGGED L1/L2 - NO GP	27947-00
TRM 27947.00+gp	TRIMBLE, RUGGED L1/L2 - WITH GP	27947-00
TRM 23903.00	TRIMBLE, PERMANENT L1/L2	23903-00
TRM 29659.00	TRIMBLE, CHOKE RING ANTENNA	29659-00
TRM 33429.00	TRIMBLE, MICRO CENTER	33429-00
SEN 67157514	SENSOR SYSTEMS, L1/L2	
SEN 67157514+cr	SENSOR SYSTEMS, WITH CHOKE RING	
SEN 67157549	SENSOR SYSTEMS, L1	
SEN 67157549+cr	SENSOR SYSTEMS, L1 WITH CHOKE RING	
SEN 67157596	SENSOR SYSTEMS, L1/L2	
SEN 67157596+cr	SENSOR SYSTEMS, L1/L2 WITH CHOKE RING	

ANNEX K

PROJECT REPORT INSTRUCTIONS

Information concerning data preparation and transmittal to NGS is found in Chapter 1, HORIZONTAL CONTROL (HZTL) DATA, in Chapter 5, VERTICAL CONTROL (VERT) DATA, and in Chapter 9, GRAVITY CONTROL (GRAV) DATA. The section titled "Media for Submitting Data" describes procedures for packaging of the data as well as information required in the letter of transmittal pertaining to the floppy disks or magnetic tape. The transmittal letter should inventory the total contents of the shipment. In addition, special instructions for submitting GPS relative positioning data to the NGS are provided in ANNEX L.

The most important supporting document that should be included with the shipment is the project report. The project report is the permanent hardcopy record that summarizes project accomplishments. It describes the general project goals and the equipment and procedures employed to meet specific conditions and requirements. The report provides information useful for verification and adjustment, including detailed explanation of unusual or special features of the project. The recommended content of a project report follows. The project sketch is an attachment to the report. For projects totally or partially supported by NGS, a different report may be required.

Report Outline for a Horizontal Control Project

I. Title page. List the type of report (Horizontal Control), order-class of survey, project title including the state, any appropriate identifying control number, beginning and ending dates of field work, agency name, and the name of the project director (supervisor). The project title should include the locality of the survey (e.g., Brainerd to Crosby, MN).

II. The report should address the following topics:

   A. Location. Briefly describe the project area, indicating each state and the counties in which the project is located.

   B. Scope

      1. Purpose. State the purpose of the survey and the extent to which the requirements were satisfied.

      2. Specifications. State the specifications which were followed and the methods used.

      3. Monumentation. Describe the monumentation that was established and recovered.

      4. Instrumentation. List the instruments and equipment used. For EDM, describe the instrument calibration and how the calibration and refractive index corrections were applied. Include model and serial numbers of all instrumentation.

      5. Special equipment. List any special equipment used.

Examples include Bilby towers, helicopters, wooden stands, Peck towers, etc.

6. Existing control. List all existing horizontal control contained in the project area, NGS-published or otherwise. For NGS control, list the quadrangle and station numbers. Also, include any bench marks used to control the elevations. For existing horizontal control <u>not connected</u> to the new survey, include an explanation of why connections were not made.

C. Comments (THIS IS THE MOST IMPORTANT SECTION OF THE REPORT!)

1. Reconnaissance. When a reconnaissance plan was submitted and approved by NGS prior to beginning the field measurements, describe any changes from the original reconnaissance and the reasons for the changes.

2. Specifications. Describe any deviations from the specifications used and the reason for such deviations.

3. Computations. Describe which computations were performed, the coordinate system used (e.g., latitude and longitude, state plane, or local rectangular grid), and what type of adjustment, if any, was performed.

4. Problems. Describe any problems encountered such as: moved or "suspect" marks, bad check angles, and poor position, azimuth, and length checks.

5. Recommendations. Describe any recommendations for future field measurements and/or recomputation of published data.

D. Statistics

1. Points. List the number of points positioned grouped by type of mark such as: new main scheme, old main scheme, and/or landmark stations.

2. Observations. List the number of observations and their precision grouped by type of observation such as: horizontal directions, zenith distances, vertical angles, distances, and astronomic azimuths.

3. Closures

a. Triangle. List the number of triangles, the average triangle closure, and the maximum triangle closure. For the maximum triangle closure, identify the three vertices.

b. Traverse. For each traverse closure, identify the traverse segment and list the azimuth closure, the position closure, the total length, the number of courses, and the minimum course length.

4. Reoccupations. List any reoccupied stations, the lines reobserved, the reason for the remeasurement.

5. Check measurements. List comparisons between previously observed angles (check angles) and/or distances with current observations. Also, list the average and maximum disagreements.

6. Fixed measurements. List comparisons between computed observations (computed from existing coordinate data) and current observations. Also, list the average and maximum disagreements.

E. Status

1. Records. Describe the current status and future disposition of the station and observation records. If submitted to NGS, they will be archived in a Federal records center.

2. Contact. Provide the name and telephone number of a person to contact regarding questions which may arise during NGS processing of the data.

III. Attachment to the report. Include as an attachment to the project report an original and three copies of a sketch of the project area. The sketch must show station names and lines which were observed for angles and distances. To ensure that reproductions and film reductions of sketches are of optimum quality, sketches should not be drawn on maps. Although linen, mylar or vellum are desirable, it is not required. A 24" x 36" sketch is preferred, but the size should not exceed 36" x 48". An overview of the project geometry is one objective of the sketch, and, therefore, a scaled drawing with tick marks is required. Symbols and notations explained in C&GS Special Publication 247, (1959: pp. 6,191, and 192) are suggested. The names of main scheme stations will be placed adjacent to the station symbol. Supplemental stations may be numbered for reference to a list of names. Submitting agency or organization name should appear in a title block. The sketch may be handlettered.

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Report Outline for a Vertical Control Project

I. Title page. List the type of report (Vertical Control), order and class of survey, project title including the state, any appropriate identifying number (for projects that have been assigned HGZ accession numbers by NGS, the numbers should be listed on the title page), beginning and ending dates of both mark setting and leveling, agency name, and the name of the project director (supervisor). The project title should include the locality of the project.

II. The report should address the following topics:

A. Location. Briefly describe the project area, including state or states in which it is located. Note the number of lines, their general configuration, and their total distance.

B. Scope

1. Purpose. State the purpose of the survey and the extent to which the requirements were satisfied.

2. Specifications. State the specifications which were followed and the methods used.

3. Monumentation. Describe the monumentation that was established and recovered.

4. Instrumentation. Describe the equipment, including a list of instruments, rods (including calibration information), and recording equipment. Include model and serial numbers of all equipment and the dates they were in use. Note the reasons for return of equipment for repairs or adjustment. For rod calibrations, cite which previously submitted calibration data are to be used to process the project. If none were submitted previously, include such calibration data with the leveling data submitted with this report.

C. Comments (THIS IS THE MOST IMPORTANT SECTION OF THE REPORT!)

1. Reconnaissance. If a reconnaissance plan was submitted and approved by NGS prior to beginning the field measurements, describe any changes from the original reconnaissance and the reasons for the changes.

2. Specifications. Describe any deviations from the specifications used and the reason for such deviations.

3. Routes. Briefly describe each line, including line number or other identification, topography and climate, features of the routing such as control point spacing and frequency of connections, unusual points leveled, unusual procedures, river or valley crossings, and ties established.

4. Problems. Describe all problems encountered, such as: moved or "suspect" marks, systematic new-minus-old comparisons, poor ground or atmospheric conditions, etc.

5. Recommendations. Mention specific sections that required additional work as a result of preliminary analysis. Describe areas which may require additional leveling in the future.

D. Statistics

1. Closures. List loop closures for all loops of concurrent surveys. State the accumulated forward-backward difference for each line.

2. Check-measurements. Compute and list new-minus-old tabulations for all releveling of previously leveled lines. Also, list the average and maximum disagreements.

3. Progress. (Needed only if submitting organization is supported by NGS funding and/or equipment). Total progress along lines, double-run progress, single-run progress, total distance leveled, distance leveled as reruns, and number of sections.

4. Reruns. For all sections that were releveled for any reason other than those exceeding the tolerance limit, list the sections and the reasons for releveling.

E. Status

1. Records. Describe the current status and future disposition of the station and observation records. If submitted to NGS, they will be archived in a Federal records center.

2. Contact. Provide the name and telephone number of a person to contact regarding questions which may arise during NGS processing of the data.

III. Attachments to the report. Include as an attachment to the report a simple sketch of the project area showing completed lines, junctions, and loops. A section of the State Index Map of Control Leveling is sufficient with progress marked and lines clearly labeled. Also, attach copies of sketches showing loop closure computations.

Report Outline for a GPS Control Project

(See ANNEX L beginning on page **L-5**)

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Assistance and Mailing Information

The point of contact at NGS for questions concerning the Input Formats and Specifications of the National Geodetic Survey Data Base is:

Mr. Sherrill Snellgrove
National Geodetic Survey
NOAA, N/NGS23
1315 East-West Highway, Station **8753**
Silver Spring, Maryland 20910-3282

Telephone: (301) **713-3200, ext. 100**

Classical horizontal and/or classical vertical data sent to NGS via U.S. Postal Service, United Parcel Service or similar commercial carrier should be addressed:

Director, National Geodetic Survey
NOAA, N/NGS12
1315 East-West Highway, Station **9202**
Silver Spring, Maryland 20910-3282

GPS data sent to NGS via U.S. Postal Service, United Parcel Service or similar commercial carrier should be addressed:

Ms. Madeline White

National Geodetic Survey
NOAA, N/NGS42
1315 East-West Highway, Station 8432
Silver Spring, Maryland 20910-3282

REFERENCE

Gossett, F.R., 1950, rev. 1959: Manual of geodetic triangulation. C&GS Special Publication 247, 344 pp. National Geodetic Information Branch, NGS, NOAA, Rockville, MD 20852.

ANNEX L

GUIDELINES FOR SUBMITTING GPS RELATIVE POSITIONING DATA

Global Positioning System (GPS) relative positioning data submitted to the National Geodetic Survey (NGS) of the National Oceanic and Atmospheric Administration for inclusion in the National Geodetic Reference System (NGRS) must meet the following requirements.

1.0 GPS RAW OBSERVATIONS (R-files): The raw GPS observations will be sent to NGS in a format specified by NGS at the time of submission. Each R-file consists of the set (one or more data files) of raw GPS data for each unique (independent) occupation of a station. For example, if there were four receivers observing during each of five sessions a total of 20 raw data sets would be collected.

2.0 GPS VECTOR SOLUTIONS (G-file): The unadjusted vectors will be submitted in the format specified in ANNEX N. Submit one G-file for each GPS survey project. The G-file may be generated from one of the following: (1) a subroutine of the GPS vector processing software; (2) a stand-alone program that reads the printer output file of the vector processing software; or (3) software that prompts the user for keyboard entries such as CR8G (NGS 1988).

The G-file contains such information as:

(1) From/to station identification
(2) Vector coordinate differences (DX, DY, DZ), standard deviations, correlations (or covariance data)
(3) Name of processing software and version
(4) Date of solution
(5) Source of the ephemerides
(6) Coordinate system (datum) for the vectors
(7) Method of reduction (i.e., fixed or adjusted orbit solutions, single session or network reduction mode, and single or dual frequencies).

When processing data from two stations at a time, the technique is called the "single" vector processing method. If one uses this method for data compiled in the G-file, the G-file may include all possible unique combinations (independent and dependent) of the vectors. With this method there will be n(n-1)/2 possible vectors for each observing session, where n is the number of receivers simultaneously observing during the session. If only the (n-1) independent vectors are submitted, then every effort must be made to submit the shortest vectors since these are most likely to be the results of fixed integer bias solutions.

If processing all data collected during an independent observing session in a combined multiple vector solution the computation is called the "session" processing method. The session G-file entry would include results for the (n-1) independent vectors, where n is equal to the number of receivers collecting data simultaneously during the unique observing session.

If processing multiple sessions in a combined solution the result is called a "network" solution. The G-file would contain (s-1) independent vectors from each network solution, where s is the total number of unique stations incorporated in the solution.

The vectors generated in the "fixed orbit" solution mode using either the "broadcast" (predicted) or "precise" (post fit) ephemerides will be referenced to the satellite or fiducial station coordinate system. The current broadcast ephemeris coordinate system is known as the World Geodetic System 1984 (WGS 84) (DMA 1987). All analyses submitted to NGS, including minimally constrained or "free" adjustments, will be completed in the WGS 84 system or an internationally recognized coordinate system.

3.0 GPS PROJECT AND STATION OCCUPATION DATA FILE (B-file): Submit one B-file for each project. It may be created by using a program like CR8BB (NGS 1990). The software functions independently of the type of receivers used during the project.

The B-file contains information related to the project (such as name, location, etc.) and information for each station occupation [such as observer's initials, model and serial number of equipment, best estimates for the station coordinates, weather data, antenna height measurements (vertical), station name, operator comments, receiver time-offset measurements (if applicable), etc.].

B-file formats are described in Volume 1, Chapter 2.

4.0 STATION DESCRIPTION FILE (D-file): Create one D-file for each GPS project. This file contains descriptive or recovery information for each station visited during the GPS survey. It would include any points connected to the GPS survey using conventional horizontal surveying and/or differential leveling techniques, and miscellaneous reports for NGRS points visited but not occupied during the GPS survey. Submit the file in agreement with the format described in volume I, Chapter 3 and annexes C, D and I.

New descriptions should be created using program DESC which is part of a set of programs called DDPROC (NGS 1992). Descriptive data for existing NGRS points in a project area should be requested from NGS prior to starting reconnaissance. The data can be downloaded from the NGS data base and converted to a form usable by the DESC program for updating purposes.

5.0 HORIZONTAL CONNECTION SURVEY DATA FILE (T-file): A T-file must be created and submitted with the GPS project if the project includes any surveys observed with conventional (terrestrial) horizontal surveying techniques. For example, if an existing station was not a suitable GPS site and an offset point was used, the data compiled in the T-file would be for the horizontal tie between the two points. The T-file may be created with MTEN (NGS 1991b).

T-file formats are described in volume I, chapters 1 and 2.

6.0 VERTICAL CONNECTION SURVEY DATA FILE (L-file): If the GPS survey project includes observations using conventional differential leveling techniques, an L-file must be created and submitted with the GPS project data. For example, if a bench mark could not be occupied directly with a GPS receiver system and an offset point was set, part of the data entered connecting the two points together would be for the leveling observations between the two points.

If only one NGRS vertical point (bench mark) was leveled to at a GPS station site, the leveling data will be considered part of the GPS survey. If a good two-bench mark tie is made to the NGS Vertical control network, the leveling will be considered as a vertical control survey. Formats for these data are in Volume II.

Create the L-file with NGS software called PCvOBS (NGS 1989). Note that this program is to be used in place of program MTEN.

7.0 ANALYSIS AND ADJUSTMENT DATA:

7.1 Loop misclosures and differences in repeat vector measurements should be computed and evaluated to check for blunders or significant vector errors. They are also used to obtain initial estimates of the consistency of the GPS survey network. They should be done according to the "Office Procedures" in the publication, "Geometric Accuracy Standards and Specifications for GPS Relative

Positioning Surveys" (FGCC 1989). Note that these checks are not an indication of accuracy but rather a measure of precision or repeatability.

Particular attention shall be given to detection of possible blunders caused by antenna offset measurements (vertical) and/or centering errors (horizontal). A tabulation of the results of repeat vector comparisons will be included in the project report.

7.2 A minimally constrained (free) least squares, three dimensional (3D) adjustment (one station arbitrarily selected and held equal to known, i.e published, NGRS coordinates) will be completed in accordance with the "Office Procedures" of the "Geometric Accuracy Standards and Specifications for GPS Relative Positioning Surveys" (FGCC 1989).

Submit a computer listing (burst and bound) that shall clearly include at least the following:

- (a) Input vector component data. (Depending on adjustment software used, this may include variance-covariance data.)
- (b) The "a priori" standard errors used if variance-covariance data were not used.
- (c) Station list with name (abbreviated as appropriate), project unique four-character identification code, project unique numeric code used in adjustment, initial coordinates (latitude, longitude, and height above ellipsoid), and the fixed station specified.
- (d) Adjusted vectors with residuals (v) and normalized residuals (v’).
- (e) "A posteriori" variance of unit weight of the adjustment.
- (f) Adjusted coordinates for each station including the station held fixed in the "free" adjustment.
- (g) Datum for the satellite coordinate system (e.g., WGS 84).
- (h) The reference ellipsoid used in the adjustment. (e.g. WGS 84 or GRS 80)
- (i) Other appropriate data or statistics.

The estimate of the variance factor ("a posteriori" variance of unit weight) should be less than 2 in the "free" (minimally constrained) adjustment. It may range between 1 and 16 or more depending upon how close the variance estimates for the vector components of the vector solutions are to the true values.

Estimates which are optimistic (i.e., too small) will result in higher variance factor values. Show clearly the name and version of the 3D adjustment software used.

7.3 A constrained 3D adjustment shall be submitted if project specifications require the computation of adjusted coordinates for the new points in relation to the local datum. A constrained adjustment for a project in North or Central America involves adjusting the GPS vector data while constraining stations to the existing network of NGS published horizontal coordinate data in the North American Datum of 1983 (NAD 1983) system and NGS published vertical data in the North American Vertical Datum of 1988 (NAVD 1988) system or their successors.

The unknown orthometric heights will be determined by the most appropriate method for achieving the specified accuracy standard for the project. This will usually involve one of two methods. The first method incorporates "a priori" geoidal undulation data in the 3D adjustment while holding fixed the orthometric heights for stations with known values (determined by differential leveling techniques). The source for the geoidal separation data (e.g., GEOID 93) must be given. This includes the name of software, version, and data used for computing the geoidal separation.

The second method for determining orthometric heights from GPS vector data involves performing 3D adjustments using no geoidal undulation data. In this method, the orthometric heights are held fixed while using zero values for the geoid height above the ellipsoid in the 3D adjustment. This forces the GPS network to fit to the geoidal surface. The success of achieving the specified accuracy standard for the orthometric heights at the points with unknown values will depend upon the flatness of the geoid in the project area and the distribution of the stations with known orthometric heights. This method is discussed in more detail in the article "On the use of GPS vectors in densification adjustments" (Vincenty 1987).

A tabulated listing of stations and fixed and adjusted coordinate values must be provided. The project report must give a description of the method used to estimate the orthometric heights.

8.0 PROJECT SKETCH: A sketch will be drawn in black ink on white paper showing all stations occupied during the GPS survey. **The sketch will have a border drawn around the edge and must include grid ticks for latitude and longitude.** Use the following standard symbols for the stations:

(a) Squares for existing vertical network control
(b) Open triangles for existing horizontal control stations
(c) Open triangles within squares for existing horizontal/vertical stations
(d) Closed triangles for GPS stations
(e) Circles for stations occupied during previous GPS projects

A "D" next to the station symbol will be used to indicate a Doppler station that has point-position coordinates determined using "precise" ephemerides. (Contact NGS for a list of Doppler stations with "precise" ephemerides point position coordinates located in North America.)

Besides the stations occupied, the sketch should show other stations of the existing network located within or near the project area. Specify in the project report whether any attempt was made to recover these stations. The report must state why the recovered stations were not occupied. To show a station that was not recovered use "NR" next to that station’s symbol. The sketch shall include a boxed-in legend that gives:

(a) project name
(b) general locality
(c) name of group making observations
(d) project leader
(e) month/year (from-to)
(f) scale of sketch

On a copy of the sketch, form closed loops of all (if practical) "independent" (non-trivial) GPS vectors measured. Show vectors common to an observing session with different line types (dashed, dotted, etc., or other clear graphic depiction). Show, next to one or more of the independent lines for each session, the observing day number/session designation (e.g., 242B, 321C, 3331, 3332, etc.).

Survey points will be shown in an inset sketch when they are too close together to be depicted clearly on the network sketch. The project sketch(es) will be included with the project report.

9.0 PROJECT REPORT: The project report will be submitted in a binder with the project name on the front of the binder and will be structured in the following manner:

I. Introduction

A. Purpose - Describe the purpose for which the survey was conducted. Show the name of the organization for which the survey was performed.

B. Time Period - State the arrival and departure dates for the field crew
and dates of first and last observing sessions.

C. Point of Contact - Supply the name, phone number, and mailing address of the point of contact within the submitting organization. Supply the same information for all organizations which participated in the survey.

D. Accuracy standards - Provide the accuracy standards (vertical and horizontal) specified for the project.

II. Location - Describe the geographic location and scope of the project in general terms.

III. Conditions Affecting Progress - Specify equipment failures, climate, scope of project, site accessibility, reconnaissance, malfunctioning satellites, etc.

IV. Field Work

A. Chronology - Give a brief description of the progression of the project.

B. Instrumentation - Describe the make, model, and serial number of each receiver used on the project.

C. Deviation from Instructions - Describe any deviation from the procedures and specifications stated in the project instructions. Specify all stations which were eccentrically occupied and state why the station(s) could not be directly occupied.

V. Data Processing Performed - Describe the data processing that was done. Include tasks such as transferring of data to different storage media, data quality checking, station descriptions, vector determinations, and closure computations. Specify the ephemeris type [broadcast (predicted) or precise (post fit)] and the source.

Complete the following sections as appropriate:

A. Software Used - Specify all software by program name and version number which was used to acquire, manage, reduce, adjust, and submit field data. If the project data were reduced or acquired with different versions of a program, specify which version was used with which block of data.

B. Rejected Data - Specify observing sessions which were rejected and reobserved. Include the reason(s) why the data from a particular session were rejected.

C. Equipment - Describe by manufacturer, model number, and serial number all receivers used to collect the data. Indicate any equipment failures which may have degraded the quality of data and/or vector determinations which were retained. Specify the data or vectors by station and session, and the failed equipment by component and serial number. Indicate data rejected because of equipment failure in section B above.

D. Weather - Tabulate required meteorological observations for the survey and include a copy with this report. List all observing sessions which occurred during periods of changing or severe weather conditions such as passing fronts, storms, etc. A simple table listing the sessions influenced and the weather condition will suffice.

E. Adjustment - Discuss in detail the type(s) of adjustment(s) performed. Show weighting technique used, station(s) constrained, method used to estimate orthometric heights and existence of independent sub-networks. Discuss possible weaknesses or distortions found or suspected in the NGRS.

F. Closures - Tabulate the results of all loop misclosure computations. Include the vectors used, vector length, maximum closure error in each component, and average closure error in each component. Tabulate closure component error in terms of Cartesian coordinates (XYZ) and in terms of the local terrestrial system [N,E,U (north, east, up)]. Also, tabulate comparisons of repeat vectors observed indicating vector length, and maximum and average closure for each vector component. Closures will be stated in both meters and parts per million.

VI. Statistics

A. Stations Occupied - List station names and give total stations occupied based on each of the following categories:

1. Existent NGRS horizontal stations
2. Existent NGRS vertical stations
3. Existent NGRS horizontal/vertical stations
4. Stations established
5. Stations previously occupied with GPS

B. Base lines Observed - Compute the total number of independent (non-trivial) vectors observed during the project. Each observing session cannot have more than (N - 1) independent vectors, where N = number of receivers. For example, if a project included 10 observing sessions and 4 receivers were used during each session, a total of 10(4-1) = 30 independent vectors would have been observed.

C. Provide the total number of observing days and total number of sessions. For example, if the total number of observing days was 5 and there were 2 sessions conducted each observing day, then the total number of observing sessions was 5 x 2 = 10.

VII. Comments and Recommendations

Include noteworthy comments and recommendations regarding the execution of the GPS survey for this project (or future projects) not found elsewhere in the project report.

VIII. Attachments and Enclosures

A. Station List - Include a table which lists the station name, four-character station identifier, coordinates, elevation, session(s) occupied, and station type for all stations occupied. The list will be alphabetical by four-character identifier. See "Planning GPS Surveys" for instructions on preparation of station lists (NGS 1986).

B. Field Project Sketch - Attach a copy of the project sketch. If there are multiple copies of the sketch showing different data, attach a copy of each. See "Planning GPS Surveys" for instructions on preparation of survey sketches (NGS 1986).

C. Project Instructions - Attach a copy of the instructions and/or contract under which this project was performed. Also include any revisions or changes to the instructions or specifications.

D. Field Logs - Provide original or clear copies of field survey notes, record books, and observation logs. When appropriate, this will include Log of Time Offset Measurements and Log of Surface Meteorological Measurements.

E. Equipment Failure Logs - Include with the report a failure log for any equipment used to gather data which failed anytime during the project. The log will state the name of the component, serial number, date of failure and nature of failure.

F. Project Observing Schedule - Prepare a list which summarizes the following: observing day numbers/session letters, four-character station identifiers, start and stop dates and times (UTC), satellites observed (PRN numbers), receiver serial numbers, antenna offset measurements, remarks, etc.

All data and material submitted must be neat and legible (typed or clearly written in black ink). DO NOT SEND THE ONLY COPY OF ANY PAPER RECORDS OR DIGITAL DATA FILES.

10.0 PROJECT SUBMISSION CHECKLIST: Exhibit A is a form that may be used to check for completeness when submitting GPS project data to the National Geodetic Survey.

11.0 DATA TRANSMISSION MEDIA: **All** computer-generated digital data files must be submitted to the NGS in digital form on media approved by NGS at time of submission.

If you have questions concerning the above requirements, please contact:

Ms. Madeline White
National Geodetic Survey
NOAA, N/NGS42
1315 East-West Highway, Station 8432
Silver Spring, Maryland 20910-3282

Telephone: 301-713-3211, Ext. 188

EXHIBIT A

PROJECT SUBMISSION CHECKLIST
GPS PROJECTS

Project Title: ______________________________

Accession Number: ______________________________

Submitting Agency: ______________________________

Observing Agency: ______________________________

Receiver Type: ______________________________

PACKAGE CONTENTS

Project Report and Attachments	**Required For**
( ) Project Report	All Projects
( ) **Approved Reconnaissance** and Project Sketch	All Projects
( ) Project Instructions or Contract Specifications	All Projects
( ) Final Station List	All Projects
( ) Station Visibility Diagrams	All Projects
( ) Final Observing Schedule	All Projects
( ) Observation Logs	All Projects
( ) Equipment Failure Logs	NGS Projects
( ) Loop Misclosures	**Optional**
( ) Free Adjustment **with Analysis**	All Projects
( ) Free Adjustment with Accuracies	**All Projects**
( ) Constrained Horizontal Adjustment	All Projects
( ) Constrained Vertical Adjustment (NAVD 88 Heights)	**All Projects**
( ) Meteorological Instrument Comparison Logs	If Specified
( ) Photographs of Views from Stations	If Specified
( ) Photographs or Rubbings of Station Marks	All Projects
( ) COMPGB Output (Validation program-B/G file)	All Projects
( ) OBSDES Output (Validation program-D-file)	All Projects
( ) OBSCHK Output (Validation program-D-file)	**All Projects**
( ) CHKDESC Output (Validation program-D-file)	**All Projects**
( ) ELLACC Output	**All Projects**
( ) BBACCUR Output	**All Projects**

Digitized Data Files **( ) Diskettes ( ) Other:**__________________

( ) Raw Phase Data (R-files)	All Projects
( ) Base Line Vectors (G-file)	All Projects
( ) Project and Station Occupation Data(Final B-file)	All Projects
( ) Descriptions or Recovery Notes (D-file)	All Projects
( ) Terrestrial Horizontal Observations (T-file)	If Applicable
( ) Differential Leveling Observations (L-file)	If Applicable

Comments - Enter on the reverse side of this form.

	Org Code	**Name**	**Date**
Received by:			

Reviewed by: ____

Reviewed by: ____

REFERENCES:

Defense Mapping Agency, 1987: Department of Defense World Geodetic System 1984 - its definition and relationships with local geodetic systems. DMA Technical Report, DMA TR 8350.2, 30 September 1987, Washington, DC, 121 pp.

Federal Geodetic Control Committee, 1989: Geometric Accuracy Standards and Specifications for GPS Relative Positioning Surveys, version 5.0: May 11, 1988, reprinted with corrections August 1, 1989, 48 pp.

National Geodetic Survey, 1992: "Program DDPROC and Documentation," version 2.0: December 10, 1992.

National Geodetic Survey, 1991a: "Program LOOP and Documentation," version 4.03: January 18, 1991.

National Geodetic Survey, 1991b: "MTEN4, A System for Use with the National Geodetic Survey Data Base Input Formats and Specifications", version 20: December, 1991.

National Geodetic Survey, 1990: "Guidelines for Digitizing GPS Project and Station Occupation Information using program CR8BB," version 3.21: July 26, 1990.

National Geodetic Survey, 1989: "PCvOBS Software and Documentation," version 2.00: October 10, 1989.

National Geodetic Survey, 1988: "Program CR8G and Documentation," version 1.1: December 27, 1988.

National Geodetic Survey, 1986: "Planning GPS Surveys," version 2, September 26, 1986 (NGS preliminary document).

Vincenty, T., 1987: "On the use of GPS vectors in densification adjustments," Surveying and Mapping (Journal of the American Congress on Surveying and Mapping), Vol. 47, No. 2, pp. 103-108.

NOTE: All National Geodetic Survey and Federal Geodetic Control Subcommittee publications are available from:

NOAA, National Geodetic Information Branch, N/NGS12
1315 East-West Highway, Room 9202
Silver Spring, MD 20910-3282.

phone: 301-713-3242
fax: 301-713-4172

ANNEX N

GLOBAL POSITIONING SYSTEM DATA TRANSFER FORMAT (G-FILE)

This annex contains information about the Global Positioning System (GPS) Data Transfer Format (G-File) records. The G-File consists of eight 80-column record types that are used to document the results of the computation of relative vectors, expressed as components, from simultaneously observed GPS phase measurements. There may be only one G-file for a project. Each G-file must contain one Project Record (A) and one or more Session Header Records (B). A Session Header Record (B) is required for each individually processed vector or each <u>simultaneously processed group of vectors</u> (session) at three or more survey points. Each Session Header Record is followed by one or more Vector (C) and/or Long Vector (F) Records, Correlation (D) or Covariance (E) Records, optional Coordinate (G) Records, and optional and/or required Station Information (H) Records. Vector and Long Vector Records contain relative vector components between two survey points. Correlation Records contain the <u>off-diagonal</u> elements only of the correlation matrix for the vector components in a session. Covariance Records contain the <u>off-diagonal</u> elements only of the covariance matrix for the vector components in a session. The records for a simultaneously processed vector set may only contain correlation **or** covariance records but not a mix of the two. A Long Vector Record may only be used when a vector component is larger than +/- 999,999.9999 meters. The Coordinate (G) Records may be used to record, for informational purposes within the G-file, the coordinates of survey points held fixed during the vector computations or to provide location information regarding the G-file. Relative vectors are required even if coordinates are included. Station Information Records are used to document differing conditions or solution types for vectors within a session. The Station Information Record (H) is required only when an external time standard is used with a receiver, when a comment needs to be made about a station occupation, or when information about a station occupation or vector solution is not the same as for all other stations or vectors in a session. Multiple H records are allowed.

This annex documents the record formats, provides an explanation of the fields within each record, and gives G-file examples using the various record types.

<u>CC-1 CODE</u>	<u>RECORD TYPE</u>	
A	Project Record	**(The A record is required)**
B	Session Header Record	**(The B record is required)**
C	Vector Record	**(The C record is required)**
D	Correlation Record	**(Either the D record or the**
E	Covariance Record	**E record is required)**
F	Long Vector Record	
G	Coordinate/Absolute Position Record (optional)	
H	Station Information Record	

Project Record

01-01	A		
02-03	Job Code (Chapter 1)		Alpha
04-07	Year, Start of Project (local)	(CCYY)	Integer
08-09	Month, Start of Project (local)	(MM)	Integer
10-11	Day, Start of Project (local)	(DD)	Integer
12-15	Year, End of Project (local)	(CCYY)	Integer
16-17	Month, End of Project (local)	(MM)	Integer
18-19	Day, End of Project (local)	(DD)	Integer
20-78	Title of project		Alpha
79-80	Reserved		

Session Header Record

01-01	B		
02-05	Year, First Actual Measurement	(UTC) (CCYY)	Integer
06-07	Month, First Actual Measurement	(UTC) (MM)	Integer
08-09	Day, First Actual Measurement	(UTC) (DD)	Integer
10-13	Time, First Actual Measurement	(UTC) (HHMM)	Integer
14-17	Year, Last Actual Measurement	(UTC) (CCYY)	Integer
18-19	Month, Last Actual Measurement	(UTC) (MM)	Integer
20-21	Day, Last Actual Measurement	(UTC) (DD)	Integer
22-25	Time, Last Actual Measurement	(UTC) (HHMM)	Integer
26-27	Number of Vectors in the Session		Integer
28-42	Software Name & Version		Alpha
43-47	Orbit Source **(agency that computes orbit)**		Alpha
48-51	Orbit accuracy estimate **(XX.xx meters)**		Implied Decimal
52-53	Solution coordinate system code	(table, N-6)	Integer
54-55	Solution meteorological use code	(table, N-6)	Integer
56-57	Solution ionosphere use code	(table, N-6)	Integer
58-59	Solution time parameter use code	(table, N-6)	Integer
60-60	Nominal accuracy code	(table, N-8)	Integer
61-66	Processing agency code	(Annex C)	Alpha
67-70	Year of Processing	(CCYY)	Integer
71-72	Month of processing	(MM)	Integer
73-74	Day of processing	(DD)	Integer
75-80	Solution Type	(table, N-7)	Alpha

Note: Columns 43 through 47 of Record B contains the symbol of the agency which computes and provides GPS satellite orbit information. Columns 61 through 66 contains the symbol of the agency that does the observation reduction processing. Columns 52 through 80 of Record B assume all stations use identical observing and computation procedures. If this is not the case use Record H to record the differences for each of those stations which vary from those conditions noted on the B record.

Vector Record

01-01	C		
02-05	Origin Station Serial Number (ssn)	(vector tail)	Integer
06-09	Differential Station Serial Number	(vector head)	Integer
10-20	Delta X	(XXXXXXX.xxxx meters)	Implied Decimal
21-25	Standard Deviation	(X.xxxx meters)	Implied Decimal
26-36	Delta Y	(XXXXXXX.xxxx meters)	Implied Decimal
37-41	Standard Deviation	(X.xxxx meters)	Implied Decimal
42-52	Delta Z	(XXXXXXX.xxxx meters)	Implied Decimal
53-57	Standard Deviation	(X.xxxx meters)	Implied Decimal
58-58	Rejection Code (use upper case R to reject)		Alpha
59-68	Origin Station Data Media Identifier		(See page N-6)
69-78	Differential Station Data Media Identifier		(See page N-6)
79-80	Reserved		

Note: Standard deviation values must be positive, non-zero numbers.

Correlation Record

01-01	D		
02-04	Row Index Number		Integer
05-07	Column Index Number		Integer
08-16	Correlation	(XX.xxxxxxx)	Implied Decimal
17-19	Row Index Number		Integer
20-22	Column Index Number		Integer
23-31	Correlation	(XX.xxxxxxx)	Implied Decimal
32-34	Row Index Number		Integer
35-37	Column Index Number		Integer
38-46	Correlation	(XX.xxxxxxx)	Implied Decimal
47-49	Row Index Number		Integer
50-52	Column Index Number		Integer
53-61	Correlation	(XX.xxxxxxx)	Implied Decimal
62-64	Row Index Number		Integer
65-67	Column Index Number		Integer
68-76	Correlation	(XX.xxxxxxx)	Implied Decimal
77-80	Reserved		

Note: This record is to record the off-diagonal correlates only from the session (or vector) correlation matrix. Since the correlation matrix is symmetric about the diagonal only the upper or the lower half should be recorded.

Covariance Record

01-01	E	
02-04	Row Index Number	Integer
05-07	Column Index Number	Integer
08-19	Covariance (XXXX.xxxxxxxx meters^2)	Implied Decimal
20-22	Row Index Number	Integer
23-25	Column Index Number	Integer
26-37	Covariance (XXXX.xxxxxxxx meters^2)	Implied Decimal
38-40	Row Index Number	Integer
41-43	Column Index Number	Integer
44-55	Covariance (XXXX.xxxxxxxx meters^2)	Implied Decimal
56-58	Row Index Number	Integer
59-61	Column Index Number	Integer
62-73	Covariance (XXXX.xxxxxxxx meters^2)	Implied Decimal
74-80	Reserved	

Note: This record is to record the off-diagonal covariances only from the vector variance-covariance matrix. The square root of the diagonal elements, the component standard deviations, are recorded on records C and F. Since the variance-covariance matrix is symmetric about the diagonal only the upper or the lower half should be recorded.

Long Vector Record

01-01	F	
02-05	Origin Station Serial Number (ssn) (vector tail)	Integer
06-09	Differential Station Serial Number (vector head)	Integer
10-22	Delta X (XXXXXXXXX.xxxx meters)	Implied Decimal
23-27	Standard Deviation (X.xxxx meters)	Implied Decimal
28-40	Delta Y (XXXXXXXXX.xxxx meters)	Implied Decimal
41-45	Standard Deviation (X.xxxx meters)	Implied Decimal
46-58	Delta Z (XXXXXXXXX.xxxx meters)	Implied Decimal
59-63	Standard Deviation (X.xxxx meters)	Implied Decimal
64-64	Rejection Code (use upper case R to reject)	Alpha
65-65	Origin station manufacturer code	(N-6)
66-68	Origin station UTC day of year of occupation (DDD)	Integer
69-69	Origin station year of occupation (Y) UTC	Integer
70-70	Origin station session indicator	Alpha
71-71	Differential station manufacturer code	(N-6)
72-74	Differential station day of year (DDD) UTC	Integer
75-75	Differential station year of occupation (Y) UTC	Integer
76-76	Differential station session indicator	Alpha
77-80	Reserved	

Note: Standard deviation values must be positive, non-zero numbers.

Coordinate Record

01-01	G	
02-02	Blank	
03-03	Record usage code K - see below	
04-05	Blank	
06-09	Station Serial Number	
10-10	Blank	
11-14	Optional "short" station name - see below	
15-15	Blank	
16-20	Coordinate frame designator (e.g. NAD 83, WGS 84, NAD 27, WGS 72, ITR 90, etc.; inquire for additions)	
21-21	Blank	
22-33	X coordinate (XXXXXXXX.xxxx meters)	Implied Decimal
34-34	Blank	
35-46	Y coordinate (YYYYYYYY.yyyy meters)	Implied Decimal
47-47	Blank	
48-59	Z coordinate (ZZZZZZZZ.zzzz meters)	Implied Decimal
60-60	Blank	
61-64	Sigma X (SS.ss m) blank if unknown or greater than 99.99 m	
65-65	Blank	
66-69	Sigma Y (SS.ss m) blank if unknown or greater than 99.99 m	
70-70	Blank	
71-74	Sigma Z (SS.ss m) blank if unknown or greater than 99.99 m	
75-80	Reserved	

K = 0 or blank indicates that the position is approximate and has no particular interpretation.
K = 1 indicates that these are exact coordinates (to 0.1 mm) used during the processing of the G-file vectors.

The 4 character "short" name, if used, should be the same abbreviation used elsewhere in the G-file or other related data files.

Station Information Record

01-01	H		
02-05	Station Serial Number (ssn)		Integer
06-09	Four Character Identifier		Alpha
10-11	External frequency standard code	(table, N-8)	
12-13	Vector meteorological use code	(table, N-6)	
14-15	Vector time parameter use code	(table, N-6)	
16-17	Vector ionosphere use code	(table, N-6)	
18-23	Vector Solution type	(table, N-7)	
24-78	Comments		Alpha
79-80	Reserved		

Use comment field to record clarifying information or instrument type if noted as "other" in Data Media Identifier.

CODE TABLES

Solution Coordinate Reference System Codes

01 -- WGS 72 Precise Ephemeris [DMA] Used from GPS beginning thru 1/3/87
02 -- WGS 84 Precise Ephemeris [DMA] from 1/4/87 thru 1/1/94
03 -- WGS 72 Broadcast Ephemeris [DOD] from GPS beginning thru 1/22/87
04 -- WGS 84 Broadcast Ephemeris [DOD] from 1/23/87 thru 6/28/94
05 -- ITRF 89 Epoch 1988.0 (International Earth Rotation Service
NOT USED AS A GPS REFERENCE FRAME
06 -- NEOS 91.25 Epoch 1988 [NGS] from Spring 1991 thru 10/19/91
SPECIAL VLBI COORDINATE SOLUTION written by Mike Abell
07 -- NEOS 90 Epoch 1988.0 [NGS] from 10/20/91 thru 8/15/92
08 -- ITRF 91 Epoch 1988.0 [NGS] from 8/16/92 thru 12/19/92
09 -- SIO/MIT 1992.57 Epoch 1992.57 [NGS] from 12/20/92 thru 11/30/93
10 -- ITRF 91 Epoch 1992.6 [NGS] from 12/1/93 thru 1/8/94
11 -- ITRF 92 Epoch 1994.0 [NGS] from 1/9/94 thru 12/31/95
12 -- ITRF 93 Epoch 1995.0 [NGS] from 1/1/95 thru 6/29/96
13 -- WGS 84 (G730) Epoch 1994.0 [DMA] from 1/2/94 thru 9/28/96
14 -- WGS 84 (G730) Epoch 1994.0 Broadcast [DOD USAF] from 6/29/94 thru 1/28/97
15 -- ITRF 94 Epoch 1996.0 [NGS] from 6/30/96 thru 2/28/98
16 -- WGS 84 (G873) Epoch 1997.0 [NIMA] (formerly DMA) from 9/29/96 to the present
17 -- WGS 84 (G873) Epoch 1997.0 Broadcast [DOD USAF] from 1/29/97 to the present
18 -- ITRF 96 Epoch 1997.0 [NGS] from 3/1/98 to the present

Solution Meteorological Use Codes

01 -- Default values used (model used)
02 -- Observed meteorological data used
03 -- Water vapor radiometer used

Solution Ionosphere Use Code

01 -- None
02 -- Dual frequency ionospheric correction used
03 -- Ionospheric model used

Solution Time Parameter Use Codes

01 -- Observed time synchronization data used
02 -- Time parameters solved for in data reduction

Data Media Identifier

Required format: ADDDYSCCCC

where, A is one of the following characters which indicates the manufacturer of the receiver used for the observation:
A = Ashtech, Inc; C = Topcon Corp; D = Del Norte Technology, Inc;
G = Allen Osborne Associates, Inc; I = Istac, Inc;
L = MINI-MAC[R]; M = MACROMETER[R]; N = Norstar Instruments Ltd;
O = Motorola, Inc; R = Trimble Navigation, Ltd; S = SERCEL, Inc;
T = Texas Instruments, Inc; V = NovAtel Communications Ltd;
W = Leica Heerbrugg AG/Wild Heerbrugg/Magnavox, Inc; X = other
DDD is the day of the year of the first data epoch (UTC)
Y is the last digit of the year of the first data epoch (UTC)
S is an alphanumeric designation of the session
CCCC is the project unique, four character abbreviation of a station designation

CODE TABLES (continued)

Solution Type Use Codes

+ L1TD--	L1SDFL	L1DDFL	IFDDFL	OTDDFL	K1DDFX
+ L2TD--	L1SDFX	L1DDFX	IFDDFX	OTDDFX	K2DDFX
+ IFTD--	L1SDPF	L1DDPF	IFDDPF	OTDDPF	KIDDFX
+ WLTD--					KWDDFX
		L2DDFL	WLDDFL		P1DDFX
		L2DDFX	WLDDFX		P2DDFX
		L2DDPF	WLDDPF		PIDDFX
					PWDDFX

Where: L1 = Frequency 1
L2 = Frequency 2
IF = Ionosphere Free Combination (Static) *
WL = Wide Lane Combination (Static or Rapid Static)**
OT = Other (Explain in Station Information Record)

K1 = L1 Kinematic Observation (Single visit, continuous lock - also known as Continuous Kinematic, Stop and Go Kinematic, or On-the-Fly Kinematic)
K2 = L2 Kinematic
KI = Ionosphere Free Combination Kinematic *
KW = Wide Lane Combination Kinematic **

P1 = L1 Pseudo-kinematic (Two or more visits, intermittent lock - also known as Pseudo-static, Intermittent Static or Reoccupation techniques)
P2 = L2 Pseudo-kinematic
PI = Ionosphere Free Combination Pseudo-kinematic *
PW = Wide Lane Combination Pseudo-kinematic **

TD = Triple Difference Solution
DD = Double Difference Solution
SD = Single Difference Solution

FL = Float (real number) estimate of biases
FX = Fixed integer estimate of biases
PF = Partial, fixed integer estimate of biases (Not all integer biases determinable).

\+ Triple Difference Solutions have no integer ambiguities, leave trailing columns blank.
* IF = ionosphere free = $\{f^2_1/(f^2_1 - f^2_2)\}L_1 - \{f_1 f_2/(f^2_1 - f^2_2)\}L_2$
** WL = wide lane = L1 - L2

Where, f_1 = 1575.42 mHz, f_2 = 1227.60 mHz, and L_1 and L_2 are phase measurements in units of cycles.

CODE TABLES (continued)

External Frequency Standard

01 -- No external frequency standard used
02 -- Rubidium frequency standard used
03 -- Cesium frequency standard used
04 -- Hydrogen Maser frequency standard used
05 -- External crystal frequency standard used
06 -- Other (Comment in Station Information Record)

Vector Nominal Accuracy Codes

Code	Intended accuracy	Order/Class
4 --	Intended accuracy 100 ppm plus 5.0 cm	3
3 --	Intended accuracy 50 ppm plus 3.0 cm	2-II
2 --	Intended accuracy 20 ppm plus 2.0 cm	2-I
5 --	Intended accuracy 10 ppm plus 1.0 cm	1
6 --	Intended accuracy 1 ppm plus 0.8 cm	B
7 --	Intended accuracy 0.1 ppm plus 0.5 cm	A
8 --	Intended accuracy 0.01 ppm plus 0.3 cm	AA

PROJECT RECORD

1	2 3	4 – 11	12 – 19	20 –
RECORD TYPE (A)	JOB CODE	C C Y Y M M D D START PROJECT	C C Y Y M M D D END PROJECT	PROJECT TITLE

– 78	79 80
PROJECT TITLE CONTINUED	

GROUP HEADER RECORD

1	2 – 9	10 – 13	14 – 21	22 – 25
RECORD TYPE (B)	C C Y Y M M D D DATE OF FIRST OBSERVATION	H H M M TIME OF FIRST OBSERVATION	C C Y Y M M D D DATE OF LAST OBSERVATION	H H M M TIME OF LAST OBSERVATION

26 27	28 – 42	43 – 47	48 – 51	52 53	54 55
NUMBER OF VECTORS	SOFTWARE ID AND VERSION	ORBIT SOURCE	X X X . x ORBIT ACCURACY (METERS)	COORDINATE SYSTEM CODE	MET. USE CODE

56 57	58 59	60	61 – 66	67 – 74	75 – 80
IONOSPHERE USE CODE	TIME PARAMETER CODE	ACCURACY CODE	PROCESSING AGENCY	C C Y Y M M D D PROCESSING DATE	SOLUTION CODE

VECTOR RECORD

1	2 – 5	6 – 9	10 – 20	21 – 25	26 – 36
			X X X X X X X . x x x x	X . x x x x	X X X X X X X . x x x x
RECORD TYPE (C)	ORIGIN SSN	DIFFERENTIAL SSN	DELTA X (METERS)	SIGMA X (METERS)	DELTA Y (METERS)

37 – 41	42 – 52	53 – 57	58	59 – 68
X . x x x x	X X X X X X X . x x x x	X . x x x x		
SIGMA Y (METERS)	DELTA Z (METERS)	SIGMA Z (METERS)	REJECT CODE	ORIGIN STATION DATA MEDIA IDENTIFIER

69 – 78	79 80
DIFFERENTIAL STATION DATA MEDIA IDENTIFIER	BLANK

CORRELATION RECORD

Columns	Format	Field
1		RECORD TYPE (D)
2–4		ROW INDEX NO.
5–7		COLUMN INDEX NO.
8–16	X X . x x x x x x x	CORRELATION
17–19		ROW INDEX NO.
20–22		COLUMN INDEX NO.
23–31	X X . x x x x x x x	CORRELATION
32–34		ROW INDEX NO.
35–37		COLUMN INDEX NO.
38–46	X X . x x x x x x x	CORRELATION
47–49		ROW INDEX NO.
50–52		COLUMN INDEX NO.
53–61	X X . x x x x x x x	CORRELATION
62–64		ROW INDEX NO.
65–67		COLUMN INDEX NO.
68–76	X X . x x x x x x x	CORRELATION
77–80		BLANK

COVARIANCE RECORD

1	2 – 4	5 – 7	8 – 19	20 – 22	23 – 25
RECORD TYPE (E)	ROW INDEX NO.	COLUMN INDEX NO.	X X X X . x x x x x x x x COVARIANCE (METERS^2)	ROW INDEX NO.	COLUMN INDEX NO.

26 – 37	38 – 40	41 – 43	44 – 55	56 – 58	59 – 61
X X X X . x x x x x x x x COVARIANCE (METERS^2)	ROW INDEX NO.	COLUMN INDEX NO.	X X X X . x x x x x x x x COVARIANCE (METERS^2)	ROW INDEX NO.	COLUMN INDEX NO.

62 – 73	74 – 80
X X X X . x x x x x x x x COVARIANCE (METERS^2)	BLANK

LONG VECTOR RECORD

1	2 5	6 9	10 22	23 27
			X X X X X X X X X . x x x x	X . x x x x
RECORD TYPE (F)	ORIGIN SSN	DIFFERENTIAL SSN	DELTA X (METERS)	SIGMA X (METERS)

28 40	41 45	46 58	59 63
X X X X X X X X X . x x x x	X . x x x x	X X X X X X X X X . x x x x	X . x x x x
DELTA Y (METERS)	SIGMA Y (METERS)	DELTA Z (METERS)	SIGMA Z (METERS)

64	65	66 70	71	72 76	77 80
		D D D Y S		D D D Y S	
REJECT CODE	ORIG INST CODE	ORIGIN DAY IDENTIFIER	DIFF INST CODE	DIFFERENTIAL IDENTIFIER	BLANK

COORDINATE RECORD (Optional)

1	2	3	4 5	6 9	10	11 14	15	16 20	21
RECORD TYPE (G)	BLANK	K (0,1)	BLANK	STATION SERIAL NUMBER	BLANK	SHORT NAME	BLANK	COORDINATE FRAME DESIGNATOR	BLANK

22 33	34	35 46	47
X X X X X X X X . x x x x X COORDINATE (METERS)	BLANK	Y Y Y Y Y Y Y Y . y y y y Y COORDINATE (METERS)	BLANK

48 59	60	61 64	65	66 69	70	71 74	75 80
Z Z Z Z Z Z Z Z . z z z z Z COORDINATE (METERS)	BLANK	SIGMA X (METERS)	BLANK	SIGMA Y (METERS)	BLANK	SIGMA Z (METERS)	BLANK

STATION INFORMATION RECORD

1	2 5	6 9	10 11	12 13	14 15	16 17	18 23
RECORD TYPE (H)	STATION SERIAL NUMBER	FOUR CHARACTER IDENTIFIER	EXT. FREQ. CODE	MET. USE CODE	TIME PARAM. CODE	ION. USE CODE	SOLUTION TYPE

24 78
COMMENT FIELD

79 80
BLANK

G-FILE EXAMPLES

Below are fragments from six independent, simulated GPS Data Transfer Format files (G-FILEs). There is one Project record (A) per G-file. Each session vector set, or individually computed vector in a multi-receiver session, requires a Session Record (B). Each vector requires at least one Vector Record (C) or Long Vector Record (F). Vector Records with Coordinate Records must follow the same Session Record. Station Information (H) Records are required as circumstances dictate and may be optionally added where not required. These records must be followed by sufficient Correlation (D) or Covariance Records (E) to express all off-diagonal correlation or covariance terms in the matrix half provided from the session computation. Correlation and Covariance Records may not be intermixed.

1. Project (A), Session (B), Vector (C), and Correlation (D) records for a single vector between two stations in a two receiver session or individually computed vector in a multi-receiver session.

```
AKS1989061619890810
B1989062221041989062300320lOMNI21JUL89    BDCST200040101025NGS    19890919L1DDFX
C02860255   22818804  691  517712752 1665  621497962 1259 M1739APACIM1739AK60A
D  1  2 -1507832  1  3 -1653265  2  3 -9400487
```

2. Project (A), Session (B), Vector (C), and Correlation (D) records for a three-receiver (two vector) session computed simultaneously in session mode.

```
AA21989061619890810
B198907191920198907192022020MNI21JUL89    NSWC  200020202026NGS   19891010IFDDFL
C02520251    2090836   21    3595939   80    5412122   45 T1735BTOLPT1735BIO35
C02520250  -42878920   42  -19024426   93  -28455946   69 T1735BTOLP71735BIO17
D  1  2 -3449463  1  3  -169254  1  4 -7443040  1  5 -3452654  1  6  1753975
D  2  3 -7698120  2  4 -6329835  2  5  1258498  2  6  8573493  3  4 -6485385
D  3  5 -6084380  3  6  -477478  4  5 -6124087  4  6 -3864367  5  6  8630812
```

Note: If a multi-receiver session is computed as if all possible vectors are independent, then there would be Session, Vector, and Correlation records for each vector in the session. Thus, the record sequence would be A, B, C, D, B, C, D, B, C, D, etc. The Session records would be nearly identical to the multi-receiver example except that start and stop times could vary with each vector. The number of vectors indicated on each Session Record would be one, i.e., there would be a Session Record for each vector and the cross correlation terms between vectors would not exist.

3. Project (A), Session (B), Vector (C), and Correlation (D) Records for a five-receiver (four vector) session computed simultaneously in session mode.

```
AW11989061619890810
B19890718192419890718225204OMNI21JUL89    BDCST 200020202025NGS   19891003L1DDFL
C03000287    5764741   77    1459095   44    2345097   54 R1765ASMILR1765ANEOP
C03000223  -52521873   47    -229406  101   -1142670   75 R1765ASMILR1765ACESZ
C03000305  -42878920   42  -19024426   93  -28455945   69 R1765ASMILR1765AX042
C03000240    7097171   69   -1171456   40   -1443438   46 R1765ASMILR1765AG042
D  1  2 -7621157  1  3 -6268111  1  4  1032188  1  5 -7397468  1  6  2749723
D  1  7 -7716473  1  8 -6339150  1  9  1294594  1 10 -2396473  1 11 -2753742
D  1 12 -5804898  2  3  -791184  2  4 -6108347  2  5 -1739462  2  6  9010327
D  2  7 -7729301  2  8 -6463718  2  9  1526641  2 10 -3826492  2 11  3610736
D  2 12 -6449538  3  4   170894  3  5 -6299216  3  6 -1003847  3  7 -5307149
D  3  8 -7680811  3  9 -6477668  3 10  1506536  3 11 -9537262  3 12 -1836426
D  4  5 -6154878  4  6  -248020  4  7 -6087715  4  8 -1633847  4  9  6354725
D  4 10 -7804602  4 11 -6047825  4 12  1262026  5  6  3746287  5  7 -7243634
D  5  8 -6110139  5  9  -321344  5 10 -6165227  5 11  8362528  5 12  9162533
D  6  7 -5971690  6  8  -516393  6  9 -6136978  6 10 -9354622  6 11  1535474
D  6 12 -5920223  7  8  -559594  7  9 -6153794  7 10  2645373  7 11 -5373742
D  7 12 -5527744  8  9 -7793107  8 10  1043462  8 11  5378213  8 12 -2564522
D  9 10 -5371777  9 11 -7908942  9 12  1046883 10 11  8354256 10 12 -3372634
D 11 12  7153372
```

4. Project (A), Session (B), Vector (C), and Covariance (E) Records for a three-receiver (two vector) session computed simultaneously in session mode.

```
AC51989061619890810
B19890719192019890719202202OMNI21JUL89    NSWC  200020202026NGS   19891010WLDDPF
C02520251    2090836   21    3595939   80    5412122   45 T1735BTOLPT1735BIO35
C02520250  -42878920   42  -19024426   93  -28455946   69 T1735BTOLPT1735BIO17
E  1  2    -3449231  1  3      169013  1  4    -7443219  1  5    -3452017
E  1  6    -1753648  2  3     7698884  2  4    -6329438  2  5     1258689
E  2  6     8573027  3  4    -6485903  3  5    -6084227  3  6     -477369
E  4  5     6124824  4  6    -3864711  5  6     8630682
```

5. Project (A), Session (B), Long Vector (F), and Correlation (D) Records for a three-receiver (two vector) session computed simultaneously in session mode.

```
AM31989061619890810
B19900312192019900312202203OMNI21JUL89    NSWC  200050202027NGS  19900605IFDDPF
F02520251  -7398138095   62   -611028070  140   -759539795   81 R0710AR0710A
F02520210 -28097365450    2   6537703840    2   1612488880    2 R0710AR0710A
D  1  2 -3449463  1  3  -169254  1  4 -7443040  1  5 -3452654  1  6  1753975
D  2  3 -7698120  2  4 -6329835  2  5  1258498  2  6  8573493  3  4 -6485385
D  3  5 -6084380  3  6  -477478  4  5 -6124087  4  6 -3864367  5  6  8630812
```

6. Project (A), Session (B), Vector (C), Coordinate (G), Station Information (H), and Correlation (D) Records for a five-receiver session computed simultaneously.

```
AG41989061619890810
B19921019162019921019202204OMNI06JAN93    NGS    50090202027NGS   19930115IFDDFX
C02520251 -121666909   30  157350726   56  117976050   41 R2932ANORDR2932ASECO
C02520250 -418472429   32  247232117   60    8372071   44 R2932ANORDR2932ABURR
C02520253 -553950607   35  500052515   64  221106176   48 R2932ANORDR2932AFIGU
C02520254 -289152973   31  300310186   55  183697838   42 R2932ANORDR2932APINE
G 1  0252 NORD SIO92 -25711011350 -45925184360  35928923390  010  010  010
H0252NORD01020202IFDDFXREFERENCE STATION
D  1  2 -7621157  1  3 -6268111  1  4  1032188  1  5 -7397468  1  6  2749723
D  1  7 -7716473  1  8 -6339150  1  9  1294594  1 10 -2396473  1 11 -2753742
D  1 12 -5804898  2  3  -791184  2  4 -6108347  2  5 -1739462  2  6  9010327
D  2  7 -7729301  2  8 -6463718  2  9  1526641  2 10 -3826492  2 11  3610736
D  2 12 -6449538  3  4   170894  3  5 -6299216  3  6 -1003847  3  7 -5307149
D  3  8 -7680811  3  9 -6477668  3 10  1506536  3 11 -9537262  3 12 -1836426
D  4  5 -6154878  4  6  -248020  4  7 -6087715  4  8 -1633847  4  9  6354725
D  4 10 -7804602  4 11 -6047825  4 12  1262026  5  6  3746287  5  7 -7243634
D  5  8 -6110139  5  9  -321344  5 10 -6165227  5 11  8362528  5 12  9162533
D  6  7 -5971690  6  8  -516393  6  9 -6136978  6 10 -9354622  6 11  1535474
D  6 12 -5920223  7  8  -559594  7  9 -6153794  7 10  2645373  7 11 -5373742
D  7 12 -5527744  8  9 -7793107  8 10  1043462  8 11  5378213  8 12 -2564522
D  9 10 -5371777  9 11 -7908942  9 12  1046883 10 11  8354256 10 12 -3372634
D 11 12  7153372
```