April 1, 1998

MEMORANDUM FOR: Distribution

FROM: D.S. Snellgrove, N/NGS23

SUBJECT: Changes to the Blue Book (September 1994)

Proposed page changes to the 1994 version of the Input Formats and Specifications of the National Geodetic Survey Data Base (Blue Book), Volume I. Horizontal Control Data and associated annexes are attached for your review.

Also attached with this memo is an index of the changes to each section of the Blue Book, referencing the proposed updates and additions to each affected page of the current version (September 1994).

Please use your own copy of the Blue Book as a reference and return your comments, if any, to me by April 6, 1998. Geodetic Advisors wiil be allowed an additional week to respond.

Proposed redesigns of Annex A and Annex C by Janet Mencher are not included in this package. And, Annex J has not been fully compiled at this time.

Distribution:

| Reviewer | Station |
|---|---|
| D. Amoroso | 9218 |
| J. Blackwell | 8458 |
| D. Conner | conner@cfm.ohio-state.edu |
| S. Frakes | 8853 |
| G. Frank | 9127 |
| S. Hilla | 9317 |
| D. Mulcare | dmulcar@ibm.net |
| R. Safford | 9557 |
| R. Shields | 8734 |
| P. Spofford | 8117 |
| J. Stem | 9357 |
| M. Vorhauer | 8562 |
| M. White | 8432 |

**Blue Book Index of Changes**

Listed below are proposed changes to the current edition of the Blue Book:

**Preface**

Page i .. Effective July 1, 1995, changed to September 1, 1995.
.. Chief, NGS changed to Director, NGS. (changed throughout)
Page ii .. Change routing code.
Page iii .. Add Annex J - GPS Antenna Codes.
Page iv .. Add Height of Antenna .... 2-11
Page vi .. Add GPS Antenna Data (*71*) Record.... 2-76a
Page viii .. Add Annex J - GPS Antenna Codes.... J-1

**Chapter 2**

Page 2-2 .. Add *71* - GPS Antenna Record.
Page 2-5 .. Add *71* for each GPS antenna used in the project.
Page 2-11 .. Add Height of GPS Antenna:
Page 2-28 .. Add *71* - GPS Antenna Record.
Page 2-28a .. Add entire page.
Page 2-28b .. Add entire page.
Page 2-41 .. Add Floating Point Field and Integer Field.
Page 2-50 .. Add CC 33-35 Job-Specific Antenna Number (JSAN).
.. Change blank field to CC 36-80.
Page 2-52 .. Add comment “More than two records can be accommodated.”
Page 2-70 .. Change CC 57-77 to CC 75-77.
Page 2-76 .. No change.
Page 2-76a .. Add entire page.
Page 2-77 .. Change in Code B the phrase from “not in the NGSIDB” to “the leveling data are not in the NGSIDB.”
.. Change definition of Code G.
.. Add Elevation Codes J and K
Page 2-82 .. Add Deflection Model Codes.
Page 2-84 .. Add Orthometric Height (OHT) Codes J and K.
Page 2-85 .. Add Geoid Height (GHT) Codes.
.. Add Ellipsoid Height (EHT) Datum Codes D and E.
Page 2-105 .. Add *71* GPS Antenna Record diagram.
Page 2-108 .. Add CC 62 for Deflection Codes; change CC 46-62 to CC 46-61 for Comments.

**Chapter 3**

Page 3-9 .. Add “O” for Other to the Condition Codes.
Page 3-16 .. Change routing code from N/CG174 to N/NGS12.

**Annex A**

Page A-1 .. Change South Carolina from NC to SC; add three codes to Other Political Units and Territories:.
Page A-2 .. Add and change codes for Central America and the Caribbean Area.

**Annex C**

Page C-1 .. Change Category page numbers; a large number of symbols have been added to Annex C since the last publication.

Page C-3 thru C-38 .. Added symbols for contributors.

**Annex F**

Page F-5 .. Added codes 244 and 245.
Page F-6 .. Change Builder's Rods and Staffs codes from 390-399 to 390-395 and added the category Precise (Geodetic) Metal-Scale, Bar-Code Rods with codes 396-399.

**Annex I**

Page I-3 .. Change Stability Codes for Sleeved Deep Setting numbers 57-60 from A to B.
Page I-6 .. Add "O" for Other to the Condition Code.

**Annex J**

Page J-1 .. Add entire page.

**Annex K**

Page K-5 .. Add category "D. Statistics" above 1. Closures; change L-6 to L-5 at bottom of page.
Page K-6 .. Change routing number in first address from N/CG124 to N/NGS23 and telephone number from 713-3187 to 713-3200, ext. 100 and in the second address change the routing code from N/CG17x2 to N/NGS12.
.. Add separate address for GPS projects.

**Annex L**

Page L-3 .. Highlight second paragraph - Create the L-file, etc.
Page L-8 .. Change station number from 8342 to 8432.
Page L-9 .. Add several attachments to PACKAGE CONTENTS.

**Annex N**

Page N-2 .. Add comment to "Orbit Source" CC 43-47 and change Implied Decimal from (XXX.x) to (XX.xx) in CC 48-51.
Page N-4 .. Change CC 67-69 to 69-69.
Page N-6 .. Add Reference System Codes 12-18.

End of additions and changes.

## 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:

NOAA, National Geodetic Survey, **N/NGS12**
1315 East-West Highway, Station 9202
Silver Spring, MD 20910-3282
Telephone: (301) 713-3242; Fax: (301) 713-4172
Monday through Friday, 7:00 a.m. - 4:30 p.m. Eastern Time.

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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.

Azimuth Data (*60*-Series) Records:

*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.

**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.

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 Resolution of the Instrument and for Units 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).

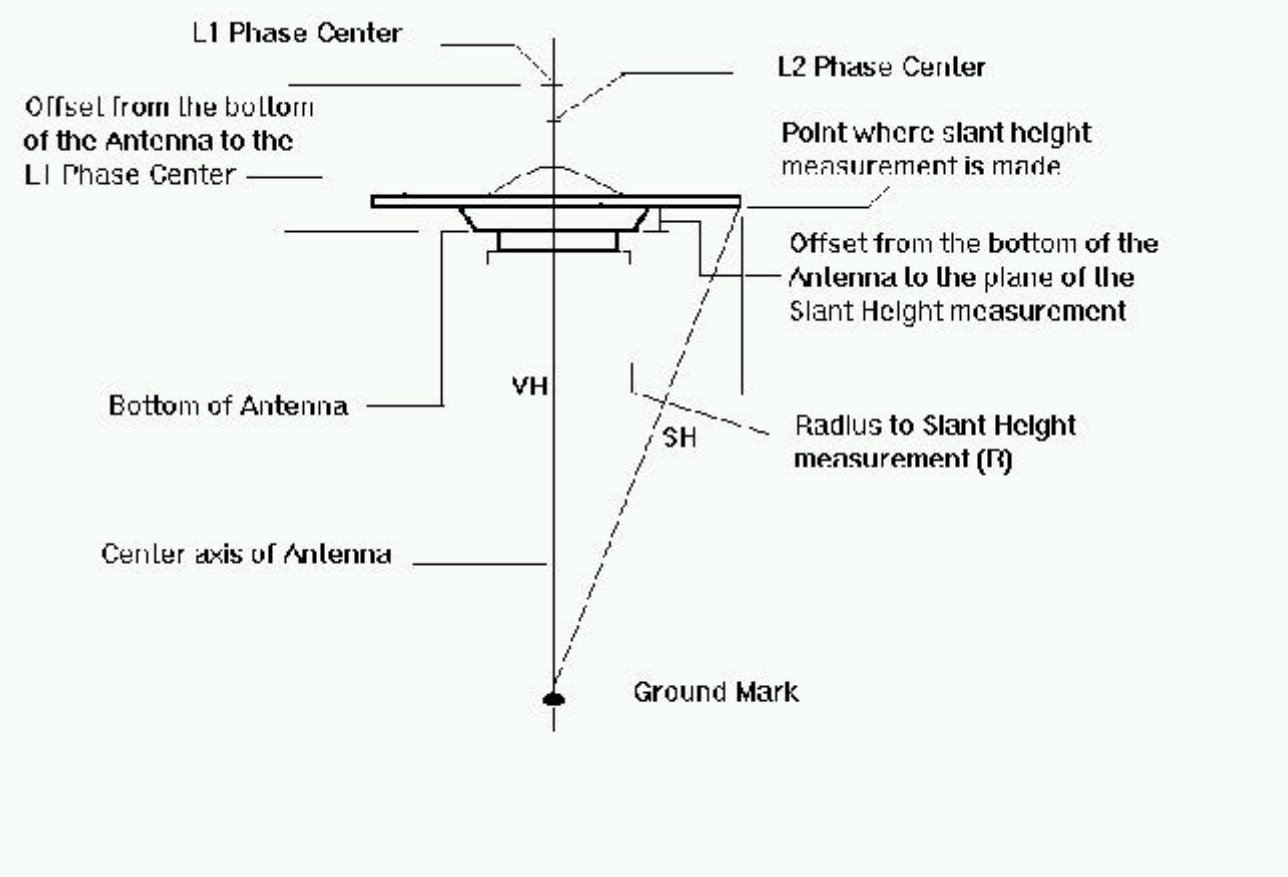
The purpose of the *71* record is to provide descriptive information pertaining to the GPS antenna which has been identified by a Job-Specific Antenna Number (see under OBSERVATION DATA RECORDS). Submit a *71* record for each antenna used in the project. Individual *71* records should appear in order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

NGS Antenna Code: 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.

Antenna Phase Pattern File: 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.

Source Organization: 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.

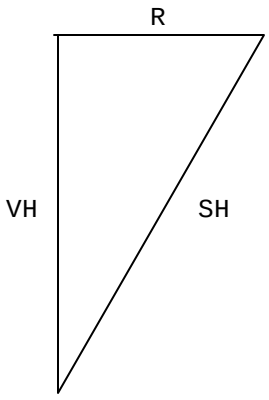
**Vertical Height (VH):** This value, reduced from the slant height measurement by the formula below, is used in computing the required vertical height of the phase center (L1/L2) above the ground mark in the *27* record.

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

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.**

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

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.**

## 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 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. |
| 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.**<br>MM - MILLIMETERS OF MERCURY<br>MB - MILLIBARS<br>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 |

## 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. |

## 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 **(not loaded in the NGSIDB)**. |
| 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.** |

## 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** |

## 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. |

*70* INSTRUMENT RECORD

```
 1         6   7     10  11   13  14   16    17       20   21 22 23                                    40
+)0)0)0)0)0), +)0)0)0),  +)0)0),  +)0)0),    +)0), +)0),   +)0), +)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0),
.)2)2)2)2)2)- .)2)2)2)-  .)2)2)-  .)2)2)-    .)2)-..)2)-   .)2)- .)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)-
  SEQUENCE      DATA      JSIN   EQUIPMENT    X X   x x    UNITS       INSTRUMENT MANUFACTURER
   NUMBER       CODE               CODE      INSTRUMENT
 (INC BY 10)                                 RESOLUTION

41                                          62 63             70 71                 80
+)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0), +)0)0)0)0)0)0)0), +)0)0)0)0)0)0)0)0)0),
.)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)- .)2)2)2)2)2)2)- .)2)2)2)2)2)2)2)2)2)-
      TYPE OF INSTRUMENT OR TRADE NAME            MODEL OF            SERIAL
                                                  INSTRUMENT          NUMBER
```

---

*71* GPS ANTENNA RECORD

```
 1         6   7     10  11   13  14                                29  30                      41
+)0)0)0)0)0), +)0)0)0),  +)0)0),  +)0)0)0)+)0)+)0)+)0)0)0)0)0)0)0),  +)0)0)0)0)0)0)0)0)+)0)0),
.)2)2)2)2)2)- .)2)2)2)-  .)2)2)-  .)2)2).)2).)2).)2).)2)2)2)2)2)2)-  .)2)2)2)2)2)2)2)2)2).)-
  SEQUENCE      DATA      JSAN             NGS ANTENNA CODE               SERIAL NUMBER
   NUMBER       CODE
 (INC BY 10)

42                     53  54         59  60                                      80
+)0)0)0)0)0)0)0)0)0)0)0),  +)0)0)0)0)0),  +)0)0)0)+)0)+)0)+)0)0)0)0)0)0)0)0)0)0)0),
.)2)2)2)2)2)2)2)2)2)2)2)-  .)2)2)2)2)2)-  .)2)2).)2).)2).)2).)2)2)2)2)2)2)2)2)2).)-
  ANTENNA PHASE PATTERN        SOURCE                          BLANK
          FILE
```

*85* DEFLECTION RECORD (OPTIONAL)

```
 1         6   7     10 11     14  15         20   21                                        45
+)0)0)0)0)0), +)0)0)0), +)0)0)0),  +)0)0)0)0)0),   +)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0),
.)2)2)2)2)2)- .)2)2)2)- .)2)2)2)-  .)2)2)2)2)2)-   .)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)-
  SEQUENCE      DATA       SSN        SOURCE                          COMMENT(S)
   NUMBER       CODE                ORGANIZATION
  (INC BY 10)
```

```
46                       61  62   63         67  68    69     71   72         76   77    78     80
+)0)0)0)0)0)0)0)0)0)0)0)0), +),  +)0)0), +)0), +),   +), +)0),   +)0)0), +)0),   +),   +), +)0),
.)2)2)2)2)2)2)2)2)2)2)2)2)-  .)-  .)2)2)-..)2)-  .)-   .)-..)2)-  .)2)2)-..)2)-  .)-   .)-..)2)-
   COMMENT(S) CONTINUED      DEFL  S S S   s s   DIR.   S   s s    S S S    s s    DIR.   S   s s
                             CODE      XI        OF   SIGMA OF XI      ETA         OF   SIGMA OF ETA
                                    (SECONDS)    XI    (SECONDS)   (SECONDS)      ETA    (SECONDS)
                                                (N/S)                           (E/W)
```

---

*86* ORTHOMETRIC / ELLIPSOID / GEOID HEIGHT RECORD (OPTIONAL)

```
 1         6   7     10 11     14   15 16   17             23     24    25     26      27      28 29
+)0)0)0)0)0), +)0)0)0), +)0)0)0),   +))),   +)0)0)0), +)0)0),     +),   +),    +),     +),     +)0),
.)2)2)2)2)2)- .)2)2)2)- .)2)2)2)-   .)))-   .)2)2)2)-..)2)2)-     .)-   .)-    .)-     .)-     .)2)-
  SEQUENCE      DATA       SSN      BLANK    M M M M   m m m      OHT   OHT    OHT     OHT      OHT
   NUMBER       CODE                        ORTHOMETRIC HEIGHT   CODE ORDER  CLASS   NGSIDB   DATUM
  (INC BY 10)                             (METERS)                          INDICATOR
```

```
30         35   36             42   43    44 45   46             52     53    54    55     56
+)0)0)0)0)0),   +)0)0)0), +)0)0),   +),   +))),   +)0)0)0), +)0)0),     +),   +),   +),    +),
.)2)2)2)2)2)-   .)2)2)2)-..)2)2)-   .)-   .)))-   .)2)2)2)-..)2)2)-     .)-   .)-   .)-    .)-
ORGANIZATION     M M M M   m m m    GHT   BLANK    M M M M   m m m      EHT   EHT   EHT    EHT
               GEOID HEIGHT (GHT)   CODE          ELLIPSOID HEIGHT      CODE ORDER CLASS  DATUM
                    (METERS)                         (METERS)
```

```
57                                          80
+)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0)0),
.)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)2)-
                    COMMENT
```

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:

```
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.**

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 VIRVIN 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** | | |

OTHER COUNTRIES OR AREAS OF INTEREST TO NGS

| | | | |
|---|---|---|---|
| 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 |

# 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


A. National Agencies . . . . . C-3
B. Inter-State or Inter-Province Agencies . . . . . C-5
C. State, Province, Commonwealth, and Territorial Agencies . . C-6
D. County Agencies . . . . . C-11
E. Municipal Agencies (Cities) . . . . . C-18
F. Inter-City and Inter-County Agencies . . . . . C-24
G. Railroads . . . . . C-26
H. Utility and Natural Resource Companies . . . . . C-27
I. Surveying, Engineering, and Construction Industry . . . . . C-29
J. Educational Institutions . . . . . C-35
K. Professional and Amateur Associations . . . . . C-36
L. Miscellaneous Commercial or Private Firms . . . . . C-36
M. Non-Specific Designators . . . . . C-38


## 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.

| 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** | | |
| 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** |

| 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 |

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)

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 | |

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**)

## 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.

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.

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: | | | |

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.

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.

**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

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.