

## Chapter 10

### GRAVITY OBSERVATION (GRAV OBS) DATA

#### INTRODUCTION

This chapter provides detailed specifications and instructions for the coding and keying of the observational data set of a gravity survey job. As explained in Chapter 9, a gravity survey job may consist of two distinct data sets which must be submitted together. The companion data set to the gravity observation (GRAV OBS) data set treated in this chapter is the data set containing original descriptions and recovery descriptions for the gravity stations that are in the gravity survey job. This description (GRAV DESC) data set is detailed in Chapter 7. The format for the GRAV DESC data set is identical to the VERT DESC format. However, it should be noted that the Data Set Identification Record accompanying the GRAV DESC data set should reflect the GRAV and not VERT data class.

The GRAV OBS format is a data transmittal format and not intended as a data acquisition format. NGS specific techniques and instructions for the acquisition of gravity field data can be found in the National Geodetic Survey Operations Manual, Chapter 2.6. These instructions apply only to NGS field parties although other agencies may elect to use them.

#### GRAV OBS DATA SET RECORDS

Data that constitute a GRAV OBS data set are organized into five categories:

1. Survey Identification Data
2. Survey Equipment Data
3. Observation Data
4. Loop Termination Data
5. Station Information Data

Within these categories, the respective data have been grouped into "records". A record is a string of characters containing data codes in a specific format. Every record in a GRAV OBS data set consists of 80 characters or "columns". Within each record, the 80 columns are divided into fixed-length fields, each field being the space reserved for a specific data item. Accordingly, for every desired data item, there exists a field of appropriate length into which the data items are entered as strings of alphanumeric characters. The set of rules according to which specific data items are converted into strings of alphanumeric characters to be entered in the fields of a record is known as the "format" of that record.

The types of records which may appear in a GRAV OBS survey job are listed in Table 10-1. Each type of record has been given a name, and a block diagram

TABLE 10-1  
GRAVITY OBSERVATION DATA SET RECORDS

FIRST RECORD

\*AA\* - Data Set Identification Record

SURVEY IDENTIFICATION DATA

- \*10\* - Survey Information Record
- \*11\* - Survey Title Record
- \*12\* - Survey Title Continuation Record (Optional)
- \*13\* - Survey Title Continuation Record (Optional)
- \*14\* - Survey Title Continuation Record (Optional)
- \*15\* - Comment Record (Optional)

SURVEY EQUIPMENT DATA

- \*20\* - Instrument Information Record
- \*21\* - Instrument Calibration Header Record
- \*22\* - Instrument Calibration Information Record
- \*23\* - Instrument Scale Factor Header Record
- \*24\* - Instrument Scale Factor Record
- \*25\* - Comment Record (Optional)

OBSERVATION DATA

- \*30\* - Land Observation Record
- \*32\* - Marine Observation Record
- \*35\* - Comment Record (Optional)

LOOP TERMINATION DATA

- \*40\* - Loop Termination Record
- \*45\* - Comment Record (Optional)

STATION INFORMATION DATA

- \*50\* - Station Information Record
- \*55\* - Comment Record (Optional)

LAST RECORD

\*AA\* - Data Set Termination Record

Note: The symbol \*AA\* denotes the two-character job code assigned by the submitting agency - see Chapter 9.

illustrating the respective format has been prepared to serve as a model for that record - see FORMAT DIAGRAMS. An example OBS data set also appears in figure 10-1. 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 type of that record (\*10\*, \*11\*, ..., - see Table 10-1). The first and last records of the data set (the Data Set Identification Record and the Data

Set Termination Record) display in this field the two-character alphanumeric job code assigned by the submitting agency (\*A1\*, \*A2\*, ..., \*ZZ\* - see Chapter 9). The first character field of every record (columns 1-6) is reserved for the respective record sequence number - see Chapter 9. The remaining portion of each record (columns 11-80) contains character fields that are specific for each individual record type.

#### STRUCTURE OF THE GRAV OBS DATA SET

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

The GRAV OBS data set records which are bracketed by these two delimiter records may pertain to one or more units of field work; i.e., field observation data for several gravity surveys may be submitted in one GRAV OBS data set under the same job code, provided that the total number of survey points in the job does not exceed 9,999 (see Chapter 9). Each loop must be terminated by a \*40\* record. A \*10\* record following a \*50\* series record (or a \*40\* series record for a marine gravity survey) signifies the beginning of a new gravity survey within this data set.

A gravity survey is a unit of field work consisting of a number of survey points which are connected by gravity observations. When coded as part of a GRAV OBS data set, a gravity survey is a block of records comprising record groups arranged in the following order:

1. Survey Identification Data (\*10\*-Series) Records:

- \*10\* Record
- \*11\* Record (\*12\*, \*13\*, and \*14\* records optional)
- \*15\* Comment Records (optional, any number allowed)

2. Survey Equipment Data (\*20\*-Series) Records:

- \*20\* Instrument Information Records
- \*21\* Instrument Calibration Header Records
- \*22\* Instrument Calibration Information Records
- \*23\* Instrument Scale Factor Header Records
- \*24\* Instrument Scale Factor Records
- \*25\* Comment Records (optional, any number allowed)

3. Observation Data (\*30\*-Series) Records:

- \*30\* Land Observation Record giving all information relative to a specific land observation at a station within a loop of a survey
- \*32\* Marine Observation Record giving information observed during a marine gravity survey
- \*35\* Comment Records (optional, any number allowed)

4. Loop Termination Record:

\*40\* Records

\*45\* Comment Records (optional, any number allowed)

5. Station Information Record:

\*50\* Records giving station information related to a specific SPSN. This includes station position, elevation and designation.

\*55\* Comment Record (optional, any number allowed)

SURVEY IDENTIFICATION DATA RECORDS

\*10\* Survey Information Record

\*11\* Survey Title Record (Optional)

\*12\* Survey Title Continuation Record (Optional)

\*13\* Survey Title Continuation Record (Optional)

\*14\* Survey Title Continuation Record (Optional)

\*15\* Comment Record (Optional)

The survey identification data records, bearing the (\*10\*-series data codes) are listed above; the block diagrams illustrating the respective formats will be found under FORMAT DIAGRAMS.

The \*10\* record contains essential survey identification data and is always required. The \*11\* record is optional; however, it is highly desirable that a survey title (reflecting the geographic location of the survey - see below) be given. The survey title should be concise so as to fit on the \*11\* record (up to 70 characters); however, one, two, or three continuation records (the \*12\*, \*13\*, and \*14\* records) may be included if the title is lengthy or if a main title followed by subtitle(s) is called for. Following the \*11\* record (or else the last title continuation record), there may be included as many \*15\* records as appropriate to give comments pertinent to the survey (e.g., significant problems encountered, deviations from standard procedures, etc.), if any.

The entries on these records (see FORMAT DIAGRAMS) are for the most part self-explanatory; however, the following data items will be explained in greater detail:

Order and Class of Survey: A two-digit code is provided on the \*10\* record to specify the intended 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 by the Federal Geodetic Control Committee (FGCC), and published by the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce, Rockville, Md. In addition to the four gravity control survey categories defined in this publication, two other survey categories need to be considered - old gravity control surveys of first order for which no class is specified, and surveys of lower-than-third-order accuracy. The respective two-digit codes are as follows:

## Two Digit Accuracy Codes

- 10- First-Order (Class Unspecified)
- 11- First-Order, Class I
- 12- First-Order, Class II
- 20- Second-Order
- 30- Third-Order
- 40- Lower-Than-Third-Order

The accuracy code assigned to a gravity survey should reflect the procedures and specifications by which that entire survey has been observed. When well-defined segments of a survey fall into different order-and-class categories, the survey must be divided accordingly and the respective parts submitted as separate surveys.

State or Country Code: Provision is made on the \*10\* record to indicate the political unit(s) and/or geographic area(s) in which the gravity survey is located using the two-letter state or country codes given in ANNEX A. Up to three such codes may be entered, in the order of progress along the line in question. In the United States or in Canada, enter the appropriate code for the respective state, commonwealth, province, or territory. Elsewhere enter the appropriate code for the respective country, island group, or geographic area - see ANNEX A.

Survey Title: The use of geographic location alone as the title of a gravity survey has traditionally been the practice of the NGS and its predecessors. In general, the title by which the gravity survey is known to the submitting agency should be given, supplemented to reflect geographic location, as required. Omit punctuation marks (periods, commas, etc.) and parentheses whenever their omission can be tolerated, and use ANNEX A state and country codes whenever reference to a state or country is necessary. Furthermore, edit and abbreviate the title in the interest of fitting the entire title on the \*11\* Survey Title Record, if at all possible. However, up to three additional records (the \*12\*, \*13\*, and \*14\* Survey Title Continuation Records) may follow the \*11\* Survey Title Record if the title must be lengthy or when a main title followed by one or more subtitles is desired.

The geographic location of the survey should be descriptive of the route followed, i.e., the starting locality, any prominent "via" points, and the ending locality should be specified in the order of progress of the survey (Example: ALBANY GA VIA MORVEN TO CALLAHAN FL). If the survey is a member of a special project or of an area network to which a specific name or title has been assigned, such a name or title should be carried as a main title on the \*11\* record and the title of the survey proper should follow as a subtitle on one or more of the continuation records. Example:

- \*11\* Record: NAVD REGION I- NEW ENGLAND
- \*12\* Record: BOSTON MA TO BANGOR ME

## DATE AND TIME

The date of the GRAV OBS data set creation must appear on the Data Set Identification Record, and the dates on which survey operations commenced and



The \*20\* Instrument Information Record contains the data required to completely identify a gravity meter.

The \*21\* Instrument Calibration Header Record contains all of the information necessary to completely identify a calibration of a gravity meter. It is extremely important that a \*21\* record immediately precede the \*22\* records which it identifies.

The \*22\* Instrument Calibration Information Record contains the actual data used to calibrate the meter. This record contains a sequence of ordered pairs, counter reading/value in mgals. The first \*22\* record for a particular calibration must start with the lowest counter reading as the first entry and proceed sequentially until the entire calibration has been recorded. As many \*22\* records as are necessary to completely record a calibration may be used. In other words, there is no limit to how detailed or gross the calibration interval may be. The standard Table 1 interval (see fig. 10-2) for La Coste & Romberg G meters is 100 counter dial units. There is no requirements to maintain this interval or even to have the interval remain constant. It should be noted that, depending upon the instruments used as well as the intended order and class of survey, the \*21\* and \*22\* records may not be necessary.

The \*23\* Instrument Scale Factor Header Record contains all the information necessary to completely identify a scale factor determination and correlate that determination with a gravity meter. A \*23\* record must precede a \*24\* record and identify the information given in the \*24\* record.

The \*24\* Instrument Scale Factor Record defines a scale factor for a gravity meter and is related to the preceding \*23\* record.

The \*25\* Comment Record may be submitted anywhere within the \*20\* series records to denote changes from normal procedures or any information which might impact the quality of the data.

NGS Gravity Instrument (Meter) File: The purpose of the \*20\* series records is to provide input to a permanent computer file in which an historic record is maintained for each gravity meter ever used in a GRAV OBS data set submitted to the National Geodetic Survey. A record is established in this file, for an instrument, the first time it is encountered in the processing of a GRAV OBS data set. Thereafter, this file is updated when new information is submitted.

NGS Survey Equipment Code: A three-digit numeric identification code is assigned to each category of survey equipment, and within each category to specific instruments or other commonly used items. In particular, gravity instruments are assigned 001-029 survey equipment codes (see ANNEX F).

Instrument Serial Number: Assigned by the manufacturer, the serial number is the ultimate identifier of a specific instrument. Serial numbers are normally numeric; however, alphabetic characters are often used as prefixes, suffixes, etc. For this reason, a serial number must be treated as alphanumeric information to be entered in the respective character field left-justified and blank-filled on the right.

The instrument serial number will be used together with the respective survey equipment code (see above) to create appropriate entries in the NGS Gravity Instrument File, to maintain these entries up to date, and to access this file for the retrieval of the respective calibration data in the course of routine processing of GRAV OBS data sets. It is therefore of utmost importance that the respective serial number be faithfully reproduced and that identical serial number representation be used consistently whenever reference is made to that specific instrument in any GRAV OBS data set.

#### OBSERVATION DATA RECORDS

- \*30\* Land Observation Record (Running Record)
- \*32\* Marine Observation Record
- \*35\* Comment Record

The observation data records, identified by \*30\*-series data codes, are listed above. The block diagrams illustrating the respective formats are given in the FORMAT DIAGRAMS. The purpose of the \*30\*-series records is to provide the means to record the observations carried out during a loop. Recall that in relative gravimetry a loop is a unit of field work consisting of a number of survey points connected by observations. A gravity loop usually begins and ends at control points (Base Stations) where gravity is either known or will be determined in this survey. A survey consists of one or more gravity loops. The observational sequence within a loop is referred to as a "running".

Submit a \*30\* record for every land observation carried out during the survey, regardless of its field acceptance or rejection status, but indicate on the record if the observation has been rejected. The \*30\* records must be submitted in the order that the survey points were observed. Table 10-2 shows a possible Land Gravity Observation Data Set.

Submit a \*32\* record for every marine observation carried out during a survey, regardless of its field acceptance or rejection status, but indicate on the record if the observation has been rejected. The \*32\* records must be submitted in the order in which the gravity observations were observed (i.e. in the direction of the trackline). If more than one observation is carried out at the same time (i.e. by more than 1 meter) they may be submitted in any consistent order. \*30\* and \*32\* records must not be mixed in the same survey. In the case of base ties to harbor stations or alongside observations, the \*30\* record must be used. The \*32\* record is to be employed only for data taken at sea and for which the assignment of Survey Point Serial Numbers (SPSN) and Archive Cross Reference Numbers (ACRN) would not be appropriate. It is of course possible to have several surveys submitted at the same time, including both land and marine observations. Table 10-3 shows a possible data set structure which includes both land and marine observations.

Submit \*35\* record for any pertinent comments during a survey. Comments pertaining to severe weather conditions and equipment malfunction are considered appropriate.



TABLE 10-2  
STRUCTURE OF A LAND GRAV OBS DATA SET

Data Set Identification Record

*10* - Series Records		
*20* - Series Records		
*30* - Series Records	first	
*40* - Series Records	loop	
*30* - Series Records	second	First Survey
*40* - Series Records	loop	
::::	::::	
::::	::::	
*30* - Series Records	last	
*40* - Series Records	loop in	
*50* - Series Records	first survey	
*10* - Series Records		
*20* - Series Records		
*30* - Series Records	first	
*40* - Series Records	loop	
*30* - Series Records	second	Second Survey
*40* - Series Records	loop	(also last survey in this example)
::::	::::	
::::	::::	
*30* - Series Records	last	
*40* - Series Records	loop in	
*50* - Series Records	survey	

Data Set Termination Record

Survey Point Serial Number: For the purpose of identifying the survey points of each survey in a concise and unique manner (e.g., on the respective \*30\* records), each point that is observed is assigned a survey-specific serial number in the range of 0001 to 9999. See Chapter 9 for a detailed explanation of the survey point numbering system.

Height of Instrument (HI): For a land survey, the HI is defined to be the distance from the station mark to the instrument. For LaCoste & Romberg Model D and G gravity meters, this distance is measured to the bottom of the meter case.

TABLE 10-3  
STRUCTURE OF A COMBINED LAND & MARINE GRAV OBS DATA SET

Data Set Identification Record

*10*	Series Records	
*20*	Series Records	Land Observations (i.e. Base tie to shipboard gravity meter)
*30*	and *35* Records	
*40*	Series Records	
*50*	Series Records	
*10*	Series Records	Marine Observations (gravity observations taken along trackline)
*20*	Series Records	
*32*	and *35* Records	
*40*	Series Records	
*10*	Series Records	Land Observations (i.e. Base tie to shipboard gravity meter)
*20*	Series Records	
*30*	and *35 Records	
*40*	Series Records	
*50*	Series Records	

Data set termination Record

For a marine survey requiring the use of \*32\* records, the HI is defined to be the distance (vertically) above or below sea level to where the gravity meter is mounted. For La Coste & Romberg models meters, this distance is measured to the bottom of the stabilized platform "bucket" which houses the gravity meter sensor.

The manufacturer will determine the appropriate place to measure to in the case of other instruments. This location should be noted with a \*35\* record, and in all cases remain unchanged during a survey.

A negative sign (-) indicates that the bottom of the meter is located below the survey point (land observation) or sea level (marine observation).

Wind Code: A one-character numeric code, the purpose of which is to denote the approximate wind conditions prevailing during the course of the running. The three wind codes are:

- 0 - Wind speed less than 10 kilometers per hour
- 1 - Wind speed from 10 to 25 kilometers per hour
- 2 - Wind speed greater than 25 kilometers per hour

Sun Code: A one-character numeric code, the purpose of which is to denote the approximate conditions of illumination prevailing during the course of an observation. The three sun codes are:

- 0 - More than 75% cloud cover
- 1 - Between 25 and 75% cloud cover
- 2 - Less than 25% cloud cover

Temperature of Air: The air temperature is recorded in first order gravimetry. This temperature is recorded in tenths of Celcius degrees. 14.3 degrees C would be recorded as 143.

Atmospheric Pressure: The atmospheric pressure is recorded in first order gravimetry. This pressure is recorded in millibars. Pressures measured in other units should be converted to millibars. 1 mbar is approximately equal to .75006 mm Hg.

Reading Quality Indicator: A qualitative appraisal of the reading should be included with each \*30\* record. This appraisal or indicator should be the field person's best estimate of the reading quality. The following should be used as general guide in deciding the most appropriate indicator:

Reading Variability

Indicator	Subjective Criteria
0	Steady (normal)
1	Slight variation
2	Moderate variation
3	Excessive variation
9	Tare suspected

LOOP TERMINATION RECORDS

- \*40\* Loop termination Record
- \*45\* Comment Record

The Loop Termination Record (\*40\*) is the record required to identify the completion of a gravity loop. It serves no other purpose. There are no other fields besides the sequence number and data code fields.

A \*45\* comment record should be submitted for any pertinent comments about a loop.

STATION INFORMATION RECORDS

- \*50\* Station Information Record
- \*55\* Comment Record

The \*50\* Station Information Record correlates a specific Survey Point Serial Number (SPSN) used within the survey to a station designation or name by which the station or survey point is commonly referred as well as with the station position and elevation.

A \*50\* record must be submitted in the station information data section for each SPSN used in the observation data section of a survey. In addition, the \*50\* record allows the inclusion of an Archival Cross Reference Number (ACRN) if known.

A \*55\* comment record should be submitted for any pertinent comments about a station. Additional information about the station name or location is considered appropriate.

**Archival Cross Reference Number:** The Archival Cross Reference Number (ACRN) is a unique alphanumeric identifying code assigned to each vertical and gravity control point used in the NGS. The ACRN is not generally made available, as a matter of practice, to the public. Thus, the use of ACRNs are expected to be specific only to NGS.

**Designation:** A control point or bench mark is normally identified by a numeric or alphanumeric symbol which is stamped on the disk marker (or is otherwise inscribed on the bench mark monument) to which is appended the abbreviation or acronym (see Annex C) of the agency whose name is precast in the monument - if other than the National Geodetic Survey, National Ocean Service, or Coast and Geodetic Survey (see Origin). For marks not having a precast agency name, append the acronym or abbreviation of the agency which set the mark (see Setting-by-Agency). If the agency cannot be determined, do not append an agency acronym or abbreviation. Less frequently, a bench mark is assigned a concise, intelligible name (e.g., when a horizontal control point also becomes a bench mark); the appropriate acronym or abbreviation should be appended to these also. A maximum of 25 characters (including all imbedded blanks) is allowed.

In every case, the survey point designation entered on the \*50\* record must be identical to the (primary) designation used to identify the same gravity control point in the companion GRAV DESC data set of the gravity control job - refer to Chapter 7. Use the same general guidelines for the designations of any survey points which lack descriptive data (e.g., undescribed temporary survey points which may have to be carried in the GRAV OBS data set but which do not appear in the companion GRAV DESC data set, i.e. Drift Station).

#### FORMAT DIAGRAMS

For each record which appears in a GRAV OBS data set (see Table 10-1), 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 (standard punched card image).
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 graphic image of the respective record.
4. Within the limits of available space, information and instructions concerning the data item to be entered in each data field are provided on the format diagrams to render them self-explanatory.
5. When appropriate, sample entities are shown in the data entry line of each format diagram.
6. Each data field is characterized as to its type by a string of lower-case characters which appear immediately below the data entry line.

### Date Field Types:

1. Alpha Field (aa...a) - intended for a data item which is coded as a string of alphabetic, numeric, and special characters, with or without imbedded blanks, to be entered into the respective data field left-justified and blank-filled on the right. See Chapter 9 for a list of special characters which are allowed.
2. Blank Field (bb...b) - to be blank-filled. Data fields which are designated as blank fields must be left blank, i.e., no date items may be entered in these fields.
3. Floating-Point Field (ff...fdd...d) - intended for a data item which is coded as a decimal number, i.e., as a string of numeric characters (prefixed with a minus sign if the number is negative) which 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 the decimal point is not coded, the "f" portion of the floating-point field is to contain the integer part of the decimal number, and the "d" portion the corresponding decimal fraction part, the decimal point being implied between the rightmost "f" column and the leftmost "d" column of the field.

Accordingly, a string of numeric characters representing m integer digits followed by n decimal fraction digits with the decimal point absent must be positioned in the floating-point field in such a manner that its integer part falls into the m rightmost "f" columns, and its decimal fraction part into the n leftmost "d" columns, with any unused "d" columns filled with zeros and any unused "f" columns either filled with blanks or zeros. When a negative number is entered, code the minus sign immediately preceding the leading digit.

4. Integer Field (ii...i) - intended for a data item which is coded as a string of numeric characters representing a positive or negative integer number, to be entered into the respective data field right-justified. In the case of a positive integer number, blank-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.
5. Specific Character Field (ss...s) - intended to contain a specific alphabetic, numeric, special character, or a specific group of characters. Every "s" column of a specific character field must contain the character shown in that position in the data line of the respective format diagram.

Required Data: In general, only those records which are applicable to the data at hand should be included in a GRAV OBS data set. The character fields intended for data items which are essential have been shaded on the format diagrams; if applicable to the data being coded, these character fields must be in accordance with the instructions given on the respective format diagrams or in the text of this chapter. Records which are optional or those which may be omitted under certain circumstances are clearly designated in the headings, footnotes, or bodies of the corresponding format diagrams.

00000000111111112222222222333333333344444444445555555555666666666677777777778  
12345678901234567890123456789012345678901234567890123456789012345678901234567890

000010\*AZ\*GRAVOBS NGS NATIONAL GEODETIC SURVEY 19840906  
000020\*10\*PO2645 1984031919840320 12AZ LMJNGS  
000030\*11\*ARIZONA LAND SUBSIDENCE PROJECT  
000040\*15\*GPS & LEVELING ALSO RUN ALONG SAME LINES  
000050\*20\*O14G081 LACOSTE G-METER NGS  
000060\*21\*G081 LACOSTE AUSTIN TEXAS 1  
000070\*25\*ONLY SUFFICIENT TABLE I VALUES FOR THIS SURVEY SUBMITTED  
000080\*22\*2500000257235026000002675370270000027784002800000288143029000002984470  
000090\*22\*3000000308752031000003190590320000032936703300000339677034000003499890  
000100\*23\*G081 78 LACOSTE  
000110\*24\*1.000259  
000120\*20\*O15D043 LACOSTE D-METER NGS  
000130\*23\*D043 81 LACOSTE  
000140\*24\*1.2424  
000150\*30\* 802 OG081 18403191515 292531002LMJ10423802  
000160\*30\* 802 OD043 8403191530 10005502LMJ10423802  
000170\*30\* 001 20G081 18403191559 293614002LMJ16423602  
000180\*30\* 001 20D043 8403191610 10904402LMJ16423602  
000190\*30\* 002 20G081 18403191623 294185002LMJ16523402  
000200\*30\* 002 20D043 8403191625 11380302LMJ16523402  
000210\*30\* 003 70G081 18403191640 294705002LMJ17623402  
000220\*30\* 003 70D043 8403191650 11798002LMJ17623402 R  
000230\*35\*THIS WAS A BAD READING. OBSERVATION BEING REPEATED  
000240\*30\* 003 70D043 8403191650 11799002LMJ17623402  
000250\*30\* 802 OG081 18403200057 292523002LMJ25525202  
000260\*30\* 802 OD043 8403200105 10003602LMJ25525202  
000270\*40\*  
000280\*45\*FIRST HALF OF LADDER SEQUENCE FINISHED  
000290\*30\* 802 OG081 18403201549 292531002LMJ19524802  
000300\*30\* 802 OD043 8403201601 10007902LMJ19524802  
000310\*30\* 002 20G081 18403202124 294165002LMJ30725502  
000320\*30\* 002 20D043 8403202132 11366502LMJ30725502  
000330\*30\* 003 65G081 18403202155 294685002LMJ33025802  
000340\*30\* 003 65D043 8403202203 11796002LMJ33025802  
000350\*30\* 001 20G081 18403202211 293583502LMJ31525802  
000360\*30\* 001 20D043 8403202220 10886102LMJ31525802  
000370\*30\* 802 OG081 18403202247 292509002LMJ31126002  
000380\*30\* 802 OD043 8403202253 09991302LMJ31126002  
000390\*40\*  
000400\*50\* 802AN 51 CZ1510 3246360C 11136000C 463743I  
000410\*55\*AN 51 IS THE BASE STATION FOR THIS SURVEY  
000420\*50\* 001X 278 CZ1034 3247480C 11137360C 457681I  
000430\*50\* 002AL 49 USE CZ1031 3248240C 11138060C 453266I  
000440\*50\* 003Q 363 CZ1032 3249180C 11138060C 456558I  
000450\*AZ\*

00000000111111112222222222333333333344444444445555555555666666666677777777778  
12345678901234567890123456789012345678901234567890123456789012345678901234567890

FIGURE 10-1 - Example of OBS Date Set

TABLE I

Milligal Values for LaCoste & Romberg, Inc. Model G Gravity Meter #130

Counter Reading*	Value in Milligals	Factor for Interval	Counter Reading*	Value in Milligals	Factor for Interval
000	000	1.04980			
100	104.98	1.04970	3600	3778.37	1.05025
200	209.95	1.04960	3700	3883.39	1.05040
300	314.91	1.04950	3800	3988.43	1.05030
400	419.86	1.04935	3900	4093.46	1.05040
500	524.80	1.04925	4000	4198.50	1.05045
600	629.73	1.04915	4100	4303.55	1.05055
700	734.64	1.04910	4200	4408.60	1.05065
800	839.55	1.04905	4300	4513.67	1.05075
900	944.46	1.04905	4400	4618.74	1.05080
1000	1049.36	1.04903	4500	4723.82	1.05085
1100	1154.26	1.04900	4600	4828.91	1.05090
1200	1259.17	1.04905	4700	4934.00	1.05090
1300	1364.07	1.04905	4800	5039.09	1.05085
1400	1468.97	1.04905	4900	5144.17	1.05085
1500	1573.88	1.04910	5000	5249.26	1.05075
1600	1678.79	1.04915	5100	5354.34	1.05080
1700	1783.70	1.04920	5200	5459.42	1.05085
1800	1888.62	1.04925	5300	5564.50	1.05080
1900	1993.55	1.04940	5400	5669.58	1.05075
2000	2098.49	1.04950	5500	5774.66	1.05060
2100	2203.44	1.04955	5600	5879.72	1.05050
2200	2308.39	1.04965	5700	5984.77	1.05040
2300	2413.36	1.04970	5800	6089.81	1.05025
2400	2518.33	1.04975	5900	6194.84	1.05010
2500	2623.30	1.04975	6000	6299.85	1.05000
2600	2728.28	1.04980	6100	6404.84	1.04985
2700	2833.26	1.04985	6200	6509.83	1.04965
2800	2938.25	1.04995	6300	6614.79	1.04940
2900	3043.24	1.05005	6400	6719.73	1.04915
3000	3148.25	1.05010	6500	6824.65	1.04885
3100	3253.26	1.05015	6600	6929.53	1.04855
3200	3358.27	1.05020	6700	7034.39	1.04820
3300	3463.29	1.05025	6800	7139.21	1.04785
3400	3568.32	1.05025	6900	7243.99	1.04750
3500	3673.34	1.05025	7000	7348.74	

NOTE: Right hand wheel on counter indicates approximately 0.1 milligal.

FIGURE 10-2 - Example of LaCoste & Romberg Internal Values

Data Set Identification Record. This must be the first record of every data set submitted. A data set may be submitted either as a deck of cards or as a magnetic tape file containing formatted records. Magnetic tape is preferred; use punched cards for small, isolated jobs only.

0000000011111111122222222233333333334444444445555555556666666667777777778 1234567890123456789012345678901234567890123456789012345678901234567890													
<p><u>Date Data Set Created</u> (e.g. date this record keyed) Century, year, month, day (CCYYMMDD). If day is unknown, leave last columns blank. If month is unknown, leave last four columns blank.</p>													
<p><u>Name of Submitting Agency or Firm</u></p>													
<p><u>Full Name</u></p>													
<p><u>Abbreviation</u> - must be unique. Enter the symbol listed in ANNEX C. See footnote for other agencies or firms</p>													
<p><u>Data Set Identification</u></p>													
<p><u>Data Type</u> - OBS for field observation data.</p>													
<p><u>Data Class</u> - GRAV for Gravity control data.</p>													
<p><u>Job Code</u> - preceded and followed by asterisk.</p>													
<p><u>Sequence Number</u> - must be 000010 on this record. Increment by 10 on successive records to allow for insertions.</p>													
000010	*CA*	GRAV	OBS	USGS	US	GEOLOGICAL	SURVEY						19820512
iiii	saas	aaaa	aaaa	aaaa	aaaa	aaaa	aaaa	aaaa	aaaa	aaaa	aaaa	aaaa	iiii
000000	0001	1111	1111	122222	22223333	33334444	44445555	55556666	66667777	77778888	88889999	9999	77777778
123456	7890	1234	5678	9012	3456	7890	1234	5678	9012	3456	7890	1234	567890

Important: To insure uniqueness, agencies or firms not listed in ANNEX C must have their proposed abbreviation symbol accepted by NGS prior to first submittal of data - see ANNEX K.





\*11\* Survey Title Record and \*12\*, \*13\*, \*14\* Survey Title Continuation Records (Optional).  
 Use the \*11\* record to give the title of the survey (or of area network or special project of which the survey is a part) and the \*12\*, \*13\*, \*14\* records for continuation and/or subtitles, if any.

000000001111111122222223333333344444445555555666666677777778 123456789012345678901234567890123456789012345678901234567890	<p><u>Survey Title</u> - use *12*, *13*, *14* Survey Title Continuation Record(s) as required if the title exceeds 70 characters or if subtitles are necessary (e.g. the title of an area network followed by title of the line).</p> <p>The title of a survey line should be descriptive of the route followed, i.e., it should indicate the starting and ending locations and prominent "via" points, if any (Example: ALBANY GA VIA MORVEN TO CALLAHAN FL).</p> <p>Do not divide words (or other character groups) between the *11*, *12*, *13*, *14* Survey Title and Survey Title Continuation Records. Omit punctuation marks (periods, commas, etc.) and parentheses whenever possible. Use ANNEX A state and country codes whenever reference to a state or country is necessary.</p> <p>Abbreviate and/or edit a Survey title in the interest of fitting the entire title on the *11* Survey Title Record, if possible.</p>	nnnnnn*11* REOBSERVATIONS OF GRAVITY STATIONS FOR EARTHQUAKE STUDIES, CA nnnnnn*12* WISTER SOUTH TO COLEXICO, DIXIELAND EAST VIA EL CENTRO TO HOLTVILLE iiiiii 000000001111111122222223333333344444445555555666666677777778 123456789012345678901234567890123456789012345678901234567890
Data Code *11*, *12*, *13*, *14* Survey Title Records		
Sequence Number Increment by 10 on successive records to allow for insertions.		

\*15\* Comment Record (Optional). Use this record for any comments pertinent to the survey. If the comment(s) exceed 70 characters, use another \*15\* record for continuation, any number of \*15\* records is allowed. Do not divide words between consecutive \*15\* records.

00000000111111112222222233333333444444445555555666666677777778 123456789012345678901234567890123456789012345678901234567890	Comment
00000000111111112222222233333333444444445555555666666677777778 123456789012345678901234567890123456789012345678901234567890	Data Code (*15* - Comment Record)
00000000111111112222222233333333444444445555555666666677777778 123456789012345678901234567890123456789012345678901234567890	Sequence Number Increment by 10 on successive records to allow for insertions.
nnnnn*15*LEVELS OBSERVED OVER THIS SURVEY iiiiiiisaa 00000000111111112222222233333333444444445555555666666677777778 123456789012345678901234567890123456789012345678901234567890	nnnnn*15*LEVELS OBSERVED OVER THIS SURVEY iiiiiiisaa 00000000111111112222222233333333444444445555555666666677777778 123456789012345678901234567890123456789012345678901234567890













\*25\* Comment Record (Optional). Use this record for any comments pertinent to an instrument. If the comment(s) exceed 70 characters, use another \*25\* record for continuation, any number of \*25\* records is allowed. Do not divide words between consecutive \*25\* records.

00000000111111112222222233333333444444445555555566666666777777778888888899999999			
1234567890		<p><u>Sequence Number</u> Increment by 10 on successive records to allow for insertions.</p>	<p><u>Data Code</u> (*25* - Comment Record)</p>
<p>iiiiiii 000000 1234567890</p>	<p>iiiiiii *25* iiiiiii 000000 1234567890</p>	<p>TABLE I VALUES WILL BE VERIFIED AFTER THIS SURVEY</p>	<p>iiiiiii 000000 1234567890</p>



\*32\* Marine Observation Record. - Submit this record for every observation taken aboard ship. A separate \*32\* record is required for each instrument used. Any instrument may be indicated on the \*32\* record providing \*20\*, \*23\*, and \*24\* records for that instrument have been recorded prior to the \*32\* record.

0000000001	1111111111	2222222222	3333333333	4444444444	5555555555	6666666666	7777777777	8888888888	9999999999	0000000000	
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	
Acceptance Criteria - Reject obs if "N". Accept if blank.											
Reading of Instrument - Decimal implied between column 75 and 76.											
Time of Reading - hours, minutes, seconds (HHMMSS)											
Date of Reading - year, month, day (YYMMDD)											
Height of Instrument (HI) - (mm) - See text.											
Depth Accuracy Code											
Depth - (MMMM.m) - Depth of bottom surface below sea level. Decimal implied between columns 48 and 49.											
Longitude Accuracy Code											
Longitude - ( $\pm$ DDMMSSs) - Same as *50* record. Decimal implied between column 39 and 40.											
Latitude Accuracy Code											
Latitude - ( $\pm$ DDMMSSs) - Same as *50* record. Decimal implied between column 29 and 30.											
Instrument Calibration Serial Number - See footnote											
Instrument Serial Number - Same format as *30* record.											
Data Code (*32* - Marine Observation Record)											
Sequence Number Increment by 10 on successive records to allow for insertions.											
nnnnnn	*32*	551	10	2045530	J	13015455	J	24334K	5100860829	080110	2730440
iiiiii	iiiiii	iiiiii	iiiiii	iiiiii	iiiiii	iiiiii	iiiiii	iiiiii	iiiiii	iiiiii	iiiiii
000000	0001	111111	122222	222233	333334	444445	555556	666667	777778	888889	999990
123456	7890	123456	7890	123456	7890	123456	7890	123456	7890	123456	7890

Accuracy Codes (Depth, Latitude, Longitude)		
Accuracy Range (Meters)		
Low	Code	High
-	J	1
1	K	10
10	L	25
25	M	50
50	N	100
100	O	200
200	P	300
300	Q	500
500	R	-

Instrument Calibration Serial Number - Must correspond with Calibration Information provided in \*21\* and \*22\* records.

\*35\* Comment Record (Optional). Use this record for any comments pertinent to the observation. If the comment(s) exceed 70 characters, use another \*35\* record for continuation, any number of \*35\* records is allowed. Do not divide words between consecutive \*35\* records.

00000000111111112222222233333333444444445555555566666666777777778888888899999999			
1234567890123456789012345678901234567890123456789012345678901234567890			
	<u>Sequence Number</u> Increment by 10 on successive records to allow for insertions.	<u>Data Code</u> (*35* - Comment Record)	<u>Comment</u>
nnnnnn*35*	NECESSARY TO CHANGE BATTERY AT 1435 HRS GCT		
iiiiiiiis	iiiiiiiis	iiiiiiiis	iiiiiiiis
00000000111111112222222233333333444444445555555566666666777777778888888899999999			
1234567890123456789012345678901234567890123456789012345678901234567890			

\*40\* Loop Termination Record. This must be the last record of each gravity loop within every data set submitted.

00000000111111112222222233333333444444445555555566666666777777778888888899999999		
1234567890123456789012345678901234567890123456789012345678901234567890		
	Data Code (*20* - Loop Termination Record)	nnnnn*40*
	Sequence Number Increment by 10 on successive records to allow for insertions.	iiiiis
		bb
00000000111111112222222233333333444444445555555566666666777777778888888899999999		
1234567890123456789012345678901234567890123456789012345678901234567890		

\*45\* Comment Record (Optional). Use this record for any comments pertinent to the loop. If the comment(s) exceed 70 characters, use another \*45\* record for continuation, any number of \*45\* records is allowed. Do not divide words between consecutive \*45\* records.

0000000011 1234567890	1111111122222222333333334444444455555555666666667777777788 123456789012345678901234567890123456789012345678901234567890	
	Comment	
	Data Code (*45* - Comment Record)	
	Sequence Number Increment by 10 on successive records to allow for insertions.	
nnnnnn	*45* CHECK THIS LOOP	
iiiiis	aa	
0000000011 1234567890	1111111122222222333333334444444455555555666666667777777788 123456789012345678901234567890123456789012345678901234567890	







Data Set Termination Record. This must be the last record of every data set submitted.

00000000111111112222222233333333444444445555555566666666777777778888888899999999  
 123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890

Data Set Structure: a GRAV OBS Data Set consists of one or more gravity surveys. A gravity survey consists one or more gravity loops.

Data Set Identification Record	
*10* - series records *20* - series records *30* - series records *40* - series records *50* - series records	FIRST SURVEY
*10* - series records *20* - series records *30* - series records *40* - series records *50* - series records	SECOND SURVEY
:::: ::::	:::: ::::
*10* - series records *20* - series records *30* - series records *40* - series records *50* - series records	LAST SURVEY
Data Set Termination Record	

Job Code - preceded and followed by asterisk.

Sequence Number  
 Increment by 10 on successive records to allow for insertions.

nnnnn\*CA\*

iiiiisaas

00000000111111112222222233333333444444445555555566666666777777778888888899999999

1234567890123456789012345678901234567890123456789012345678901234567890

bb  
 00000000111111112222222233333333444444445555555566666666777777778888888899999999  
 12345678901234567890123456789012345678901234567890123456789012345678901234567890