

CHAPTER 9

GRAVITY CONTROL (GRAV) DATA

INTRODUCTION

For coding and processing purposes, the data associated with geodetic gravity control (GRAV data) have been divided into three groups. The three gravity control data groups are (1) the field observations of gravity data between survey points, i.e., counter dial readings (OBS data), (2) descriptive data including original and recovery descriptions (DESC data), and (3) adjusted gravity values (ADJU data). Detailed instructions and formats for the coding and keying of the OBS, DESC, and ADJU gravity control data sets are contained in Chapters 10, 7, and 11, respectively. The formats and specifications for the keying of GRAV DESC data are identical to those used for VERT DESC data.

Although all three data types are normally generated in connection with each gravity control survey project, OBS, DESC, and ADJU data must be submitted to the National Geodetic Survey as separate data sets. There are two modes in which gravity control data may be submitted to the National Geodetic Survey. In order of preference, they are:

MODE 1 - Field Observations and Descriptive data
(GRAV OBS and GRAV DESC data)

MODE 2 - Adjusted Gravity Data (GRAV ADJU data)

The foregoing implies that every gravity control survey project (or several projects submitted as one "job" - see below) will be received at the National Geodetic Survey as one of two distinct data sets: either OBS and DESC data sets under mode 1, or ADJU data under mode 2. The data sets of each gravity control job must be submitted at the same time. There are distinct benefits to be realized when gravity control data intended for insertion in the gravity data base are submitted in the mode 1 configuration. Because the field observations which connect the survey points are given, mode 1 data can be rigorously examined and edited if necessary. This process insures that the values of the new survey points will be consistent with the existing gravity control in that area.

By contrast, mode 2 data consist of isolated points whose final adjusted gravity values are submitted. Because the connecting observations are not available, these adjusted values cannot be fully verified.

Mode 2 data are not entered into the National Geodetic Survey gravity data base. This type of data is entered into the NGS gravity working file. The format for ADJU data must conform with the specifications in Chapter 11.

The distinction between the gravity data base and the working file is thus made. The gravity data base contains values for control points whose accuracy and descriptions are verifiable by NGS. The working file contains values for survey points which are not fully verifiable by NGS and/or for which descriptions do not exist within the NGS.

JOB CODE AND SURVEY POINT NUMBERING

The basic unit or grouping of data to be submitted is given the name "job". A gravity control job may consist of data for a maximum of 9999 OBS data stations or an unlimited number of ADJU stations. A job may consist of a single survey (i.e., one unit of field work), or a number of surveys may be included in one job. It is suggested that geographic proximity be the determining factor in selecting gravity control surveys for inclusion in any one job. A gravity "control point" (base station) is defined as a survey point which is monumented (or otherwise permanently marked), described and whose (adjusted) gravity value is known. A gravity control point may be a National Geodetic Survey vertical control "bench mark" (BM) but usually is not. A "survey point", in turn, is defined as any point which has one or more gravity differences measured to it or from it. A survey point may or may not have an accompanying description.

A "loop" is the basic component of any gravity control survey. A loop consists of a sequence of gravity observations which begins on a gravity control point and ends on a gravity control point. There are three common types of loop sequences:

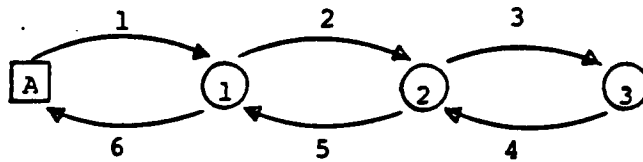
1. Ladder Sequence
2. Modified Ladder Sequence
3. Line Sequence

The ladder sequence loop begins and ends at the same control point. The survey points are observed twice during the loop. The return portion is run opposite to the forward run. This loop sequence is often used for scale factor determinations or high accuracy network densification.

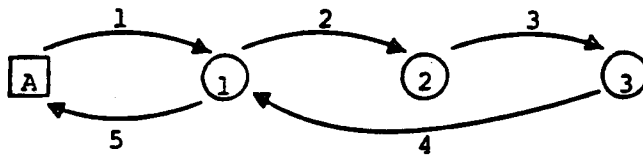
The modified ladder sequence loop also begins and ends at the same control point. However, not all the survey points are observed twice during the loop.

The line sequence loop begins at a control point and ends at a different control point. The survey points are often only observed once.

Figure 9-1 illustrates each of the loop sequences.

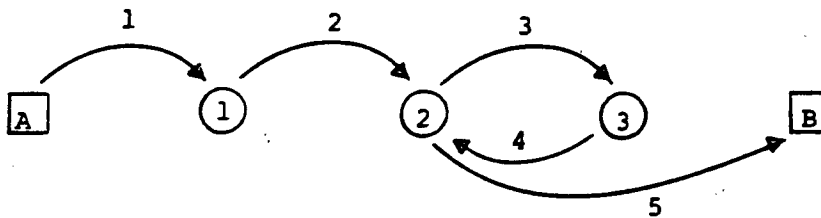


A. Ladder Sequence Loop (A-1-2-3-2-1-A for lines, A-B-C-B-A for Base Station Ties)



Reobserve at least 1 intermediate station.

B. Modified Ladder Sequence Loop (A-1-2-3-1-A)



C. Line Sequence Loop (A-1-2-3-2-B)

KEY:

□ = Control point (base station where the gravity value is known or is tied directly to a known base station)

○ = Survey points on which gravity values are to be established.

↔ = Observing sequence and direction.

Figure 9-1 Examples of Loop Sequences

A two-character alphanumeric code must be assigned to each gravity control job submitted by an agency in accordance with this publication. This job code, the data set type, the name of the submitting agency, and the data set creation date will serve to uniquely identify every data set received by NGS. The first character of the two-character job code must always be a letter; the second character may be either a letter or a number (1 through 9). Begin the assigning of job codes with A1 and end with ZZ, i.e., A1, A2, ..., B1, ..., Z1, ..., ..., Z9, AA, AB, ..., ZZ. This allows a total of 910 uniquely identified job codes to be submitted by any one agency. Should this sequence be exhausted, start assigning job codes again from the beginning: A1, A2, etc.

Each survey point that is observed and each control point used in a gravity control job must be assigned an unique four-digit serial number (not necessarily consecutive) in the range 0001 through 9999. If known, the point must also be identified by its Archive Cross Reference Number (ACRN). If the number of survey points exceeds 9999, the gravity control data in question must be divided and submitted as two or more jobs. If possible, gravity surveys should not be subdivided. The same survey point serial number (SPSN) must be consistently used whenever reference is made to the same point in either the OBS, DESC, or ADJU data sets of a gravity control job. All control points for which recovery descriptions are written in this current survey, but which are not observed in this current survey, will be assigned the SPSN code 0000.

MEDIA FOR SUBMITTING DATA

At present, the only computer readable media acceptable to the National Geodetic Survey on a routine basis is standard 9-track magnetic tape. Magnetic tape is the preferred medium for both small and large volumes of data: agencies submitting large volumes of data should use this medium exclusively. Printed data may be accepted by NGS only for very small, isolated jobs on a case-by-case basis.

The following information must be given for each data set submitted as printed data:

1. Name and address of the submitting agency.
2. Description of the contents of the printed sheets by data type.
3. Name and telephone number of person to be contacted in case of difficulty with the data.

This information should be given in a letter of transmittal, a copy of which should be packed with the data in question.

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

1. Name and address of the submitting agency.
2. Reel number or identification symbol assigned by submitting agency.
3. Number of files and a description of each file and data type.

4. Computer system on which the tape was created (e.g., IBM 360/XXX, CDC 6600, etc.).
5. Internal label information (non-labeled).
6. Number of tracks (9) and parity (even or odd).
7. Recording density (800, 1600, or 6250 BPI).
8. Record length (80) and block size.
9. Character representation code (ASCII).
10. Name and telephone number of person to be contacted in case of difficulty with the data.

In addition to being given in the respective letter of transmittal, this information should be entered on one or more "stick-on" labels affixed to the magnetic tape reel.

A letter of transmittal in which the data are described and itemized should always be prepared for each data shipment. One copy should be enclosed with the data shipment, one sent by mail to the National Geodetic Survey, and another copy should be retained by the sender. See ANNEX K for the current mailing instructions. In every case, the submitting agency should retain a back-up of all data included in a shipment until the specific data have been successfully read by the National Geodetic Survey.

CODING, KEYING, AND DATA VERIFICATION

All data submitted to the National Geodetic Survey must be coded and keyed in strict conformity with the formats and specifications contained in this publication. In addition, the keying of all data must be verified. Detailed formats and specifications for the coding and keying of gravity control jobs are contained in Chapter 10 (GRAV OBS data), Chapter 7 (VERT DESC data), and in Chapter 11 (GRAV ADJU data). The formats were designed to allow the keying and verification of the data to be accomplished on standard equipment. The 80-character record (card image format) has been adopted for all applications.

In keying the data entries, care must be taken to ensure that alphabetic characters (letters) are always keyed using the alphabetic keys on the keying device, and that numeric characters (numbers) are always keyed using numeric keys. In particular, the miskeying of the following characters must be avoided:

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

SPECIAL CHARACTERS

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

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

NOTE: A restriction on characters is imposed for the designations of survey points (see ANNEX D).

SEQUENTIAL RECORD NUMBERING

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

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

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