This document has been converted from the original publication:

Morgan, J. G., Spradley, L. H., Worthington, G. A. and McClelland, I. J., 1983, Special report on SEG standard exchange formats for positional data: Geophysics, 48, no. 04, 488-503.

SEG standard exchange formats for positional data[1]

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ABSTRACT

Standard data exchange formats are introduced for the transfer of navigation and survey data on digital tape. The four interrelated formats presented are as follows:

(1) **Postplot location data exchange format** – This is the principal format which involves the exchange of shotpoint locations.

(2) **Marine positioning field data exchange format** – This format is concerned with the exchange of field-acquired marine positioning (navigation) data.

(3) **Land survey field data exchange format** – This format is concerned with the exchange of land survey measurement data.

(4) **Doppler satellite field data exchange format** –This format is concerned with satellite data in a form to permit a fix recomputation.

Data exchanged via formats 2, 3, and 4 would be used to recompute the shotpoint base maps normally transmitted via format 1. Although the formats were designed for seismic surveying, they may have application in other areas of geophysics.

The standards have been deliberately termed "exchange formats" since the variety of proprietary acquisition, processing, and archival formats within the industry precludes standardization. However, in the future the formats presented here will provide the basis for all industry systems so that reformatting is not required for data exchange.

The formats are sufficiently flexible to accommodate those new techniques which might reasonably be expected to be in production during the next decade.

INTRODUCTION

There are many formats for the transfer of positional data between companies involved in seismic exploration. This report describes four related formats developed by the SEG

Developed by the SEG Subcommittee on Potential Fields and Positioning Standards.
Manuscript received by the Editor December 8, 1982.

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Subcommittee on Potential Fields and Positioning Standards. All explorationists involved with the acquisition, processing, or interpretation of seismic data should be aware of these standards and should encourage their widespread use.

The formats are concerned with the exchange of postplot shotpoint locations, with marine radiolocation and acoustic data, with land survey observational data, and with Doppler satellite data. By postplot, we mean those computed locations which are the best estimates of where geophysical data points were in the field (e.g., shotpoints). The postplot locations are derived from field data by processes of varying complexity. Under most circumstances, the exchange of postplot data is sufficient to permit the construction of a reliable base map. However, there are times when the shotpoint locations may be suspect, so that reprocessing the field acquired data may be desirable. In this case, the marine, land, or Doppler satellite raw data would be exchanged using the standard formats.

The benefits of standardization are many. Three important reasons justifying the widespread adoption of these formats are concerned with eliminating seismic mis-ties, speeding up the archival and mapping process, and unambiguous contract specifications. Most seismic interpreters have experienced a mis-tie problem at one time or another. In many circumstances these mis-ties are caused by shotpoint positioning errors. Most positioning systems have an inherent accuracy or repeatability which may be quoted by the survey contractor; however, positioning errors are often significantly greater after base maps have been produced and the seismic data are loop tied. In many cases, the source of the error is not poor field performance by a contractor, but rather misunderstandings and lack of adequate documentation after retrieving and exchanging survey information. The data exchange formats presented here provide the necessary information to avoid many mis-ties in the future.

The use of digital data bases containing positional information has proliferated in recent years. Similarly, rapid advances in computer mapping technology have provided the means to produce position base maps at an unprecedented rate. Even so, it is sometimes difficult to keep up with the demands of seismic interpreters, especially when position data are exchanged or traded in a bewildering variety of formats, often with insufficient explanation. Standardized data exchange formats will permit the streamlining of retrieval and mapping procedures.

Although this report may be of general interest to many geophysicists, it is aimed at those specialists in navigation and surveying operations together with their data processing and mapping colleagues. It is assumed, therefore, that the specialist reader is familiar with much of the terminology used here; consequently, explanation will be minimal. A bibliography is included for those who wish to pursue the subject further. For example, the use of the term UTM is commonly abused. The publication by the Joint Committee of the American Congress on Surveying and Mapping and the American Society of Civil Engineers should provide a clear definition.

Finally, and maybe most importantly for the adoption of these standards, we appeal to managers and contract implementers in the industry. It is our hope that in the future geophysical contracts will simply specify the formats described here as SEG P1 (1983), etc., and this will be understood by all concerned to mean the appropriate parts of the SEG Standard Positioning Formats published in 1983. By this means, widespread use of the standard formats will be greatly encouraged.

THE DATA EXCHANGE FORMATS

General

The four data exchange formats themselves, along with coded card image examples of their use, appear in Appendices A through D. The purpose of this section is to provide more description and comments for each one. It can be seen that items 1, 2, and 3 in the Appendices are an identical set for all formats. This redundancy was considered necessary to preserve each format as a separate entity which may be extracted and used on its own.

Later it will become clear that it is imperative to describe the data block parameters adequately. This is achieved by free format coding in the header blocks. We emphasize that the suggested entries in the header blocks described and shown in the examples in the Appendices are minimum requirements. It is far better to have excess information than insufficient description to be able to produce a map.

Three-dimensional (3-D) seismic surveying is becoming more common, and vast amounts of positioning data need to be stored. The committee examined this problem and concluded that the present formats are sufficiently flexible to accommodate the requirements of 3-D work.

Within the data exchange formats, those designated for use with Doppler satellite data records and those for land survey data are least familiar to persons who have previously worked with automatic processing of positional information. As a result, the number of questions received by the committee indicates a need for some amplification of the use of data fields within these two formats. Therefore, the format descriptions have been expanded to include several types of records which fall within the flexible usage of the formats as defined.

Postplot location data exchange format

This format is designated SEG P1 (1983).

The purpose of this tape format is to provide a means by which positioning data can be permanently stored after processing. It is envisaged that such a tape will become a standard part of the data to be furnished by a contractor upon the completion of a seismic survey, and that it will also be routinely exchanged between operators as part of a seismic purchase or trade agreement.

Once the use of the format is established in the industry, the addition of new data to an operator's data base will be possible with no further changes to existing software.

The format is designed to be applicable to both land and marine locations, and to have sufficient flexibility for use in 3-D seismic surveys. By lengthening the data record, other geophysical information such as gravity and/or magnetic data could be accommodated.

Marine positioning field data exchange format

This format is designated SEG P2 (1983).

It is emphasized that the marine positioning field data exchange format is an exchange format. It is not expected, nor would it be practical, for existing field systems to be modified immediately to accommodate this format. We anticipate that companies within the geophysical industry will use this format to exchange marine positioning field data and that the proposed format may be used for archival data storage. However, developers of future marine navigation (positioning) systems are encouraged to adopt this format because they will find that most, if not all, of the pertinent navigation information required of a marine geophysical survey is included. Furthermore, there is sufficient flexibility in the format for expansion to accommodate additional data. By adopting this format for a field system, a data tape can be merely copied for exchange or storage and the intermediate step of reformatting the data is eliminated.

Land survey field data exchange format

This format is designated SEG P3 (1983).

General information. – The procedures used in land surveying in the geophysical industry are quite varied, particularly in the United States where there is a mixture between plane table methods and angular survey techniques. In the past, the primary medium for conveying horizontal locations has been the plotted positions on a map, while the vertical part of the survey has been reduced to numeric form as a listing of elevations. Current trends in computer plotting and digital data base systems have created increasing demand for land survey in coordinates rather than in direct mapping. In spite of the differences in instrument type, the basic measurements made in the field consist of a horizontal and vertical angle, a distance measurement and a rod reading or target height.

Data exchange format. – The data exchange format for land survey data has been constructed to accommodate the broadest range of instrument and measurement methods, while staying within the labeling and header structures of the other formats. The information contained within the land survey observations can permit full recomputation of the survey, if later surveys or line ties prove the original coordinates to be in error.

Doppler satellite field data exchange format

This format is designated SEG P4 (1983) and has been constructed to accommodate all known dual-frequency satellite radio receivers which are capable of receiving signals from the U.S. Navy Navigation Satellite System (also known as Transit). The information contained within the SEG P4 (1983) format will allow recomputation of satellite Doppler position fixes. The format does not conform with any format of individual equipment manufacturers but provides a standard format for data exchange. Equipment manufacturers and purveyors of integrated satellite navigation systems are encouraged to adopt this format for field data recording in the future.

SUMMARY

The four SEG standard positioning data exchange formats, SEG P1 (1983) through SEG P4 (1983) described in detail in the Appendices, have been developed by the SEG Subcommittee on Potential Fields and Positioning Standards. It is recognized that changing technology will necessitate changes in these standards in the future. Suggestions for periodic revisions should be addressed to the above SEG committee. It is expected that revisions will not be made at intervals of less than two years.

In addition, since the SEG is committed to the process of metrication, the committee endorses the increasing use of metric units for data exchange whenever appropriate.

Using the postplot location data exchange format presented here, geophysical interpreters will be provided with base maps that are reliable and indeed reflect correctly the geodetic and mapping principles employed, as well as the most accurate positional information available within the constraints of systems, personnel, and practices employed. In addition, the marine, land, and Doppler satellite field data exchange formats provide the contractor or operating company the ability to recompute positions for confirmation (quality control) or to postprocess field acquired data by various levels of sophisticated techniques to provide position information improvement.

Although uniformity of information is a major objective in standardization of positional data exchange, an equally important characteristic of the formats presented herein is the provision for, indeed the strong cry for, the necessary data and information to document the parameters so important to proper location of a geophysical prospect.

The SEG Subcommittee on Potential Fields and Positioning Standards urges the early adoption of the standard data exchange formats presented here. The specialist involved with acquiring and processing positioning data will benefit almost immediately, but the seismic interpreter, and ultimately the end user of the data, will benefit most of all.

Finally, we recommend readers to seek clarification of concepts and terms used herein from the recommended list of references.

ACKNOWLEDGMENTS

The work necessary to specify the standards described here was done by the SEG Subcommittee on Potential Fields and Positioning Standards. The SEG greatly appreciates those companies who allowed personnel to contribute their time and knowledge.

Those who have been most directly involved are: C. J. Byrnes, Conoco Inc.; T. H. Dial, Exxon Co., U.S.A.; M. W. Evans, Western Geophysical Co.; K. Fairweather and J. A. Lane, Geophysical Service Inc.; I. J. McClelland, Mobil Oil Corp.; J. G. Morgan, Chevron Geosciences Co.; L. H. Spradley, Digicon Geophysical Corp.; K. Worley, Geosource Inc.; and G. A. Worthington, Mobil Oil Corp.

The pioneering work of the United Kingdom Offshore Operators Association Position Fixing Group is also acknowledged, as are the encouragement and dedication provided by the former Chairmen of the SEG Technical Standards Committee, E. P Meiners of Chevron Geosciences Co. and L. L. Lenz of Exxon Production Research Co.

Finally, the SEG wishes to thank the many individuals and companies that took the time to review and comment upon various drafts of this work before it was completed.

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APPENDIX A

POSTPLOT LOCATION DATA EXCHANGE FORMAT SEG P1 (1983)

(1) Definition of terms

a. A logical record consists of 80 bytes.

b. A block or physical record is a group of 20 logical records physically separated by an inter-record gap.

c. A logical file is a group of blocks or physical records, beginning with a header block(s) and terminating with a single EOF.

(2) Specification of digital tape

a. ½-inch magnetic tape, IBM compatible.

b. 9 track, 1600 bpi standard (either 800 bpi or 6250 bpi is a permissible alternative) density.

c. Coded EBCDIC mode standard (ASCII is a permissible alternative), odd parity, data and header blocking size 1600 bytes.

The tape reel should be clearly marked with an affixed sticker to identify its contents as listed in the header records (a later section of this appendix), and its specifications as described immediately above.

(3) Subdivision of tape contents

a. No computer operating system information should appear on the tape, and no record of data should precede the first header block described in the following section.

b. Any number of data blocks may follow the header block(s).

c. A logical file, as described in the first section of this Appendix, may contain only data with grid coordinates computed on the same grid projection and origin, e.g., if data extend over various projection boundaries (such as UTM zones), they may appear on the same tape but must form a separate logical file.

d. Any number of logical files may appear on the same tape with the last logical file followed by a second EOF mark to signify the end of data.

(4) Form of header block(s)

The header block(s) will consist of twenty, 80 byte records identified by an H as the first character of its block.

The data contained in the header and its arrangement are flexible in free format, but the following information is mandatory.

a. **Area information** – Survey name/area, license block number(s).

b. **Client information** – Client operator, geophysical contractor, navigation/positioning acquisition contractor, navigation/positioning processing contractor, survey dates.

c. **Positioning information** – All positioning systems employed, description of point mapped (e.g., center of seismic source array) with offset distance from the antenna/sensor or navigation/positioning reference point.

d. **Geodetic information** – Ellipsoid name, if recognized in the U.S. Department of Defense World Geodetic System 1972 (WGS 72); otherwise ellipsoid semi-major axis and flattening. Datum name and all parameters used for datum transformation if satellite fixes (or other system fixes) were shifted from WGS 72 (or other datum) to a local datum (e.g., from WGS 72 to NAD 27, dx = + 22m, dy = - 157m, dz = - 176m). Also, include reference source of geodetic information (government agency, institution, or company providing information).

e. **Projection information** – Map projection name, standard Universal Transverse Mercator (UTM) zone or central meridian, or the following if not UTM: (1) name of projection, (2) origin of grid with longitude of origin and false Easting, and latitude of origin with false Northing, (3) standard parallels if Lambert projection, (4) origin of longitude if not Greenwich, and (5) scale factor and location(s) for which scale is defined.

Item	Description	Field Specification	Record Number	Columns
1	Data record identifier	Blank	1	1
2	Line name (left justified)	4A4	1	2-17
3	Shotpoint number or event parameter as specified in sections 4c and 4g (right justified)	I8 (or as specified)	1	18-25
4	Reshoot code for repeated numbers on the same lines, A for first reshoot, B for second, etc.	1A1	1	26
5	Latitude (deg., min., sec to two decimal places,N or S; or grads to five decimal places, N or S)	I2, I2, F4.2, A1, Or	1	27-35
		(F8.5, A1)	(1)	(27-35)
6	Longitude (deg., min., sec to two decimal places,E or W; or grads to five decimal places, E or W)	I3, I2, F4.2, A1, Or	1	36-45
		(F9.5, A1)	(1)	(36-45)
7	Map grid Easting	F8.X	1	46-53
8	Map grid Northing	F8.X	1	54-61
9	Water depth or elevation above mean sea level	F5.X	1	62-66
10	Year	I2	1	67-68
11	Day of year	I3	1	69-71
12	Hours (GMT)	I2	1	72-73
13	Minutes (GMT)	I2	1	74-75
14	Seconds (GMT)	I2	1	76-77
15	Spare		1	78-80

f. **Unit information** – Units used in grid coordinates, water depth or elevation, quadrant reading instrument, etc.

g. **Survey information** – Any relevant information pertaining to the conditions under which the survey was conducted, including any definitions and/or identifiers for differentiation between seismic or non-seismic events.

In addition to the above, it is recommended that other pertinent information regarding the positioning efforts be included in the header block(s). For example, such information as unique system details, shore base station locations, and which shore base stations were used in position fixes, are recommended for inclusion in the header block(s).

(5) Form of data record

Each record is to contain data for one seismic event (e.g., shotpoint) or non-seismic event (e.g., time). The position recorded is to be the position of the shotpoint shown on the seismic section and plotted on shotpoint maps. Non-seismic events may be based on locations recorded at constant time intervals or at event time.

The content of the data record block is as follows:

(6) Discussion

A listing of a header block followed by a single block of data records is illustrated in Figure A-1

The F4.2 format description in items 5 and 6 of the data record allows 0.01 sec of arc precision, the decimal point being implicit. The F8.X format description in items 7 and 8 indicates that there may be up to 8 decimal places in the quantity being measured so long as it is defined in the header.

FIG. A-1. Example of SEG P1 (1983) header and data records.

```
HPEARL RIVER MOUTH BASIN, SOUIH CHINA SEA
 GROUP PARTICIPANTS
 CONTRACTOR: OSI, NAV. CONTRACTOR: ONI, NAV. PROCESSOR: GSI
 SURVEY DATES: SEPT. 1979 TO MARCH 1980
 NAVIGATON SYSSYSTEMS: PRIMARY: ARGO, SECONDARY: MAXIRAN
 POSITION MAPPED: AIRGUN, 56M OFFSET
 SPHEROID: WGS-72
 PROJECTION: LAMBERT
 LAT. ORIGIN: 021000000N
 LONG. ORIGIN: 114000000E
 FALSE EASTING: 500000
 FALSE NORTHING: 500000
 SCALE FACTOR: 0.998639
 NORTHERN PARALLEL: 024000000N
 SOUTHERN PARALLEL: 018000000N
 UNITS: METERS
 BASE 1: 23125600N116471867E  LANE WIDTH:92.490432
 BASE 2: 22444394N115490381E  LANE WIDTH:92.490432
 BASE 3: 22400969N114444301E  LANE WIDTH:92.490432
 BASE 4: 21370973N112000801E  LANE WIDIH:92.490432
 CLT4960            12340B17543354N110445881E  155590 161670  85779197065028
 CLT4960            12350B17544044N110445458E  155470 161885  8637919?065151
 CLT4960            12360B17544727N110445012E  155343 162097  91679197065316
 CLT4960            12370B17545421N110444563E  155215 162313  98779197065440
 CLT4960            12380B17550118N110444121E  155090 162530 101279197065605
 CLT4960            12390B17550814N110443685E  154966 162747 1117919?065729
 CLT4960            12400B17551513N110443252E  154843 162964 1006791 9?065853
 CLT4960            12410 17552219N110442824E  154721 163184 100479197070015
 CLT4960            12420 17552930N110442412E  154604 163405  98379197070136
 CLT4960            12430 17553633N110441988E  154484 163624  99779197070258
 CLT4960            12440 17554332N110441557E  154361 163841 1014791 9?0?0420
 CLT4960            12450 17555022N110441109E  154234 164056 1102791 9?0?0540
 CLT4960            12460 17555706N110440652E  154104 164269 109879197070701
 CLT4960            12470 17560386N110440186E  153971 164481 10707919 70?0824
 CLT4960            12480 17561064N110435719E  153838 164692 11117919 70?0948
 CLT4960            12490 17561750N110435272E  153711 164905 124779197071113
 CLT4960            12500 17562454N110434840E  153588 165124 131079197071238
 CLT4960            12510 17563157N110434409E  153465 165343 130779197071402
 CLT4960            12520 17563853N110433972E  153341 165560 119679197071530
 CLT4960            12530 17564548N110433538E  153218 165776  99479197071754
```

APPENDIX B

MARINE POSITIONING FIELD DATA EXCHANGE FORMAT SEG P2 (1983)

(1) Definition of terms

a. A logical record consists of 80 bytes.

b. A block or physical record is a group of 20 logical records physically separated by an inter-record gap.

c. A logical file is a group of blocks or physical records beginning with a header block(s) and terminating with a single EOF.

(2) Specification of digital tape

a. ½-inch magnetic tape, IBM compatible.

b. 9 track, 1600 bpi standard (either 800 bpi or 6250 bpi is a permissible alternative) density.

c. Coded EBCDIC mode standard (ASCII is a permissible alternative) odd parity, data and header blocking size 1600 bytes.

The tape reel should be clearly marked with an affixed sticker to describe its contents as listed in the header records to follow and its specifications as described immediately above.

(3) Subdivision of tape contents

a. No computer operating system information should appear on the tape and no record or data should precede the first header block described in the following section.

b. Any number of data blocks may follow the header block(s).

c. A logical file as described in the first section of this Appendix may contain only data related to the specifications stated in the header block. If the prime position control is changed, a new logical file must be formed, preceded by a new header.

d. Any number of logical files may appear on the same tape, with the last logical file followed by a second EOF mark to signify the end of the data.

(4) Form of header block(s)

The header block(s) will consist of twenty, 80 byte records identified by an H as the first character of its block.

The data contained in the header and its arrangement are flexible in free format, but the following information is mandatory. Any relevant information pertaining to the conditions under which the survey was conducted should be described in the header block(s).

a. **Area information** – Survey name/area, license block number(s).

b. **Client information** – Client operator, geophysical contractor, navigation/positioning acquisition contractor, navigation/positioning processing contractor, survey dates.

c. **Positioning information** – All positioning systems employed, specifically stating which system is prime; point of reference for prime and secondary system positions; layback distances from antennas to source; offset distance from source to near trace group; group interval distances; seismic source depth; geoidal height of transit satellite antenna; height above water line of all antennae; type and model of water depth recorder, and velocity of sound in water used (or assumed) and transducer depth below water line.

d. **Geodetic information** – Ellipsoid name, if recognized in the U.S. Department of Defense World Geodetic System 1972 (WGS 72), otherwise ellipsoid semi-major axis and flattening. Datum name and all parameters used for datum transformation if satellite fixes (or other system fixes) were shifted from WGS 72 (or other datum) to a local datum (e.g., from WGS 72 to NAD27, dx = +22m, dy = -157m, dz = -176 m). Also include reference source of geodetic information (government agency, institution, or company providing information).

e. **Projection information** – Map projection name, standard Universal Transverse Mercator zone or central meridian, or the following if not UTM: (1) name of projection, (2) origin of grid with longitude of origin and false Easting, and latitude of origin with false Northing, (3) standard parallels (if applicable, e.g., Lambert projection), (4) origin of longitude if not Greenwich meridian, and (5) scale factor and location(s) for which scale is defined.

f. **Radio and/or acoustic navigation system(s) data** – To include reference station geodetic and grid coordinates, elevations or depths from sea level, frequencies, propagation velocities, and lane widths (constant or on baselines as appropriate and/or if applicable). Data field assignment of raw measurements in data records to appropriate base stations. If this assignment changes, then a new header block needs to be written. Source of base station geodetic data. Include contractor name for base station surveys, type of survey (conventional or satellite), and reference document describing sites and survey operation.

g. **Assignment of what the two reference parameters in the data records refer to** (e.g., shotpoint number, seismic file number if available, time, etc.). The shotpoint numbering system should be defined if shot-point is a reference parameter (pop points per shot-point, line up points, and any use of negative numbers should be noted).

h. **Streamer attitude data (if applicable)** – Number of cable-bearing sensors; type of bearing sensor; layback of first bearing sensor from source; bearing sensor interval(s); number of cable depth sensors; layback of first depth sensor; depth sensor interval(s); magnetic declination (if applicable, and when and how determined); cable bearing and depth sensor calibration data including date(s) of calibration.

i. **Units information** – Units used in layback and offset distances, group interval(s) distances, antenna heights, water depths, velocities, geodetic datum transformations, grid coordinates, etc. Care should be taken to note exact units to avoid ambiguity (e.g., exact definition of feet units).

(5) Form of data record

Each group of five, 80 byte data records (4 groups to a block) is to contain data for one sample (shotpoint or time, etc.) as defined in the header. Each block is to be followed by an inter-record gap. The last block is to be followed by a single end-of-file (EOF) mark.

When specifications of data in the header and/or data records change, the last block before the change will constitute the last block of a logical file and will be followed by a single (EOF) mark. The next block will be a (possibly) revised header block followed by more data records. Note that the data record identifier is always a blank in the first byte of each 400 byte, data record.

The content of the data record blocks is as follows:

Item	Description	Field Specifications	Record Number	Columns
1	Data record identifier	Blank	1	1
2	Line name or number	4A4	1	2-17
3	Reference parameter 1	2A4	1	18-25
4	Reference parameter 2	2A4	1	26-33
5	Reshoot code	1A1	1	34
6	Year	I2	1	35-36
7	Day of Year	I3	1	37-39
8	Hours (GMT)	I2	1	40-41
9	Minutes (GMT)	I2	1	42-43
10	Seconds (GMT~	I2	1	44-45
11	Ship's gyro heading	I3	1	46-48
12	Ship's track	I3	1	49-51
13	Water depth	F6.1	1	52-57
14	Spare		1	58-80
15	System latitude (deg/min/sec~	I2, I2, F4.2, A1	2	1-9
16	System longitude (deg/min/sec)	I3, I2, F4.2, A1	2	10-19
17	Satellite fix latitude	I2, I2, F4.2, A1	2	20-28
18	Satellite fix longitude	I3, I2, F4.2, A1	2	29-38
19	Satellite fix time (day/hr/min/sec)	I3, I2, I2, I2	2	39-47
20	Secondary system latitude	I2, I2, F4.2, A1	2	48-56
21	Secondary system longitude	I3, I2, F4.2, A1	2	57-66
22	Spare		2	67-80
23	Positioning system raw pattern 1	F8.X	3	1-8
24	Positioning system raw pattern 2	F8.X	3	9-16
25	Positioning system raw pattern 3	F8.X	3	17-24
26	Positioning system raw pattern 4	F8.X	3	25-32
27	Positioning system raw pattern 5	F8.X	3	33-40
28	Positioning system raw pattern 6	F8.X	3	41-48
29	Positioning system raw pattern 7	F8.X	3	49-56
30	Positioning system raw pattern 8	F8.X	3	57-64
31	Positioning system raw pattern 9	F8.X	3	65-72
32	Positioning system raw pattern 10	F8.X	3	73-80

Item	Description	Field Specifications	Record Number	Columns
Note: The above three 80 column records are intended to be standard. The following two 80 column records are intended to be flexible for changing industry requirements and field specifications and must be specified in the header (e.g., as in 4h). The following is given as an example.				
33	Cable depth # 1	F4.1 (or as defined in header)	4	1-4
34	Cable depth # 2	F4.1 (or as defined in header)	4	5-8
35	Cable depth # 3	F4.1 (or as defined in header)	4	9-12
36	Cable depth # 4	F4.1 (or as defined in header)	4	13-16
37	Cable depth # 5	F4.1 (or as defined in header)	4	17-20
38	Cable depth # 6	F4.1 (or as defined in header)	4	21-24
39	Cable depth # 7	F4.1 (or as defined in header)	4	25-28
40	Cable depth # 8	F4.1 (or as defined in header)	4	29-32
41	Cable depth # 9	F4.1 (or as defined in header)	4	33-36
42	Cable depth # 10	F4.1 (or as defined in header)	4	37-40
43	Cable depth # 11	F4.1 (or as defined in header)	4	41-44
44	Cable depth # 12	F4.1 (or as defined in header)	4	45-48
45	Cable depth # 13	F4.1 (or as defined in header)	4	49-52
46	Cable depth # 14	F4.1 (or as defined in header)	4	53-56
47	Cable depth # 15	F4.1 (or as defined in header)	4	57-60
48	Cable depth # 16	F4.1 (or as defined in header)	4	61-64
49	Spare		4	65-80
50	Cable sensor data # 1	I3 (or as defined in header)	5	Open format as defined in header
51	Cable sensor data # 2	I3 (or as defined in header)	5	
52	Cable sensor data # 3	I3 (or as defined in header)	5	
53	Cable sensor data # 4	I3 (or as defined in header)	5	
54	Cable sensor data # 5	I3 (or as defined in header)	5	
55	Cable sensor data # 6	I3 (or as defined in header)	5	
56	Cable sensor data # 7	I3 (or as defined in header)	5	
57	Cable sensor data # 8	I3 (or as defined in header)	5	
58	Cable sensor data # 9	I3 (or as defined in header)	5	
59	Cable sensor data # 10	I3 (or as defined in header)	5	
60	Cable sensor data # 11	I3 (or as defined in header)	5	
61	Cable sensor data # 12	I3 (or as defined in header)	5	
62	Cable sensor data # 13	I3 (or as defined in header)	5	
63	Cable sensor data # 14	I3 (or as defined in header)	5	
64	Cable sensor data # 15	I3 (or as defined in header)	5	
65	Cable sensor data # 16	I3 (or as defined in header)	5	

(6) Discussion

A listing of a header block followed by a single block of data records is illustrated in Figure B-1. The F4.2 format description in items 15, 16, 17, 18, 20, and 21 of the data record allows 0.01 sec of arc precision, the decimal point being implicit. The F8.X format description in items 23 through 32 indicates that there may be up to 8 decimal places in the quantity being measured so long as it is defined in the header.

FIG. B-1. Example of SEG P2 (1983) header and data records.

H MACDUFF GAS FIELD NORTH SEA BLOCK NS49
AMERICAN NATIONAL OIL CO., CONTRACTOR: OSI, NAV. CONTRACTOR: GSI
NAV. PROCESSOR: GSI SURVEY DATES: JUNE-JULY 1978
NAV. PRIME: SYLEDIS, NAV. SECONDARY: SATELLITE, NAV. BACKUP: MINI-RANGER
USING PRIME ANTENNA-OFFSET TO SOURCE: 41.81, SOURCE TO
NEAR TRACE: 276, GROUP INTERVAL: 50, SOURCE DEPTH: 6.5, SIMRAD FATH. MODEL
EA, VEL. CONVERSION 1500 M/SEC. FATH. DEPTH BELOW WATER LINE: 10 FEET
SPHEROID: INTERNATIONAL, DATUM=ED-50 (X=+84, Y=+103,Z=+127) DMA
PROJECTION: TIME, ZONE 31
SYLEDIS: OP. FREQUENCY 440MHZ LANE WIDTH 1 METRE
BASE1 60512460N001280964E Y=6747971 X=416842CC 9-16
BASE2 61032067N001424614E Y=6769840 X=430503CC 17-24
BASE3 61214834N001344770E Y=6804257 X=424064CC 25-32
MINIRANGER: CC 1-8 NOT FULLY OPERATIONAL
BASE STATION CONTRACTOR: GSI, SATELLITE SURVEY
REFERENCE PARAMETER 1 = SPNUMBER, REFERENCE PARAMETER 2 = SEISMIC REC.
NUMBER STREAMER:16 DIGICOURSE COMPASSES,OFFSET FROM SOURCE TO 1ST CMP:324,
16 DEPTH SENSORS, OFFSET FROM SOURCE TO 1ST DEPTH TRANSDUCER: 270,
MAG. DECLINATON: 10 W
UNITS: METRES FOR ALL VALUES.
TEST 17 17 78194181455 79 71 141.9
61085984N001275684E61085985N001275760E19418150061091556N001281854E
0272660003265943016962170358595З
9.010.011.0 9.0 9.010.0 9.010.011.010.0 9.0 9.0 9.010.010.011.0
98.196.3 95.2 96.1 97.0 96.8 95.9 94.7 95.9 93.4 95.9 96.2 98.1 97.3 95.2 93.0
TEST 25 25 78194181607 82 74 149.9
61090001N001281025E61090009N001281020E19418161261091612N001283223E
02730500032664230166500703617943
10.011.0 9.010.010.011.011.010.010.010.0 9.0 9.0 9.010.010.011.0
96.4 95.1 94.3 95.6 98.1 96.4 95.7 94.0 95.5 93.0 96.8 95.3 97.0 96.5 95.3 95.2
TEST 33 33 78194181717 80 72 149.9
61090006N001282360E61090015N001282420E19418172261091617N001284515E
02730500032664230166500703617943
10.010.010.0 9.0 9.010.010.010.011.011.011.011.010.010.010.011.0
96.4 95.1 96.3 96.6 97.0 93.0 95.3 95.2 95.6 96.1 97.0 97.3 97.0 96.696.496.3
TEST 41 41 78194181828 81 73 150.1·
61090028N001283711E61090037N00128382TE19418183361091639N001285907E
02733400032672630164972703634473
10.0I1 .011.011.011.010.010.010.010.010.010.011.0i1 .011.010.010.0
95.4 95.3 95.8 95.2 96.4 96.3 97.1 97.3 96.8 96.9 97.4 97.7 98.0 98.098.498.2
TEST 49 49 78194181937 84 76 150.2
61090011N001285045E61090020N001285120E1 9418194261091622N001291254 E
027352000326739[30163430703650713
10.0 9.0 9.0 9.011.011.011.0 9.0 9.0 9.010.010.011.011.011.011.0
96.0 96.4 96.4 96.7 96.5 96.3 97.4 96.8 97.3 97.6 97.8 98.0 98.2 98.398.097.9

APPENDIX C

LAND SURVEY FIELD DATA EXCHANGE FORMAT SEG P3 (1983)

(1) Definition of terms

a. A logical record consists of 80 bytes.

b. A block or physical record is a group of 20 logical records physically separated by an inter-record gap.

c. A logical file is a group of blocks or physical records, beginning with a header block(s) and terminating with a single EOF.

(2) Specification of digital tape

a. ½-inch magnetic tape, IBM compatible.

b. 9 track, 1600 bpi standard (either 800 or 6250 bpi is a permissible alternative) density.

c. Coded EBCDIC mode standard (ASCII is a permissible alternative) odd parity, data and header blocking size 1600 bytes.

The tape reel should be clearly marked with an affixed sticker to describe its contents as listed in the header records given in later sections and its specifications as described immediately above.

(3) Subdivision of tape contents

a. No computer operating system information should appear on the tape and no record or data should precede the first header block described in the following section.

b. Any number of data blocks may follow the header block(s).

c. A logical file, as described in the first section of this Appendix, may contain only data related to the specifications stated in the header block. If the prime position control is changed, a new logical file must be formed, preceded by a new header.

d. Any number of logical files may appear on the same tape with the last logical file followed by a second EOF mark to signify the end of the header.

(4) Form of header block(s)

The header block(s) will consist of twenty, 80 byte records identified by an H as the first character of its block.

The data contained in the header and its arrangement are flexible in free format, but the following information is mandatory. Any relevant information pertaining to the conditions under which the survey was conducted should be described in the header block(s).

a. **Area record(s)** – Country, state, or province, county, region name.

b. **Client record(s)** – Client operator, geophysical contractor, survey contractor, survey dates (optional: surveyor name and license or registration number).

c. **Surveying record(s)** – Method of survey, instrumentation types employed, types of distance measurements (chain, stadia, EDM), basis of azimuth (from control, astronomical), magnetic declination (when and how determined).

d. **Instrument calibration record(s)** – Instrument serial number(s), date of calibration.

e. **Geodetic record(s)** – Ellipsoid name, if recognized in the U.S. Department of Defense World Geodetic System 1972 (WGS 72), otherwise ellipsoid semi-major axis and flattening. Datum name and all parameters used for datum transformation if satellite fixes (or other system fixes) were shifted from WGS 72 for other datum) to a local datum (e.g., from WGS 72 to NAD 27 dx = +22m, dy = -157m, dz = -176m). Also include reference source of geodetic information (government agency, institution, or company providing information).

f. **Projection information** – Map projection name, standard Universal Transverse Mercator (UTM) zone or central meridian, or the following if not UTM: (1) name of projection or U.S. state plane zone name, (2) origin of grid with longitude of origin and false Easting, and latitude of origin with false Northing, (3) standard parallels (if applicable, e.g., Lambert projection), (4) origin of longitude if not Greenwich meridian, and (5) scale factor and location(s) for which scale is defined.

g. **Unit record(s)** – Definition of units used in survey for distance measurements (meters, American survey feet, etc.) and in grid system, units used in angular measurements (degrees-minutes-seconds of arc, grads, quadrant readings).

h. **Measurement data type record(s)** – Definition of horizontal and vertical angle reference origin and direction, slope distance or horizontal distance.

i. **Detailed formats and data codes** – In order to provide correct definition and interpretation of data from the various types of survey measurements, these records shall provide detailed description of data formats used for each measurement type, and descriptions of coded characters used to describe points measured.

Item	Description	Field Specifications	Record Number	Columns
1	Data record identifier	Blank	1	1
2	Line name (left justified)	A16	1	2-17
3	Point identification number (right justified)	A16	1	18-33
4	Measurement type code	A2	1	34-35
5	Instrument face	I1	1	36
6	Horizontal angle (format described in header)		1	37-44
7	Vertical angle or differential height (format described in header)		1	45-51
8	Distance (slope distance, horizontal distance, or stadia hair readings; format described in header)		1	52-59
9	Rod reading or EDM target height (format described in header)		1	60-64
10	Auxiliary measurements (as defined in header)		1	65-80

(5) Form of data record

Each record is to contain measurement data which can be uniquely related to the survey observations of an instrument station, shotpoint, geophone group, a monument or location used in horizontal or vertical control, and such property lines and cultural features which may be required for site identification and mapping. Multiple observations of the same object should be entered as separate, sequential records.

The content of the data record is as follows:

(6) Codes for survey measurement type, instrument face

Columns 34 and 35 provide the user the opportunity to designate additional identification for the type of point measured (e.g., to designate geophone groups and shot-points, and to identify which measurements correspond to run points, control points, or instrument station locations). Any alphanumeric quantities may be used in these fields, as long as their use is defined in the header record.

Column 36 should be either a numeric one (1) or a two (2) depending on whether the instrument reading is made on the "face I' for direct reading of the vertical circle, or "face II' for readings with the telescope plunged 180 degrees.

(7) Discussion

The wide variety of surveying instruments and methods used within the geophysical industry would seem to defy any effort to provide a single format for conveying field measurements. However, the measurements themselves are fairly basic in type, consisting of angles in the horizontal and vertical planes and of distance measurements and rod readings at the points being surveyed. While the methods for computing survey notes may vary, depending upon whether the surveyor performed one type of traverse or another, the basic ingredients of angles and units of length remain the same, and can be accommodated within a single format.

One source of concern to some surveyors who have not been exposed to computer formats is the amount of space within a field. In particular, there is a need to understand the difference between explicit and implicit decimal points in a field of numbers. For those familiar with reading a number such as 2.123, it would appear that five (5) spaces would be required to contain that value. However, by specifying an implicit decimal place between the first and second columns of the field, the number can be recorded as 2123, and only requires four (4) places to carry four significant figures.

Figure C-1 illustrates a typical listing of a header block followed by a single block of data records.

Note that a data record is always identified by a blank in the first byte to distinguish it from a header record.

FIG. C-1. Example of land survey field data exchange format.

```
H USA, NORTH DAKOTA, WILLIAMS CO., WILLISTON BASIN PROSPECT "HILLSIDE"
 TARPITZ OIL CO. (OPERATOR), HAZELTWIG GEOPHYSICAL CORP. (GEOPHYSICAL
 AND SURVEY COMIRACTOR) ROBERT PLUMB R.L.S. 26173 (CH. OF SURVEY PARTY).
 SURVEY 1-8 JULY, 1979. ORIGINAL LINE LAYOUT BY MAG. COMPASS AND
 CHAINED INTERVALS. FINAL SURVEY OF COORDINATES BY PLATE TRAVSERSE
 USING 0.1 MINUTE THEODOLITE, (WILD T-16 S/N 1863116, CALIBRATED
 6/22/79), DISTANCE MEASURED BY E.D.M (K&E AUTO-RANGER S, S/N 01152,
 CALIBRATED 5/30/79, PPM SETTING 45) AZIMUTH CONTROL FROM GEODETIC
 MARKERS, SUPPLEMENTED BY SUNSHOTS. SURVEY DA2UM: NAD (1927), NORTH
 DAKOTA STATE PLANE NORTH ZONE, LAMBERT, STD. PARALLELS 47 DEG 26 MIN,
 48 DEG 44 MIN. ORIGIN OF GRID: FALSE EASTING = 2000000 FT. AT CENTRAL
 MERIDIAN OF 100 DEG 30 MIN W. LONG., NORTHING = 0 AT 47 DEG 0 MIN NLAT.
 GEODETIC CONTROL FROM TRI. STATIONS IN N.G.S. SQUAD 481073:
 STA. "BALD ROCK", X = 1188312.4, Y = 520173.78
 STA. "BALD RDCK" AZ", GRID AZIMUTH 225 DEG 13 MIN 45.2 SEC, RE-
 FERENCED FROM GRID SOUTH, MEASURED AT STATION "BALD ROCK"
 STA "UNDERHILL", 'X' =1175716.61, 'Y' = 528643.9"
 VERTICAL CONTROL FROM MAP SPOTS ON USGS 1:2/4000 SHEETS.
```

MEASUREMENT UNITS IN U.S. SURVEY FEET, ANGLES MEASURED CLOCK-
WISE IN DEGEEES, MINUTES, DECIMAL MIN.
H VERTICAL ANGLES MEASURED FROM ZENITH, CONTINUOUS FROM
O DEG TO 90 DEG. AT HORIZON, TO 180 DEG. AT NADIR, 270 DEG.
AT HORIZON ON FACE 2. DISTANCES MEASURED AS SLOPE DISTANCE FROM
INSTRUMENT TO ROD REFLECTOR.

HORIZONTAL ANGLE FORMAT: DDDMM.M, COLS 38-44, DECIMIAL POINT IN COL. 43
ZENITH ANGLE FORMAT: DDDMM.M IN COLS. 45-51, DECIMAL POINT IN COL. 50
SLOPE DISTANCE FORMAT: FFFF.FF IN COLS. 52-59, DECIMAL FORMAT IN COL. 57
ROD TARGET HEIGHT FORMAT: FF.FF IN COLS. 60-64, DECIMAL POINT IN COL. 62
COLUMNS 65-80 CONTAIN VERBAL DESCRIPTORS OF SOME POINTS.

CODING OF POINT ID~-IDENTIFIERS: B = BACKSIGHT TURN POINT, F = FORE-
SIGHT TURN POINT I = INSTRUMENT SETUP LOCATION, H= HORIZONTAL
CONTROL, V= VERTICAL CONTROL, G= GEOPHONE GROUP, S = SHOTPOINT
LOCATION, W = WELL SITE, C = SECTION CORNER.

```
TFZ-79056CTL           11001B 1 00000.0 9012.3 2963.18 6.00 BALD ROCK AZ
TPZ-79056CTL           11003F 1 11726.7 9023.8 3529.42 6.00
TPZ-79056CTL           11001B 2 17959.926947.6 2963.43 6.00
TPZ-79056CTL           11003F 2 29726.526926.2 3529.09 6.00
TPZ-79056CTL           11002IH1 00000.0 9000.0 0000.00 5.13 BALD ROCK TRI
TPZ-79056CTL           11003I 1 00000.0 9000.0 0000.00 5.21
TPZ-79056CTL           11002BH1 00000.0 8947.5 3529.26 6.00 BALD ROCK TRI
TPZ-79056CTL           11004F 1 19246.2 9003.4 2881.12 6.00
TZP-79056CTL           11002BH2 18000.027012.4 3529.39 6.00
TPZ-79056CTL           11004F 2 01246.126956.5 2880.95 6.00
TFZ-79056CTL           11005V 1 13823.3 9034.2 1566.31 6.00 MAP SPOT
TPZ-79056              1004I  1 00000.0 9000.0 0000.00 4.99 BEGIN LINE
TPZ-79056              11003B 1 00000.0 8956.6 2881.86 6.00
TPZ-79056                 21GF1 17337.6 9008.2 2312.88 6.00
TPZ-79056              11003B 2 17959.827003.3 2881.20 6.00
TPZ-79056                 21GF2 35337.826952.0 2313.01 6.00
TPZ-79056                  1G 1 17332.2 9000.6  110.82 6.00
TPZ-79056                  2G 1 17332.8 9001.7  221.13 6.00
TPZ-79056                  2S 1 17051.1 9002.2  226.29 6.00
TPZ-79056                  3G 1 17331.8 9001.9  331.53 6.00
```

APPENDIX D

U.S. NAVY NAVIGATION SATELLITE SYSTEM (TRANSIT) SATELLITE FIELD DATA EXCHANGE FORMAT SEG P4 (1983)

(1) Definition of terms

a. A logical record consists of 80 bytes.

b. A block or physical record is a group of 20 logical records physically separated by an inter-record gap.

c. A logical file is a group of blocks or physical records, beginning with a header block(s) and terminating with a single EOF.

(2) Specification of digital tape

a. ½-inch magnetic tape, IBM compatible.

b. 9 track, 1600 bpi standard (either 800 or 6250 bpi is a permissible alternative) density.

c. Coded EBCDIC mode standard (ASCII is a permissible alternative) odd parity, data and header blocking size 100 bytes.

The tape reel should be clearly marked with an affixed sticker to describe its contents as listed in the header records as given below and its specifications as described immediately above.

(3) Subdivision of tape contents

a. No computer operating system information should appear on the tape and no record or data should precede the first header block described in the following section.

b. Any number of data blocks may follow the header block(s).

c. A logical file, as described in the first section in this Appendix, may contain only data related to the specifications stated in the header block. If the prime position control is changed, a new logical file must be formed, preceded by a new header.

d. Any number of logical files may appear on the same tape with the last logical file followed by a second EOF mark to signify the end of the header.

(4) Form of header block(s)

The header block(s) will consist of twenty, 80 byte records identified by an H as the first character of its block.

The data contained in the header and its arrangement are flexible in free format, but the following information is mandatory. Any additional relevant information pertaining to the conditions under which the survey was conducted should be described in the header block(s).

a. **Area records** – Descriptive identification of region: offshore region or concession area; onshore country, state or province, county or region name.

b. **Client record(s)** – Client operator, geophysical contractor, navigation/positioning or survey contractor, survey dates.

c. **Antenna record(s)** – Antenna type, model, serial number, height of electrical center of antenna above local vertical reference monument (or above waterline on vessel). Horizontal offset of antenna from monument or from navigation reference of vessel.

d. **Satellite receiver record(s)** – Type, model and serial number of Doppler satellite receiver (and local reference oscillator, if it is not the original internal oscillator provided as a receiver component); nominal frequency of reference oscillator for Doppler channel, Doppler counting intervals (number of bits or time basis for counting).

Item	Column
"S" format designator	1
Pass I.D. number (sequential counter)	2-7
Record number within the data of this pass (001)	8-10
Date (year, day number)	11-20
Time at message synchronization of first lock on (GMT hours, minutes)	21-30
Estimated latitude at time of lock on	31-40
Estimated longitude at time of lock on	41-50
Estimated spheroidal height	51-60
(Optional) temperature, pressure, time of auxiliary system	61-80

e. **Doppler record format description** – To accommodate differences between receiver types and to permit both land and marine data, these records shall describe detailed format used in Doppler data records, including Doppler and refraction counts, specialized time recovery or fractional data, and (for marine data) units and format of velocity measurements.

f. **Information record(s)** – Method or formula for measurement and computation of refraction, formats and units of optional meteorological data, format and interpretations of receive status flags. Units of antenna offset measurement.

g. **Geodetic record** – Computed latitude and longitude, datum and datum shifts.

(5) Satellite pass data records

The data for each satellite pass will continue as lines or information within the "S" type header format, i.e. 80-character line records, with an "S" in column 1 of the first line in each 20-line physical record.

a. **Satellite pass timing record**

b. **Satellite orbital data records** – Four records, of 80 characters each, shall be used to contain the data describing satellite orbital data broadcast during the pass. These records shall include the pass ID number as recorded in the satellite pass timing record, and the number 002 through 005, respectively, to remove ambiguity in the interpretation and decoding of the message data. The data record number 002 shall contain the first seven (7) ephemeral words broadcast, number 003 the next seven (if required, otherwise the values should be filled with zeroes). The record numbered 004 shall contain the first seven Keplerian variables, and record number 005 the last seven Keplerian variables. All data records shall use "majority voted" (M.V.) values. For each variable within the data records, an additional character is provided within the format to provide information (if available) as to the status of the majority vote performed. The coding of this character should be described in the header records.
The satellite data record format within each line is:

c. **Optional satellite orbital data records** – Four additional records, identical in format to records 002-005 but numbered 006-009, are available for use in cases where satellite data injections occur during a pass. This optional data permit both the preinjection and postinjection data to be carried.

d. **Satellite Doppler records** – The data used in computing the fix consist of Doppler counts, refraction information, and timing data specific to the receiver system used. The number of the records is highly variable, depending upon the length of the pass observed and the Doppler counting interval used. The format within each line should be specified in the header record, with each record number identified by the pass ID number and a record counter which increases for each successive Doppler interval for the duration of the pass. Each line should contain differential position or velocity information where applicable in marine operations.

(6) Use of Doppler satellite data for dynamic conditions

In the case of Doppler satellite data acquired under dynamic conditions, the correct processing and interpretation of the Doppler data require knowledge of the velocity vector of the user's antenna. Various systems measure and record this information in different ways. However, as long as the header block contains the specific form of conveying the velocity data, the fields within the Doppler record can be adapted to fit the usage which most closely conforms to the acquisition system.

By way of example, some systems measure and record components of velocity in SPEED (knots) and HEADING (degrees) and average their values over each Doppler collection interval. Other systems log V-North and V-East vectors in units of meters per second. Most common is the practice of integrating the velocity information over each of the Doppler intervals, then recording the accumulated differential positions as "DELTA LATITUDE" and "DELTA LONGITUDE" values.

(7) Discussion

Figure D-1 (p. 502) illustrates a typical listing of a header block and the data for one pass (39) and its 39 Doppler intervals (10 to 48).

Figure D-2 (p. 503) illustrates by examples typical ways Doppler satellite data for dynamic conditions can be handled.

Description	Column
Blank (unless first line of block)	1
Pass ID number	2-7
Record number within the data of this	
pass (002-005)	8-10
Majority vote characters for first variable	11
First variable	12-20
M.V. character for 2nd variable	21
Second variable	22-30
•	
•	
•	
M.V. character for 7th variable	71
7th variable	72-80

FIG. D-1. Example of Doppler satellite data exchange format.

```
H (SATELLITE RECORD) USA, NOFTH DAKOTA, WILLIAMS OD., WILLINGSTON BASIN
 TARPITZ OIL CO (OPERATOR), HAZELTWIG GEOPHYSICAL CORP (GEOPHYSICAL CONTRAC-
 TOR), GEO-MEASURE CORP (DOPPLER SURVEY CONTRACTOR) DATA COLLECTED 6-8
 JULY, 1979 SATELLITE RECEIVER: MAGNAVOX 1502 S/N 00247, USING INTERNAL OSCIL
 LATOR AND ORIGINAL ANTENNA S/N OA-00212. RED MARK ON ANTENNA MEASURED BY
 STEEL TAPE TO BE 41 INCHES DIRECTLY ABOVE MONUMENT FOR STATION "TREELINE",
 NGS 3RD ORDER TRAVERSE STATION, LOCATED IN S.W. 1/4 OF SEC. 23, T 157 N,
 R 102 W. NOMINAL FREQ. OF RECEIVER AT 400.000 MHZ. DOPPLER COUNTS ACCUMULATED
 FROM ORIGINAL 4.6 SEC INTERVALS TO 5 INTERVALS OF 1170,1170,1170,1170
 AND 1423 BITS PER TWO MINUTES. PRIMARY (400 MHZ) CHANNEL DATA GIVEN AS
 COLLECTED AND ACCUMULATED; IONOSPHERIC REFRACTION MEASUREMENTS GIVEN AS
 DIFFERENCE BETWEEN SECONDARY (150 MHZ) CHANNEL DATA AND PRIMARY CHANNEL
 DATA AFTER MULIPLYING SECONDARY DATA BY 8/3. FRACTIONAL DOPPLER DATA
 GIVEN AS NUMERIC CORRECTION TO BE ADDED TO DOPPLER COUNT, AND HAS RANGE
 -2 TO 2.
 FORMAT OF DOPPLER RECORD: PASS NO., COL 2-7, DOPPLER INTERVAL NO. (BE-
 GINNING WITH 10), COL 8-10; 400 MHZ DOPPLER COUNT FOR INTERVAL, COL
 13-20 WITH DECIMAL POINT IN COL 20; REFRACTION, COL 23-30 WITH DECI
 MAL FRACTIONAL DOPPLER COUNT IN COL 33-40 WITH DECIMAL POINT IN COL 36.

S     390011979 187 2116      48 25     103 58    792.6
      39   23250420703326058101532707213603280841745329094213436010125153611052856
      39   33621073155363106338836410435453201013619321096360532209235093230883315
      39   43043230940383740435038028136603800210970380005258038074518103820855960
      39   53900005090380012763038285064903800301400382150079038099991903801960000
      39 10   560156.  -16.0364    -.6877
      39 11   562448.  -18.6545     .1323
      39 12   565198.  -18.6545    -,2955
      39 13   568496.  -18.3273    1.2041
      39 14   696820.  -23.5636    -.6420
      39 15   578322.  -20.2909     .6359
      39 16   5U4220.  -19.6364    -,8724
      39 17   591294   -18.3273     .3271
      39 18   599760.  -16.6909    -.1839
      39 19   743256.  -18.3273    -.1639
      39 20   624746.  -12.7636    -.7068
      39 21   639364.  -10.8000     .5053
      39 22   656280.   -7.8545     .6577
      39 23   675458.   -4.2545     .2496
      39 24   850204.    -.9818   -1.5066
S     39 25   724280.    5.2364     .5631
      39 26   747638.   11.1273    -.0197
      39 27   770602.   18.9818     .5286
      39 28   792342.   26.1818    -.3132
      39 29   990280.   42.2182     .5598
      39 30   833458.   44.8364    -.7009
      39 31   848356.   54.9818     .2004
      39 32   861066.   65.4545    -.8579
      39 33   871802.   74.2909     .2284
      39 34  1072320.   90.3273    -.0696
      39 35   889834.   59.2364    -.3026
      39 36   895920.   33.0545     .6793
      39 37   900998.   10.8000   -1.0831
      39 38   905236.    1.9636     .8277
      39 39  1105686.    0.0000     .5458
      39 40   912292.    0.0000    -.7861
```

	39 41	914666.	2.2909	.9551
	39 42	916636.	4.2545	-.5981
	39 43	918276.	4.9091	-.3115
	39 44	1118640.	4.9091	.0717
s	39 45	920952.	-.6545	-.7930
	39 46	921812.	-6.5455	.1683
	39 47	922488.	-11.7818	1.0108
	39 48	923008.	9.4909	-1.1316

FIG. D-2. Examples of handling dynamic satellite data. Each example corresponds to the same type of velocity information, but is recorded in the Doppler data record in different form. All correspond to end points of 23 sec intervals.

Example A. Speed and heading format

(From Header Record)

```
FORMAT OF DOPPLER RECORD: PASS NO., COL 2-7, DOPPLER INTERVAL NO. (BEGINNING
WITH 10), COL. 8-10; 400 MHZ. DOPPLER IN COLUMN 13-20 WITH DECIMAL POINT IN COL
20; REFRACTION CORR'N IN COLUMN 23-30, WITH DECIMAL PT. IN COL 26; FRACTIONAL
DOPPLER COUNT 13~ COL 33-40, DECIMAL IN COL 36; SPEFD (KNOTS) IN COL 37-42, WITH
DECIMAL IN COL 40; HEADING (DEGREES, TRUE) IN COL 41-46, DECIMAL IN COL 45.
```

(Lines from Doppler data record)

```
41   16   585232.   -21.1265       -1.1603  6.21 121.6
41   17   592306.   -19.4118        -.8115  6.19 121.3
41   18   600780.   -18.0271         .1276  6.22 121.4
```

Example B. V-NOR and V-EAST format

(From Header Record)

```
FORMAT OF DOPPLER RECORD: PASS NO., OOL 2-7, DOPPLER INTERVAL NO. (BEGINNING
WITH 10), COL. 8-10; 400 MHZ. DOPPLER IN COLUMN 13-20 WITH DECIMAL POINT IN COL
20; REFRACTION CORR'N IN COLUMN 23-30, WITH DECIMAL PT. IN COL 26; FRACTIONAL
DOPPLER COUNT IN COL 33-40, DECIMAL IN COL 36; V-NOR (M/SEC) IN COL 37-42, WITH
DECIMAL IN COL 39; V-EAST (M/SEC) IN COL 41-46, DECIMAL IN COL 43.
```

(Lines from Doppler data record)

```
41 16      585232.   -21.1265       -1.1603-1.675 2.723
41 17      592306.   -19.4118        -.8115-1.655 2.722
41 18      600780.   -18.0271         .1276-1. 668 2.733
```