PRELIMINARY

DRAFT

UNITED STATES GEOLOGICAL SURVEY

STRONG-MOTION INFORMATION RETRIEVAL SYSTEM

USER'S MANUAL

by

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PREFACE

The Strong-Motion Information Retrieval System was developed as part of the Strong-Motion Program operated by the US Geological Survey for the National Science Foundation (NSF). Anyone involved in earthquake engineering may access the system, and it should prove to be of considerable value in the aftermath of a major earthquake by providing a central source of current information for strong-motion data users.

Information about earthquakes that have produced significant strong-motion records, the recording sites, the records recovered, and the extent of the analysis that has been performed on the records is available from the system. Most of this information is related to the network maintained by the Geological Survey for NSF and other agencies, but the system may be expanded in the future to include information about other strong-motion networks as well.

This manual introduces new users to the system and supplies experienced users with complete descriptions of all the items that may be retrieved from the system.

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CONTENTS

I. OVERVIEW

I.1 Introduction

Descriptions of strong-motion accelerograph records and the circumstances in which the records were recorded are made available to persons involved in earthquake engineering through the Strong-Motion Information Retrieval System. The system is maintained by the US Geological Survey (USGS) and the information is continually updated as new information is gathered. With an ordinary phone line and a teleprinter keyboard terminal, users of the system may review the information from their own offices.

The information is contained in computer files at the USGS computing center in Menlo Park and also at the Lawrence Berkeley Laboratory computing facility in Berkeley, California. Most users will access the system through the computer in Menlo Park and this manual contains instructions for that version only. The alternate version is intended primarily for internal use by the USGS and for system backup, and therefore provides much less user assistance than does the Menlo Park version. An addendum to this manual is available to those users who need the alternate version.

The computer files are organized, maintained, and accessed using BDMS[1], a general-purpose data base management and information retrieval program that was developed at the Lawrence Berkeley Laboratory computing facility. Several special-purpose program modules used in conjunction with the BDMS program were designed specifically for the Strong-Motion Information Retrieval System.

The data base contains information that was previously stored on file cards. Users of the system may review that data in much the same way as they might have browsed through the file card cabinet located in the USGS office. The computer system provides more selective searching mechanisms than does a file cabinet however, and the system allows remote access to the information by users from their offices.

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[1] "BDMS, Berkeley Data Base Management System User's Manual", Version 1.2; LBL-4683; Dave Richards; April 1976.

There are currently (September 1978) about 5000 data base entries that describe strong-motion records and the level of processing and analysis that has been performed on them. Also included in the data base are about 2000 entries that describe the characteristics of the recording stations and about 600 entries that describe the events that produced significant strong-motion records. Also, there are several supplementary entries; the most important for a new user are those that contain instructions, guidelines, or just general information about the system itself. (Note: Digitizations of strong-motion records are not included in this data base. If a record has been digitized, the record description entry will indicate where the digitized data is available.)

The contents of the data base will be expanded as the system develops. The data base currently describes only those strong-motion records and stations for which the USGS has a primary responsibility, but information about other strong-motion programs in the US, particularly the California Division of Mines and Geology program, may be added in the future. Also, additions and corrections may be made to any of the entries that are currently in the data base. Subjective remarks, such as comments about the quality or usefulness of a record, will be added to many of the existing entries.

All users are encouraged to indicate corrections or remarks that they think should be included in the data base entries. At the end of each session users will be given the opportunity to type messages to those who maintain the system. Messages that require a response will be answered when the user next logs onto the system.

I.2 Topics of Data Base Information

The following paragraphs contain brief descriptions of general, real world entities that are abstractly represented in the strong-motion data base.

A seismic "event" is an earthquake or a similar earth vibration caused, for example, by an explosion. Instruments in the strong-motion network record the acceleration (or in some cases the displacement) they undergo during an event. These instruments do not record continuously; they are triggered by motion that is strong enough to be of interest in the study of the behavior of structures during seismic events.

A "recorder" is the instrument that records the acceleration on paper, film, or magnetic tape.

A "transducer" is the device that detects acceleration and transfers the signal to a recorder. Some types of strong-motion instruments have transducers that are situated in locations remote from their recorder, but most of the instruments in the network at the present time consist of a recorder and its transducers in a single unit. Most transducers are placed in groups of three to

record orthogonal components of motion.

A "record" is the paper, film, or magnetic tape on which an event has been recorded. The physical record made by remote transducers may contain traces from several locations. Such traces are regrouped for data analysis and for description within this system so that each record consists only of traces from transducers that are located at the same level of the same structure.

Several stages of data "analysis" are routinely performed on the digitized traces from significant records. The raw digitized trace and the results from the various analyses are not stored within the data base, but their existence and availability are indicated.

An "array" of stations consists of a group of recording stations designed to provide data on a specific aspect of seismic engineering interest. An array may consist of closely situated stations or it may span distances of up to several hundred kilometers. The instruments in an array may or may not be interconnected for simultaneous operation.

A recording "station" is an entire location or general site containing strong-motion recording instrumentation. Each station in the network has been assigned a unique four-digit station number.

A "substation" is a subdivision of a station. Normally, it is a structure or site adjacent to the parent station. It may be anything which houses strong-motion instruments: an instrumented building, bridge, or dam; or a lone instrument shelter. Most stations consist of a single substation, but those stations having instruments in several structures with different characteristics are said to be composed of several substations.

I.3 Information Retrieval

The information in the data base may be displayed on a small, inter-active terminal, or the information may be printed on a high-speed line-printer or microfilm device. Normally, short queries relating to small portions of the data will be requested and received over an interactive terminal and lengthy, comprehensive reports will be requested in batch mode and the results received on microfilm or printer pages.

When the data base query program is run interactively, the program is under the user's control (to some extent) as it is performing the user's requests. The user can interact with the program in a conversational manner, the user typing his commands to the program from a key-board terminal and the program responding by typing its results to the same terminal. This is convenient

and timely when trial and error is necessary to determine which queries will bring results that are of interest to the user. Rapid response from the computer allows the user to maintain his continuity of thought as he browses through the data base.

Interactive query procedures can be inconvenient to a user who is in no particular hurry for results, who has his queries so well formulated that he knows he will get the results he expects from them, and who prefers to review the printed results when they are completed without having to monitor the program's progress as it is printing. Interactive queries are particularly inconvenient if a user's requests are so long or complex that the computer cannot respond quickly. For these reasons, the retrieval programs are being designed so that a user can choose whether to run them in interactive or in batch mode. In batch mode, all desired commands are assembled together and submitted as a complete group to the computer's input queue. The user has no control over his job once it has been submitted.

The computer programs that will handle data base queries are still in the design process. They will probably consist of two distinct types; one, designed primarily for interactive use, will handle simple requests, and the other, designed primarily for batch use, will handle more complicated report generating functions. The program designed for interactive queries is available now although many changes will be made to the program in the future. None of the report generating programs are available at the present time (September 1978).

I.4 Data Organization

The strong-motion information has been arranged into several data sets. The three major data sets are the record descriptions, the station descriptions, and the event descriptions. There are also several smaller, less important data sets.

An entry in the records data set will contain the following information.

- an identification of the event that triggered the record
- station identification of the recording site
- epicentral distance and site intensity
- the peak acceleration on the record
- an indication whether digitization and analysis have been performed
- references to papers that have been written about the data

An entry in the stations data set will include the following items of interest.

- the station identification, or station number, and address
- its latitude and longitude
- structure and foundation geology information

An entry in the events data set will contain the following relevant items.

- date and time of the event
- the epicenter's latitude and longitude
- magnitude and maximum intensity

Each real world entity is characterized in the data base by a collection of one or more data elements. Such a collection of data elements is called a data base entry, and the collection of all entries that represent the same type of entity is called a data set. This terminology is illustrated in Figure 1.

Entries in several of the data sets have a hierarchal structure where-in one group of data elements can have any number of subordinate groups associated with it; each of these subordinate groups can have other groups of data elements subordinate to it, and so on. The subordinate groups of data elements will be called subordinate entries or sub-entries. When necessary to distinguish the group of data elements at the beginning of the hierarchy from those below it in the hierarchy, the term root entry will be used.

The two levels of an entry in the stations data set are illustrated in Figure 2. In the root are several data elements describing the station's general characteristics. Associated with the station may be any number of sub-entries, each containing a group of data elements describing characteristics of a specific structure that are not necessarily shared with the station as a whole. There are four levels in the structure of recorder entries, the hierarchy of subordinate entries fanning out from the root in a logical structure that resembles an inverted tree.

It is the root together with all its associated subordinate entries (call the whole collection the data set entry) that is the basic unit used for retrieving information. When a user interrogates the data base, the system provides every data set entry that satisfies the user's selection criterion. The contents of each such entry can be listed on a printer or on a user's interactive terminal in a variety of formats. In the "long" format all data element values in an entry will be listed in an order that shows their hierarchal relationships.

Every value in the strong-motion data base is associated with a data element name that is from one to ten characters long. The first character or two in a name indicates the entry type to which the data element belongs and the remaining characters indicate, in brief, which real world attribute the data element value represents.

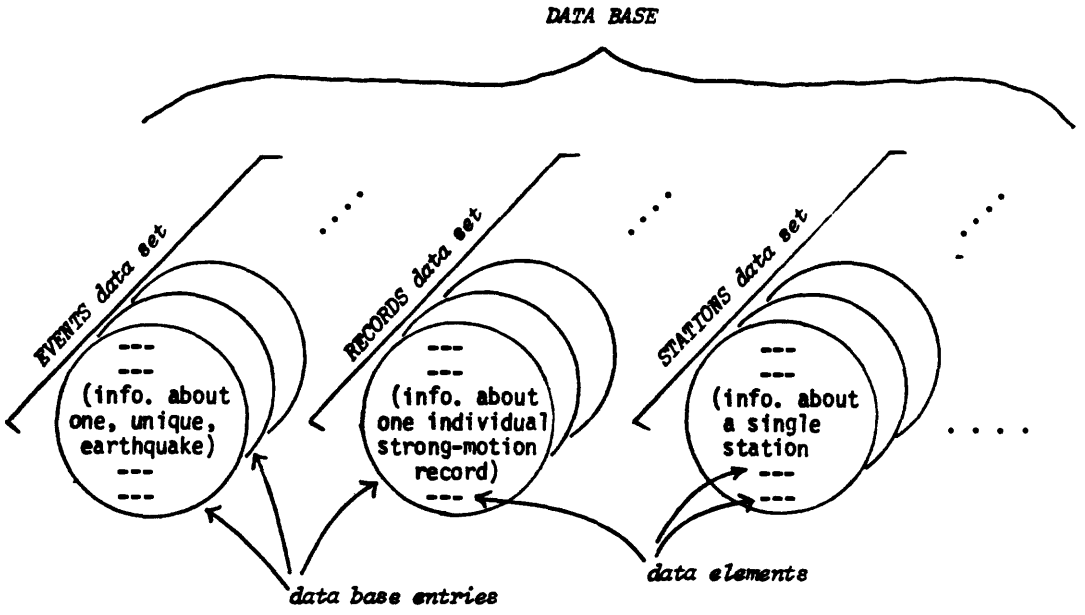

Figure 1.

Representation of the data base, the data sets, the data base entries, and the data elements.

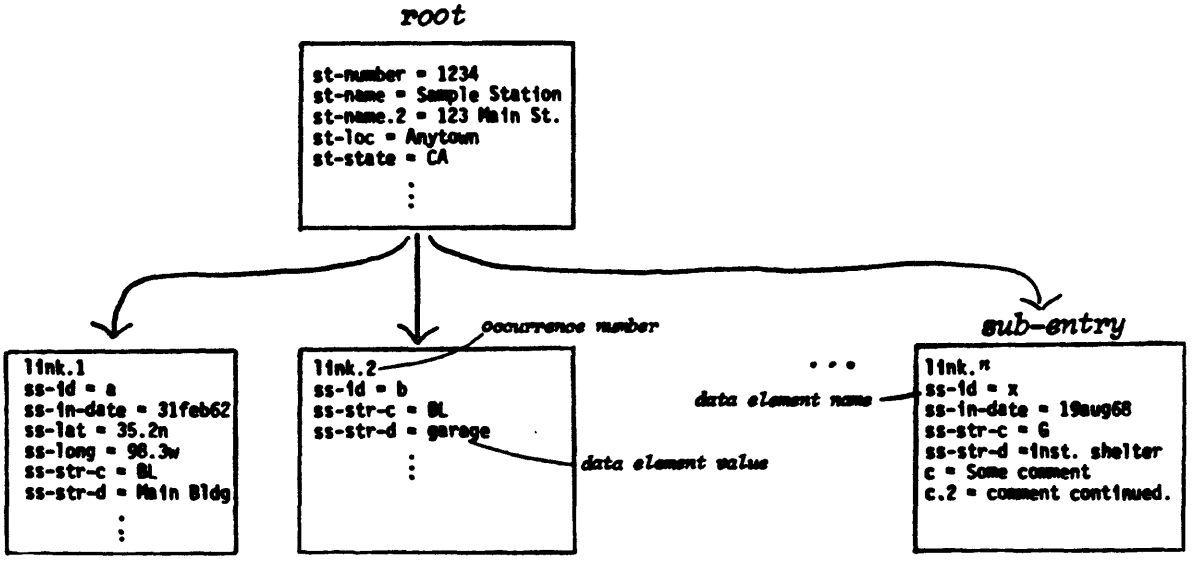

Figure 2.

A hypothetical entry in the stations data set.

All the data element names that will be recognized by the system are given in section IV along with a definition of the values they may carry.

The data elements that may occur in an entry type may occur once, several times, or not at all in any specific occurrence of that entry. If a data element occurs more than once in a single entry, that data element will be shown with occurrence numbers in the "long" format. These are printed as an integer following the data element name and separated from it by a period (e.g., the second line, or second occurrence of a station's name will be labeled as "st-name.2").

I.5 Sample Query Session

The computer program used to query the data base allows a user to retrieve and display data base entries in various ways. Detailed instructions for running the program are given in section II, but a sample terminal listing from a short series of interactive queries is shown here. This sample illustrates some of the concepts that were discussed above in section I.4, and it also illustrates the important commands named "find", "list", and "format". "find" is used to find, or retrieve specific data base entries; "list" is used to display the retrieved entries on the terminal, and "format" is used to indicate the format in which the entries should be listed.

In this example, the user was interested in records taken at station #1013. Since there were quite a few record descriptions retrieved by the find request, the user first listed them in the short format and then determined from the short list that it was the fifth record description retrieved that was of interest to her. She then listed just that fifth entry in its entirety. The description of the corresponding event was then retrieved and listed, and finally the description of the station that contained the transducers (whose signals were recorded) was retrieved and listed.

The lines that were typed by the user are underlined and the symbol <CR> in those lines represents the carriage-return key. The <LF> symbol at the beginning represents the line-feed key that the user typed to signal her presence to the computer, and the next few lines that are marked with brackets in the left-hand margin are those generated by the computer as an acknowledgement of the user's connection.

Figure 3a.

```
<LF>
The Commands and Active Functions Manual is now available.
Multics MR6.2D: USGS; Menlo Park, California
Load = 31.0 out of 85.0 units: users = 31
enter Sue-User Sebab <CR><LF>

   Welcome.
   If you need help whenever you are asked to give a command or response,
      type the question_mark key then the carriage-return key.
   Remember that every response you enter must be completed by the carriage
      return key.  Before striking carriage-return, you can make correction
      to your line by using the #-key (to delete characters) or the
      @-key (to delete the entire line).

 -- Want some introduction? --  no <CR>

   There may be a short wait now.

   entering strong-motion records information retrieval system.
 -- enter command --
  find r-stn = 1013; **  <CR>
7 member(s) in set 1
 -- enter command --
  format=short  list <CR>

     r-event-id    r-stn    r-peak-a    r-trans-l
  1)  27jun66       1013       0.500    ground level
  2)  02jul66       1013       0.045    ground level
  3)  03aug66       1013       0.021    ground level
  4)  00may67       1013                ground level
  5)  23jul67       1013       0.024    ground level
  6)  31dec67       1013       0.021    ground level
  7)  17nov69       1013                ground level
 -- enter command --
  format=long  list,5 <CR>
<bdms-id= 17>
changed.1 = 22aug78;
changed.2 = 19may78;
changed.3 = 01apr78;
r-event-id = 23jul67;
r-stn = 1013;
r-trans-l = ground level;
r-rr-id = ar-240&133;
r-epi-d = 18.000;
r-peak-a = 2.4000e-02;
 -- enter command --
  find event-id= 23jul67 <CR>
       ; **  <CR>
1 member(s) in set 2
 -- enter command --
```

Figure 3b.

```
format=short   list<CR>

     event-id    e-mag  e-max-mmi  event-name
     23jul67      3.70     6        Central California
 -- enter command --
 find st-number =1013; **   list <CR>
1 member(s) in set 3

     st-number    ss-str-d            st-name
          1013    small prefab bldg   Cholame-Shandon:
                                      Station 2
 -- enter command --
format=long  list <CR>
<bdms-id= 9>
changed.1 = 22aug78;
changed.2 = 19may78;
changed.3 = 26apr78;
changed.4 = 26apr78;
changed.5 = 01apr78;
st-number = 1013;
st-name.1 = Cholame-Shandon:;
st-name.2 = Station 2;
st-state = CA;
link1;
  ss-lat = 35.730n;
  ss-long = 120.290w;
  ss-str-c = IS;
  ss-str-d = small prefab bldg;
 -- enter command --
   stop <CR>
   exiting smr irs.

 -- Want to type some remarks? --  no<CR>

   Ending session.  Hang up your phone or re-enter and try again.
```

II. INTERACTIVE QUERIES

II.1 Accessing the System

The system can be interrogated using an ordinary telephone and an interactive keyboard terminal that operates in half duplex mode and which uses ASCII character codes. A terminal that supports both upper- and lower-case characters is more suitable than one that uses only upper case characters. A user needs to know only how to dial the computer and what to type to enter the retrieval system to begin using it. Once accessed, the system will offer a general introduction and will tell the user how to request more detailed instructions.

Perform the following steps to gain access to the system.

1) Set the switches, keys, or buttons on the terminal that allow a choice of operating modes .
   transmission speed = 30 characters per second
   half duplex
   on line
   lower case ASCII characters

2) Plug in and turn on the terminal. Turn on the acoustic coupler too, if it's a separate device. Look for a label or diagram on the acoustic coupler that will show you in which direction the telephone cord should go.

3) Telephone the USGS computer at Menlo Park. Dial (415) 326-4350 and wait for a high-pitched tone.

   If Menlo Park is a toll call, you will probably be able to dial a closer number in the TYMNET telecommunications network. See appendix A for details.

4) Quickly place the telephone handset in the cradle on the acoustic coupler. Watch for the "carrier detect" light to turn on, indicating that the terminal is properly receiving the signal.

5) Type the line-feed key. The computer will respond with several lines that will tell you which computer system you have accessed, how many other users are connected, etc.

6) If your terminal will transmit both upper- and lower-case characters, type:

   enter <your_name> SMIRS <CR> <LF>

   where <CR> is the carriage-return key,
   <LF> is the line-feed key, and
   <your_name> is your name typed without any embedded blanks.

Note that the word "enter" is in lower case and "SMIRS" is in upper case.

If your terminal has only upper-case characters, type:

MAP <CR> <LF>
ENTER <your-name> \S\M\I\R\S <CR> <LF>

The "MAP" statement instructs the computer to interpret all the alphabetic characters you will subsequently type as though they were in lower case, excepting those characters that follow a left-slant (\).

7) From now on, the system will prompt you whenever it expects you to type something. All the prompt lines begin and end with two dashes. Answer by typing the question mark key if you don't know what is expected of you.

If you have a terminal that won't operate in the appropriate modes, or if other access problems are encountered, contact April Converse ((415) 323-8111, ext. 2881 or FTS #467-2881).

Once you've entered the system you will be given an opportunity to review some introductory remarks, and then you will be asked to "-- enter command --". You may then direct the query-interpreting program. The commands you may use are described in detail below, in Section II.3. They are "help", "find", "format", "list", "print", "line", "set", "purge", and "stop". After the program has processed one command, it will again ask you to "-- enter command --". Type the various commands repeatedly to retrieve and display the data base entries in which you are interested. When you have finished your queries, indicate so by typing the "stop" command. You will then be given an opportunity to type remarks to the SEB staff. Outside users are encouraged to make suggestions toward improving the system.

II.2 Typing Conventions

The computer accepts one line of typing at a time. No command will be processed until you type a carriage return at the end of its line. Before the carriage-return key is typed, you can delete the entire line by typing the "@" character, or you can delete a series of characters by typing the "#" character an appropriate number of times.

The break key is another important key. It is used after a list command if you decide, once the listing has begun, that you're not interested in it after all, or that it's so long that you'd rather have it printed instead. You'll get a few more lines printed at the terminal and then you'll be asked to "-- enter command --" just as though the list had been allowed to finish. The break key is also called ATTEN, BRK, INTERRUPT or QUIT on various terminals.

(BEWARE, the break key causes problems sometimes. The problems will be corrected eventually, but for now, if the program aborts after you use the break key, just re-enter the system as you did initially. Another problem that often occurs when the break key is used is that the next "- enter command --" prompt gets suppressed right along with the listing.)

The query interpreter will accept commands in a free format. A command may begin at any location in a line, and there may be more than one command in a single line, although the commands must be separated from one another by one or more blanks. The command names must not contain any blanks. The several commands that may be followed by a comma and an integer that identifies the entry to be acted upon (e.g., "list,3") must not contain any blanks either.

The end of each data element value given in a find command must be explicitly indicated by typing the semicolon (;), and the end of the entire find command must be explicitly indicated by typing a double asterisk (**). This is because some data element values may contain blanks and because a complicated find command may span several lines. Notice in the sample query session shown above in section I.5 that the user made the common mistake of forgetting to type the semicolon after a data element value in one of her "find" requests. After she realized that the system was not responding to her request (because it was waiting for her to finish it), she typed the missing semicolon and double asterisk on the next line (since she had already typed the carriage-return key). The system then proceeded as was expected.

It is often best not to type any other commands after a find command on the same line, for it's easy to make a mistake in a complicated "find". If an error is encountered when the program processes a "find", the program will still attempt to interpret any other characters you've typed on that line, usually causing a lot of error messages to be printed. Also, if a large number of entries are found, you may want to list just a few of them, or if just a few entries are found, you may want to list them in a different format than you'd choose if more were found.

II.3 User Commands

Each time the program prints "- enter command --" on the terminal, the user should respond by typing a "find" command to retrieve a set of entries from the data base, a "list" command to display one or more of the entries that were found, a "stop" command, or one of the several other commands available for controlling the way retrieved data base entries are displayed.

The following commands are available at the present time.

help or ?

This instructs the program to print the short message "If you

need help, type: find info = general; ** list" that shows the user how to acquire instructions from the system. The info= general entry contains a table of contents for the other entries that provide instructions, news, or general information. That entry also contains a summary list of all commands that are available.

find <selection expression> **

The "find" command is used to search the data base for a specific set of entries. If any entries are found that satisfy the selection criterion, they form a new set on which subsequent "list" or "print" commands will act. The command consists of a "find" statement that is followed by an expression that describes the entries to be selected. The end of the selection expression must be signaled with a double asterisk (**).

The program will respond to a "find" command with

<n> members in set <s>

where the symbol <n> is the number of entries that satisfied the selection expression, and the symbol <s> is an identification number given to that set of entries. You may use the set number <s> as a component of subsequent selection expressions.

The selection expression describes the values of keyed data elements that occur in the data base entries that are to be returned by the "find" command. The expression may be a simple statement involving a single keyed data element and the value(s) for which the data base will be searched, or it may be a compound expression involving several keyed data elements. Two simple selection expression examples:

```
find info= general; **
find st-number > 1000; to 2000; **
```

The value specification may involve equality (=), inequality (>, >=, <, <=, or <>), or ranges (<value 1>; to <value 2>;). Furthermore, it is possible to search for entries having an occurrence of a specified data element regardless of value (e.g., "find info; **"). Truncated value specification may be used to search for those entries having an occurrence of a character string key that begins in a particular way.

You must know the names of the data elements in which you're interested in order to retrieve any information about them from the data base. You must also know which of the data elements have been keyed (i.e., have an index into the data base), for it is only the keyed data elements that can be used successfully in a "find" command.

The names of all data elements that may occur in the data base are shown in Figure 4a, section IV, and those that are keyed are shown with a question mark (?) before the name.

Data element names can also be found within the data base under the appropriate "dataset" entry. For example, a list of the names and attributes of all data elements that may occur in a station entry may be obtained by typing:

```
find data set = stations; ** list
```

A compound selection expression may be constructed by combining several simple selection expressions (or previously found set numbers) using the Boolean operators, " and ", " or ", and " not ". Two examples:

```
find info; and changed >01jan78;**
find 1 and changed >01 jan78;**
```

Note that the Boolean operators must be typed with a space on each end.

Nested parentheses may be used to construct an arbitrarily complex selection expression. An example:

```
find st-number >1000; to 2000; and (not ss-in-date;
or (ss-in-date > 01jan69; and not ss-rm-date;)) **
```

Notice that the semicolon (;) must be used to signal the end of each value given in the selection expression. If you forget the semicolon, anything else that you type will be accepted by the program as a continuation of the (unintentionally) unterminated value. It will be a nonsensical value, of course, but the program won't sense that until it tries to process the expression (which the program won't begin to do as long as it's accepting the characters you have typed as part of the data element value).

Keep both termination delimiters (; and **) in mind whenever it seems that the program is not responding to your "find" command. If you realize that you've misused or forgotten either of the delimiters, just type the semicolon and/or double asterisk. The nonsensical "find" will be processed and when you are again asked to "-- enter command --" you can retype the "find" command correctly. Of course, if you realize that you've mistyped a line before you strike the carriage-return key, you can just delete or correct the line by using the "@" or "#" keys.

The syntax of selection expressions is described in detail in a later subsection (II.4).

list or list,<n>

This command lists the n-th entry in the current set on your terminal. If the number <n> is omitted, all entries in the set will be listed.

The format in which entries are listed is controlled by the format command.

Once the listing begins, you can stop it by typing the break key. (The break key is also called ATTEN, BRK, INTERRUPT, or QUIT on some terminals.)

print or print,<n>

This command is identical to "list" except that the entries are not listed on your terminal, but rather on a computer file that can be sent to the computer's line printer once the session has concluded. If you issue any "print" commands during the session you will be asked, after you've issued the "stop" command, if you want the file printed. If you respond "yes" you will then be asked for your mailing address.

format=<format specification>

This command sets the format in which entries will be listed or printed. <format specification> can be "ident", "short", or "long". The default is "short".

Each format statement you type remains in effect until you change it with another format statement.

Command	Resulting format
format=ident	one line per entry that shows only the name and value of the primary data element and the date the entry was was last changed.
format=short	one or two lines per entry showing just the more frequently needed items of information. Most entry types have their own short format, although some have no short form (yet). Those entries that can't be listed in a short format will be listed in long format.
format=long	each data element that occurs in the entry will be listed on a separate line and will be numbered if several occurrences of that data element are linked to the same parent occurrence, or if it is a root level data element that occurs more than once. Subordinate data elements will be listed following the parent occurrence to which they are linked and will be indented according to their level in the hierarchal structure.

More formats will be available in the future.

set,<s>

This command makes a previously-found set of data base entries (set number <s>) the current set on which subsequent "list" and "print" commands will act. Unless this "set" command is used to change the current set number, the current set is the set created with the last "find" command.

purge

This command purges all previously-found sets of data base entries, freeing the disk and main memory space the sets use. It is good practice to purge sets you are unlikely to refer to again.

line,<n>

This command resets the input/output line length to <n> characters. The default is 80 characters.

stop

This signals that you are ready to end your session. You will be asked for your mailing address if you issued any print commands during the session, and you will be given an opportunity to type remarks to the SEB staff.

II.4 Selection Expression Syntax

Entries are retrieved from the data base when the user types a "find" command in the following form.

find <selection expression> **

Simple selection expressions

A simple selection expression has the form:

<keyed data element name> { { = / > / >= } <value>; to [{ [=] / < / <= } <value2>;] / { < / <= / <> } <value>; / ; }

Where curly brackets surround a set of options, one of which must be chosen, and square brackets [] surround a completely optional element.

The relational operators <=, >=, and <> stand for "less than or equal", "greater than or equal", and "not equal", respectively. Thus, an exact value, an inclusive or exclusive upper or lower bound, or a range of values may be specified.

Some Examples of valid simple expressions:

```
st-state = CA;
st-state <> CA;
dataset;
r-peak-a >= 0.5;
r-peak-a = 0.3; to 0.5;
r-peak- > 0.3; to < 0.5;
```

The latter two examples differ in that the second excludes both end-points of the range.

The expression

<keyed data element name> <> <value>;

will be satisfied by all entries which

a) have at least one occurrence of the named data element, and
b) have no occurrence of that data element whose value matches that given.

If no value appears after the relational operators "=" or "<>", a search is made for those entries which respectively do or do not have an occurrence of that data element with a null value. (However, there are very few data elements in this data base that have been assigned a null value.)

The last form allowed for a simple selection expression, i.e.,

<keyed data element name>;

selects the set of all entries having any occurrence of the specified data element, regardless of value. Thus, to find all entries that contain a value for the data element named info, one should type the following.

find info; **

Truncated Values

Truncation provides a way of searching for entries that contain occurrences of a character-type data element whose value begins in a specified way, regardless of the rest of the value. The truncation is requested by typing a single slash (/) following the partial value.

The truncation feature is particularly useful when used with the data elements named "event-id" and "r-event-id". These are the event identifiers in the event and record entries, respectively. The identifiers usually consist of just the date of the event, but if records have been taken for several distinct events that occurred on the same day, additional characters are added onto the end of the date to distinguish the several identifiers.

The command

find event-id = 30aug66; **

will only select an event entry which contains the identifier "30aug66" with no additional characters in it. The command

find event-id = 30aug66/; **

will select all entries that have 30aug66 as the first, and perhaps only, part of their identifiers.

Compound Selection Expressions

The most general selection expression that may appear in a find command is constructed out of simple selection conditions and previously-found sets of data base entries according to the following recursive definition:

<condition> ::= [not] { <simple condition> / <set number> } [{ and / or } <condition>]

That is, simple conditions and previously-found sets of data base entries, identified by number, may be combined using the Boolean operators " and ", " or ", and " not ". " not " has the highest precedence and " or " the lowest; this ordering may be overridden through use of parentheses.

Note that simple selection conditions and set numbers play equivalent roles in a compound selection condition. This is because each simple condition may be viewed as defining an intermediate set of data base entries. These sets, along with any existing sets appearing in the "find" command, are then combined by union (" or "), intersection (" and "), and complement (" not ").

It should be noted that the two conditions

```
st-state <> CA;
```

and

```
not st-state = CA;
```

are not equivalent. The first will be satisfied by those entries that have at least one occurrence of the data element named st-state, yet have no occurrences with the value of "CA". The second differs in that entries having no occurrence of st-state will also satisfy it. "not st-state = CA" would select not only those entries that describe stations outside of California, but would also select all record entries, all event entries, and so forth. (Not a very reasonable thing to do unless the expression is "and"-ed with another that will limit the number of entries that will be selected.) This happens because " not " complements the set defined by the condition which follows the " not " against the entire data base. Thus, the effect of a " not " operator cannot simply be absorbed into the relation operator and

not =	are not equivalent to	<>
not <		>=
not >		<=
not <=		>
not >=		<
not <>		=

II.5 Guidelines for Constructing Find Commands

- Remember to use the semicolon to delimit the end of each data element value you type in a "find" command. The program cannot assume that the value has ended when you type a space because the space is an acceptable part of a character string value.

- Remember to type the double asterisk to delimit the end of a "find" command. The program will not just assume that the "find" command has been ended when you begin to type another command; for all that you type will be accepted as just a continuation of the "find". Also, it cannot assume that the command has ended when you type the carriage-return key because a selection expression can get so long and complicated that it must span several lines.

- Only the data elements that have been keyed (i.e., those that have an index into the rest of the data) may be used in a selection expression. (However, the program may be changed someday to accept the unkeyed data elements too.) It's easy to forget which data elements are keyed and which are not, so it's a good idea to break a complicated selection expression into several "find" commands so you won't have to retype the entire expression when the program tells you that you've made an error.

- Remember that you can use the number that identifies a set of data base entries that you've already found as a component in subsequent "finds". Let's say, for instance, that you issued a "find" command and the program responded with

  173 members in set 3

  Well, you're not going to want to list 173 entries on the terminal, so you would probably find a subset of those 173 entries for listing purposes. If they were record entries, you might select those entries that had a significant peak acceleration, e.g.,

  find 3 and r-peak-a > 0.3; **

- The values for each type of data element are stored in one of several forms: an integer number, a real number, a character string, or a node. (A node is a special type that carries no value; nodes are used only as flags or as links between parent and subordinate entries.)

  When using inequalities in your find expressions, remember that "greater than" is used in an alphabetical sense for character-type data elements. Thus, the character string "35" is greater than the character string "1256".

If you wish to know which data elements are stored as numbers and which are characters, refer to the tables in Section IV or in the appropriate data set entry. (e.g., type "find data set = stations; ** list" to learn whether station numbers are stored as numbers or as characters.) The tables also indicate which of the data elements are keyed. They also show a 2-character synonym that may be used in place of the longer data element name.

Some of the data element types are shown in the tables as being "special". Values for these data elements are processed specially so that they appear in one form in the listings, but they are stored internally in another. Thedates, latitudes, and longitudes are all special; although they contain alphabetic characters in the lists, they are stored in a numeric form so that it makes sense to use them with inequalities in find expressions. Otherwise, an expression like "st-in-date = 21jan75; to 01apr78;" wouldn't make any sense.

- Although the character string values may be of any length, it is only the first few characters (12 on MULTICS and 10 on the LBL computers) that are kept in the index for keyed character string values.

- The recorder identifications that occur in the record entries (r-rr-id) and in the recorder entries (rr-id) also receive special processing. These ids consist of a mnemonic record code followed by the ampersand character (&), followed by the recorder's serial number. The truncation feature can be used in a selection expression to specify just the recorder id, but a separate key has been maintained to allow just the serial number portion of the id to be specified in a selection expression. The serial number keys are named rr-sn and r-rr-sn.

- Remember to type the "purge" command to release the main memory and disk space taken up by sets of retrieved entries that you're unlikely to refer to again. The main memory space is limited and the program will stop if it runs out of room in its working storage area.

II.6 Common Problems

A list of problems that sometimes occur when using the query-interpreting program is given below. An effort will be made to change the system to eliminate (or improve) them, but in the meantime, users should keep them, and the suggested techniques for avoiding them, in mind.

As the system develops, it is likely that new problems will arise. A current list will be kept in the data base in the info=problems entry.

- If the program doesn't respond, it's often because you've forgotten to use the "**" or ";" properly in a "find" command. Try typing the asterisks; if that doesn't evoke the "-- enter command --" prompt, try "; **".

- Another reason that the program may not be responding may be that you just typed the break key and the " -- enter command --" prompt was suppressed right along with the listing you were trying to halt. To check whether the system is waiting for you to type something, try typing the question-mark key.

- If you don't type anything for 15 minutes the computer will assume that you've left the terminal and have forgotten to hang up the telephone. So the computer will disconnect the line for you. (A very annoying thing for it to do if you're just sitting there taking a long while to think about some information you've just displayed!) In the future the system will ask you if you're still there rather than arbitrarily disconnecting the line, but in the meantime, try to remember to type something (the question-mark key would be a good choice) occasionally just to let the computer know you're still there.

- Working storage space in the computer's main memory is limited. The program will stop if there's not enough working storage left for it to continue. So use the "purge" command to release the space used by sets of entries that you'll not likely want to refer to again.

As a last resort, you can just hang up the phone and try again when the system behaves strangely.

III. COMPREHENSIVE PRINTED REPORTS

Computer programs are being developed that will generate a variety of printed reports on the information in the strong-motion data base. These reports are intended primarily for the SEB for its regular use and for publications, but others also may make use of the reporting capability. The report generators will allow the user to select various subsets of the data to be printed in a standard report format, and will allow the user to choose the sequence in which to report the information.

Some of the reports forseen include the following:

- Annual station list publication. This report will show all information in the data base for every station and instrument in the network. Presently, this report is generated from a sequential file of data card images by the program named ANLST. The data from the ANLST file will be loaded into the data base when the new reporting capability is satisfactory. The new report will have a considerably different format than does the report generated by the ANLST program, since much more information will be available from the data base than is available from the ANLST data file.

- An abbreviated station list that shows only a general description of each station. Presently, this list can be generated by the program named STNLST, which uses the ANLST station data file.

- Record labels. Labels for the strong-motion records are plotted by the computer onto 35mm film. They are then photographically enlarged onto mylar film and spliced to the records for identification. Presently, labels can be generated from the program named LABELS, which uses the ANLST station-data file.

These report capabilities will be an improvement over the report generators that are presently available. However, as the data base is used and expanded, it is anticipated that the system will be developed further to provide new types of reports.

IV. DATA BASE CONTENTS

IV.1 Introduction

The meaning of every type of data element that may occur in the strong-motion data base is detailed in this section. Each data element type is identified by a unique name, and all the names that will be recognized by the system are shown in Figure 4 (subsection IV.2). A description of the range and meaning of the values each data element can assume is then presented in the tables in subsection IV.3.

The data element names are from one to ten characters long. The first character or two in a name indicates the entry type to which the data element belongs. For example, all data elements that may occur in the root level of a station entry have names beginning with "st-". The remaining characters in a name indicate, in brief, which real world attribute the data element value represents.

The data element names are used to retrieve information from the data base, so, for those who dislike typing the long names, each name has been given a short two-character synonym. The synonyms are listed along with the long form of the names in the tables below.

The tables also show which of the data elements have been keyed (i.e., have an index into the data base), for it is only the keyed data elements that can be used successfully in a "find" command.

Each data element's data type is also shown in the tables. It may be an integer number, a real number, a character string, or a node. A node is a special type that carries no value; nodes are used only as flags or as links between parent and subordinate entries. Data types for some of the data elements are indicated as being "special". Their values are processed specially so that they appear in one form in the lists, but are stored internally in another form.

Data elements may occur once, several times, or not at all in any specific entry. Those that reasonably can be expected to occur more than once in any one entry are indicated in Figure 4 and in the tables by an underscored data element name. The other data elements still may occur multiply in some entries, particularly those that contain preliminary information, the several occurrences indicating an upper and lower bound for an uncertain value.

Many of the data elements that are described in this section do not actually occur in the data base yet, but they will in the future. For example, the entire recorders data set is empty at the present time (September 1978).

IV.2 Summary Diagram

The diagram in Figure 4 illustrates how the strong-motion data has been arranged in a data base that is divided into several data sets. Each data set is composed of a hierarchy of progressively subordinate entry types with each entry type containing a prescribed set of named data elements.[1]

The meanings of the symbols shown with the data element names given in the diagram are as follows.

- Collections of data elements representing root or sub-entries are enclosed in rectangles. The approximate number of entities presently occurring in each data set is noted along the top of the rectangle enclosing the root.

- Solid arrows indicate the hierarchy among entries belonging to the same data set. The link name and the number of subordinate entries that are frequently associated with a single occurrence of the parent are noted alongside the arrows.

- Dashed lines indicate some of the important logical cross-references among entities belonging to different data sets.

- An underlined data element name indicates that the data element may occur more than once within a single entry.

- "?" indicates that the data element is a retrieval key. The system maintains an index for each key to effect efficient retrieval of entries according to the value of that key.

- "**" indicates that the only values the data element may assume are those codes defined in one of the smaller data sets.

- "*" indicates that the data element value may be only one of a few valid codes.

- "#" indicates that the data element, when missing from a specific subordinate entry, has the same value that it had in the previous entry (under the same parent). When such a data element is genuinely undefined, it will carry a "null" value.

---

[1] Different data base and file management systems use a variety of different terms for these concepts. Some systems use the term "file" or "data base" rather than "data set"; some use "field" or "elementary item" instead of "data element"; and many systems, including BDMS, use the word "record" instead of "entry". "Entry" will be used here, however, to avoid confusing a strong-motion record with the computer program's input/output record.

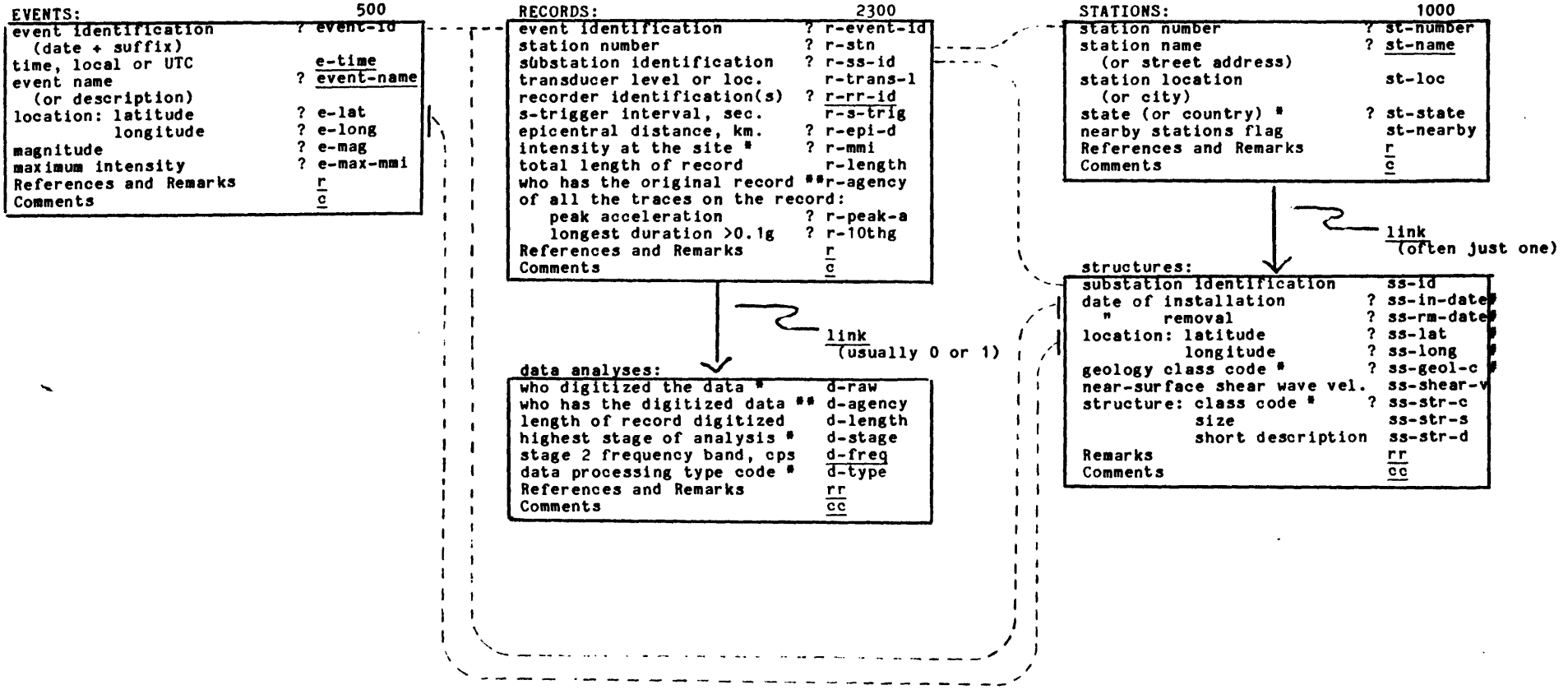

Figure 4a. The names of the data elements.
See text for meanings of various symbols.

A. RECORDERS: 1800

recorder identification (**)	?	rr-id
owner agency	?	rr-owner
date of installation	?	rr-in-date
" removal	?	rr-rm-date
Remarks		r
Comments		c

link1 (usually just one)

substations serviced:

station number	?	sss-stn
substation identifier		sss-id
Remarks		rr
Comments		cc

link2 (often 3,5,9 or 12)

transducers:

transducer serial number		t-sn
date of installation		t-in-date#
" removal		t-rm-date#
location: code #	?	t-loc-c #
short description		t-loc-d #
direction of acceleration for positive trace		t-accel
orientation		t-orient
relative location on the physical record.		t-trace
Remarks		rrr
Comments		ccc

link3 (any number)

transducer calibrations:

calibration date		c-date #
sensitivity, cm./g.		c-sens
period, sec.		c-period
damping, fraction of crit.		c-damping
Remarks		rrrr
Comments		cccc

B. Dictionary data sets

B.1 Recorder TYPES: 25

recorder type code (**)	?	rec-code
Remarks describing the recorder and its transducers.		r
Comments		c

B.2 AGENCIES (recorder owners and sources of information):

agency code (**)	?	agency
Remarks about the agency, its full name, address and names of people or sub-organizations who can provide information.		r
Comments		c

B.3 ARRAYS:

array name (**)	?	array
list of: stations and their substions in the array.	?	a-stn a-sub-stn
Remarks		r
Comments		c

B.4 groups of NEARBY stations:

a list of stations that are nearby one another.	?	nearby
Remarks		r
Comments		c

C. General information data sets

C.1 Remarks about this data base and other sources of strong-motion information:

name of one of the categories of general information (e.g., "news", "commands"" "data processing" ...)	? info
Remarks	r

C.2 Information about the other data sets:

data set name	dataset
date to which the data in the named data set is current.	current
Remarks about the data set	r

Figure 4b.

IV.3 Detailed Data Element Descriptions

The format and restrictions on the values each data element can usually assume are described in the lists below, along with the data element name. The date values and the latitude and longitude values occur in several different data sets, however, so they are described here. Other codes that are frequently used but that are subject to change are described within the data base itself in one of the dictionary data sets.

Date values are displayed as seven characters, the day of the month (two digits), the month (three characters), and the year (two digits). Although this format is easy for a user to read, it does not lend itself to determining chronology in a computer program. For this reason, the program converts dates to a numeric format for its internal storage.

Latitudes and longitudes also are displayed in character form but stored in the data base as numbers. They are displayed as a number, representing degrees in geographic coordinates, followed by a "n", "s", "e", or "w" suffix to indicate direction.

a. Miscellaneous Data Elements

There are a few entries in the data base that offer general information rather than specific descriptions of the strong-motion network. These are retrieved by issuing a "find" command for a specific value of the data element named "info" or the data element "dataset". When listed, these entries will show commentary on the type of general information requested or the data set requested.

The values that the data element named "info" assumes will vary according to the messages that those who maintain the data base wish to make available to the general user. The new user should retrieve and list the entry for info=general (to do this type "find info= general; **") to learn of other info entries that provide information useful to an inexperienced user. A user who is familiar with the system can retrieve and list the entries for info=news to learn if any changes have recently been made to the system.

The values that the data element named "dataset" may assume are the names of the data sets in the data base. When a "dataset" entry is retrieved and listed (e.g., type "find dataset= stations; ** list"), it will show general remarks about that particular data set, examples for retrieving entries from the data set, and a list of the names and synonyms of all the data elements that may occur in the data set along with their data type and a short description.

Remarks, such as those in the "info" and "dataset" entries, also can occur in every other entry in the data base. They'll include subjective information about the rest of the information in the entry, references to published papers concerned with the information, and perhaps items that were not planned for when the system was designed

but which will occur separately when the data base is next restructured. Comments, like the remarks, also can occur in every entry in the data base, but they are meant to contain temporary commentary that will not appear in the printed reports.

"PRELIM", "changed", and "source" are also special data elements that may be members of every root level entry in the data base. If present, "PRELIM" indicates that the entire contents of the entry should be considered quite preliminary and subject to change. The remarks and comments included in the same entry will probably indicate why the information is unreliable. (None of the entries in the data base at the present time have been flagged with "PRELIM", since all of them must be considered to be preliminary.) Each "changed" value represents the date a change was made to the entry anywhere in the root or any of its subordinate entries. The "source" data element has not been used at all yet, but it may be used in the future to indicate the source of the rest of the information in the entry.

b. Record Information

An entry in the records data set may have two levels. The root contains general information about the record, where the record is stored, what event it recorded, etc. Subordinate to the root may be entries that describe the data analyses that have been performed on the record traces. Most records will not have been digitized at all, but some may have been digitized several times and may have been analyzed to various stages.

There may be several distinct record entries for the same event, station and substation. For example, there may be one record for an event/station/substation for those traces taken on the roof of a structure, another for those taken at mid-level, and yet another for traces taken in the basement of the same structure.

The data elements that may occur in the root entry are described in the table below. The full data element name and its two-character synonym are given in the first column. Those data elements that are keyed are also indicated in the first column.

element name	data type	description
r-event-id r2 (keyed)	integer (special)	Identification of the event recorded. This unique event identifier will be the date of the event if it was the only event recorded that day, or the date plus a unique suffix if there were more than one event recorded that day. The suffix is an identifier that has no meaning outside the framework of this data base. It is used to cross-reference record entries with event entries by comparing "r-event-id" to "event-id".

Record Information, continued

element name	data type	description
r-stn r1 (keyed)	integer	Station number at the site of the transducers. This data element can be cross-referenced to "st-number" in the stations data set described below.
r-ss-id ra (keyed)	character	Substation identification at the transducer site. This data element can be cross-referenced to "ss-id" in the stations data set.
r-trans-l r4	character	Transducer level or location. This information may be available more accurately as "t-loc-c" and "t-loc-d" in the appropriate member of the recorders data set, but it is repeated here for convenience.
r-rr-id r5 (keyed)	character (special)	Recorder identification, consisting of a recorder type code and serial number, separated by the ampersand symbol (&). This data element can be cross-referenced to "rr-id" in the recorders data set to learn more about the recording instrument, the different places it may have resided at different times, and the calibration history of the transducers connected to the recorder. The recognized recorder type codes are stored as "rec-code" in the recorder types data set. Record entries may be retrieved from the data base based on just the recorder code portion of "r-rr-id" by using the truncation feature of the query language (e.g., find r-rr-id = SMA/; **), but a separate key, named "r-rr-sn" has been maintained to allow just the serial number portion of "r-rr-id" to be specified in a selection expression. "r-rr-id" may occur more than once in record entries describing those (few) logical records that consist of traces occurring on more than one physical record. A logical record consists only of traces from transducers that are located at the same level of the same structure. It may differ from a physical record made by remote transducers placed in several locations.

Record Information, continued

element name	data type	description
r-s-trig rb	real	S-trigger interval, in seconds; the time lapse between the beginning of the record and the estimated arrival of the S-wave.
r-epi-d r3 (keyed)	real	Distance between the recording site and the event's epicenter, ± 10 km or, at least, dependent on the accuracy of the locations of the source and site. This item should be recalculated whenever the latitude and longitude of the recording site and of the event epicenter are also available in the data base since the latitude and longitude of either may have been re-evaluated since r-epi-d was last calculated. Epicenter latitude and longitude are stored as "e-lat" and "e-long" in the events data set. Recording site latitude and longitude are stored as "ss-lat" and "ss-long" in the stations data set.
r-mmi rc (keyed)	character	Event intensity at the recording site, Modified Mercali intensity scale.
r-length rd	character	Total length of the record, in seconds.
r-agency re	character	A code indicating the agency that stores the original record. The recognized codes are stored as "agency" in the agencies data set.
r-peak-a r6 (keyed)	real	Approximate maximum acceleration recorded, in g's, of all the traces on the record.
r-10thg rf (keyed)	real	Approximate time interval between the first and last peaks >0.1g, in seconds. If there was just a single peak on the record, "r-10thg" will be present in the entry, but will carry no value.
r	character	References and remarks about the record.
c	character	Comments.
link	-	Parent links to analyses sub-entries.

Record Information, continued

Record Analysis sub-entries

Only significant records are digitized and only the more significant of these are analysed. Therefore, most members of the records data set will have no analysis sub-entries at all. If the record has been digitized more than once and analyses performed on each, then there will be several analysis entries and they will be given in order of decreasing significance. The data elements that may occur in such an entry are the following:

element name	data type	description
d-raw rg	character	Source of the raw digitized data. Analog traces must be digitized before computer analyses can be performed on them. The recognized digitizer codes are:

code	description
DG	Dynamic Graphics Corporation (Hand-held cursor; 6-foot light table)
IOM	I/O Metrics Corporation (Automatic trace-following laser: 12 cm X 12 cm frames)
EEC	Stanford University Earthquake Engineering Center (Hand-held cursor; 6-foot light table)
GSCD	USGS Cartography Division (Hand-held cursor; 6-foot light table)
CIT	Caltech (Hand-held cursor; 2-ft light table)
EDS	Environmental Data Service (Rotating drum scanner)

Signals that are recorded digitally onto magnetic cassettes must be transferred from the tape cassettes to standard computer-readable magnetic tapes before computer analyses can be performed. The codes that indicate which machine performed this task are as follows:

code	description
CM7	Terra Technology's CM7000 machine converted the data from a Terra Technology DCA cassette.

Record Information, continued

element name	data type	description
		EEC Stanford University Earthquake Engineering Center's machine converted the data from a Terra Technology DCA cassette. USGS USGS Office of Earthquake Studies converted the data using a PDP-11/70 computer.
d-agency rh	character	A code indicating the agency that can supply the digitized data and analysis results.
d-length ri	character	Length of the record that was digitized, in seconds.
d-stage rj	character	Highest stage of routine analysis that has been performed on digitized data. Each stage of analysis operates on the results from the previous stage. "d-stage" indicates analyses that are routinely performed on the data, but not any special studies that may have been made with the data. The results from each stage of routine analysis are available in reports, on cards, or magnetic tape. Information may be obtained from the Data Management Section of the SEB (telephone Gerry Brady or Virg Perez at (415) 323-8111, ext. 2881).

The recognized stage codes are:

code	meaning
0	Raw, uncorrected data.
1	Data has been scaled for time and fixed base line; time is scaled to seconds; accelerations are scaled to g/10.
2	Acceleration data includes instrument and base-line corrections. Computed ground velocities and displacements are included with the data.
3	True velocity spectra, Fourier amplitude spectra, and pseudo velocity spectra have been computed.

Record Information, continued

element name	data type	description
		4 Fourier amplitude spectra have been computed.
		5 Velocity response envelope spectra (VRES) have been computed.
d-freq rk	character	Frequency band used in the stage 2 analysis, in cps.
d-type rl	character	Data processing type code. This code (yet to be devised) will indicate those analyses that have been performed differently than the standard processing currently used by the SEB.
rr	character	References and remarks about the raw digitized data or the analyses performed on it.
cc	character	Comments.

c. Event Information

Each event entry describes a seismic event that produced at least one of the strong-motion records described in the records data set. There may be several distinct entries for a single event if several agencies have made significantly different determinations of the event's characteristics.

The data elements that may occur in an event entry are the following:

element name	data type	description
event-id el (keyed)	integer (special)	Identification of the event recorded. This unique event identifier will be the local date of the event if it was the only event recorded that day, or the date plus a unique suffix if there were more than one event recorded that day. The suffix is an identifier that has no meaning outside the framework of this data base. It is used to cross-reference event entries with record entries by comparing "event-id" to "r-event-id".

Event Information, continued

element name	data type	description
e-time e2	characters	Time of the event followed by a suffix indicating the time zone. If the suffix is missing, it is the time zone in which the event occurred. Two values may be given, one for local and the other for Universal Time Coordinated (UTC). If the UTC corresponds to the day before that given in "event-id", then the suffix will be followed by a minus sign (UTC-). The suffix will be followed by a plus sign (UTC+) if the UTC corresponds to the day after the date given in "event-id".
event-name e3 (keyed)	characters	Event name or description.
e-lat e4 (keyed)	real (special)	Latitude of the epicenter.
e-long e5 (keyed)	real (special)	Longitude of the epicenter.
e-mag e6 (keyed)	real	Magnitude of the event.
e-mag-type ea	character	Type of magnitude indicated in "e-mag" S = surface-wave B = body-wave L = local
e-max-mmi e7 (keyed)	character	Maximum intensity of the event, Modified Mercali intensity scale. (Note: The data type for "e-max-mmi" will be changed soon so that it will be stored as an integer but displayed in Roman numerals.)
r	character	References and Remarks. These will include identification of the agencies that determined the other values given in the entry.
c	character	Comments

d. Station Information

A member of the stations data set has two levels. The root contains general information about the station, and subordinate to the root are descriptions of the instrumented structures or free-field sites that are included in the station.

It should be noted that the arrangement of structures in their stations is somewhat arbitrary. Station identification is assigned to the transducer sites according to the way a specific recording site is organized and not according to any generally applied rule. For example, the instrumentation associated with a dam site may be scattered over several miles, and it may or may not all be regarded as a single station, depending on how the maintenance people regard the instruments.

Although the data base is organized as though a structure may contain any number of recorders, in the past each recorder was assigned its own, unique station number. Recorders that were formerly thought of as separate stations but which are located in the same building have been collected together as members of a single substation within a single station. The station number chosen for the collection is the smallest number from the group of former station numbers. The former station numbers will be retained in the recorders data set.

A structure may contain any number of transducers and any number of recorders. These transducers and recorders need not be interconnected. A transducer residing in a substation may be attached to a remote recorder that resides in a different substation or even in a different station. For this reason the information about the instruments that are, or ever have been, in a station is not included in the station entry, but is stored separately, in the recorders data set.

The following data elements may occur in the root:

element name	data type	description
st-number s1 (keyed)	integer	Station number, 1 to 9999.
st-name s2 (keyed)	characters (special)	Station name and address. If the station has both a name and an address the first occurrence of "st-name" will be its name and the second occurrence will be its street address. Any leading numbers in a "st-name" value will be assumed to be street numbers; the program moves them from the beginning of the character string to the end when storing the value in the data base, so station information may be sorted by street name.

Station Information, continued

element name	data type	description
st-loc s3	characters	City or rural location.
st-state s4	characters	State or country. The state codes are the 2-character zip-code abbreviations used for states within the USA. A non-duplicating 2-character code for nation-states will be devised when needed.
st-nearby sa	-	Nearby stations flag. This will be present if there are other stations that are located near, or are closely related to, this one. The numbers of the other stations can often be found by retrieving those groups-of-nearby-stations entries and those array entries that include "st-number" in their "nearby" list or "a-stn" list.
r	character	Remarks.
c	character	Comments.
link	-	Parent links to instrumented structure sub-entries.

Station Structure sub-entries

There may be any number of structure and free-field sites collected together as a single station. The term substation is used to refer to either a structure or a free-field site.

The following data elements may occur in a substation sub-entry. The hash symbols (#) shown with some of the data elements indicate that the data element, when missing from any but the first substation, has the same value as it had for the previous substation.

element name	data type	description
ss-id sb	character	Substation identification. This data element will usually be given only if the station is composed of more than one structure or free-field site.
ss-in-date sc (keyed)	integer (special) (#)	Installation date.

Station Information, continued

element name	data type	description
ss-rm-date sd (keyed)	integer (special)	Removal date. If the substation is still in the network, there will be no "ss-rm-date" in the sub-entry. The dates when instrumentation was physically installed or removed are stored in the recorders data set as "rr-in-date", "rr-rm-date", "t-in-date", and "t-rm-date".
ss-lat s5 (keyed)	real (special) (#)	Latitude of the substation.
ss-long s6 (keyed)	real (special) (#)	Longitude of the substation.
ss-geol-c se (keyed)	character (#)	A code indicating the site geology. Refer to the info=geology codes entry for an explanation of the codes.
ss-shear-v sf	character (#)	Near-surface shear wave velocity.
ss-str-c s8 (keyed)	character	Structure class code. The recognized structure class codes are: G ground (approximately free-field) BL building D dam BR bridge X other
ss-str-s s7	character	Size of the structure (e.g., 12 story, 50m high, or 4km long)
ss-str-d s9	character	A short description of the type of construction, to supplement "ss-str-c" and "ss-str-s".
rr	character	Remarks.
cc	character	Comments.

e. Recorder Information

Details about each recorder that has ever been in the network are stored in the recorders data set. The different locations in which a recorder may have resided in the past will each be described in a separate record entry.

There are four levels in these entries. The root level simply identifies the recorder, its owner, and the time interval during which the recorder was in place. Each sub-entry at the second level identifies a substation that contains some of the recorder's transducers. Each sub-entry at the third level describes a transducer, and each fourth level sub-entry provides calibration information for the transducer.

The following data elements may occur in the root:

element name	data type	description
rr-id ia (keyed)	character (special)	Recorder identification, consisting of a recorder type code and serial number, separated by the ampersand symbol (&). This data element can be cross-referenced to "r-rr-id" in the records data set to learn whether any significant records have been taken by this instrument. The recognized recorder type codes are stored as "rec-code" in the recorder types data set. Recorder entries may be retrieved from the data base based on just the recorder code portion of "rr-id" by using the truncation feature of the query language (e.g., "find rr-id = SMA/; **"), but a separate key, named "rr-sn", has been maintained to allow just the serial number portion of "rr-id" to be specified in a selection expression.
rr-owner ib (keyed)	character	Owner agency code. The recognized agency codes are explained in the agencies data set.
rr-in-date ic (keyed)	integer (special)	Date the recorder was installed.
rr-rm-date id (keyed)	integer (special)	Date the recorder was removed.

Recorder Information, continued

element name	data type	description
r	character	Remarks.
c	character	Comments.
link	-	Parent links to substations serviced by the recorder. Most recorders service just one substation.

The data elements that may occur in any of the substations linked to the recorder root entry are:

sss-stn ie (keyed)	integer	Station number.
sss-id if	character	Substation identifier.
rr	character	Remarks.
cc	character	Comments.
link2	-	Parent links to transducer sub-entries. Most recorders have three transducers.

The data elements given in the next list may occur in any of the transducer sub-entries linked to a substation. Any data elements shown with a hash symbol (#) may be omitted in a specific sub-entry. These will be considered to have the same values as they have in the preceding transducer occurrence (parented by the same substation occurrence). Since most transducers are connected together as three orthogonal sensors, there should be no need to repeat the location and installation/removal dates in all three transducer sub-entries. If such an element's value is unknown and not meant to assume the value in the preceding sub-entry, then it will carry a "null" value.

t-sn ig	character	Transducer serial number.
t-in-date ih	integer (special) (#)	Date the transducer was installed. This will be given only if the transducer's installation date is different than the recorder's installation date, "rr-in-date".

Recorder Information, continued

element name	data type	description
t-rm-date ii	integer (special) (#)	Date the transducer was removed. This will be given only if the transducer has been removed and the removal date is different than the recorder's removal date, "rr-rm-date".
t-loc-c ij (keyed)	character (#)	Transducer location code. The recognized transducer location codes are G Ground level in an instrument shelter (approximately free-field.) B Basement or ground level within a structure. U Above ground level in a structure, V Instrument vault, and X Other.
t-loc-d ik	characters (#)	Short transducer location description, supplementing "t-loc-c".
t-accel il	character	Direction of ground acceleration for positive trace, in azimuthal notation. 001 to 360 degrees from north in the clockwise direction.
t-orient im	character	Orientation of pendulum motion for positive trace, in quadrantal notation. This is being phased out in favor of "t-accel", which is just the opposite direction. Different notation is used for the two forms to minimize confusion.
t-trace in	character	Relative location of the trace on the physical record. Trace location numbers start at the top of the record (with emulsion side up and the record progressing from left to right) and increase downwards. Time traces and fixed reference traces are not counted. This number corresponds to the manufacturer's channel number.
rrr	character	Remarks.
ccc	character	Comments.

Recorder Information, continued

element name	data type	description
link3	-	Parent links to calibration sub-entries.

The data elements that may occur in a calibration sub-entry are shown in the next list. The transducer may have been recalibrated any number of times, and the calibration sub-entries will occur in reverse chronological order, the most recent set of calibration data being the first of the sub-entries.

c-date io	integer (special)	Calibration date
c-sens ip	real	Accelerometer's sensitivity, cm/g, or displacement meter's magnification.
c-period iq	real	Transducer period, seconds.
c-damping ir	real	Transducer damping, as a fraction of critical damping.
rrrr	character	Remarks.
cccc	character	Comments.

f. Dictionary Data Sets

There are several small data sets in the data base that contain explanations of the codes that are used in other types of entries. The recorder type codes, agency codes, and station array names are explained in these dictionary type data sets.

f.1 Recorder Types

Various brands and models of recording devices are used in the network. Each type of recording device and its identifying code is described in an entry in this data set. The recorder type codes also occur as the leading characters in "rr-id" and in "r-rr-id" in the recorders and records data sets, respectively.

element name	data type	description
rec-code (keyed)	characters	Recorder type code.
r	characters	Remarks describing the recorder and its transducers.
c	characters	Comments.

f.2 Agencies

Each entry in the agencies data set describes one of the various agencies that owns or maintains the strong-motion instruments, or that offers information about any aspect of the network. The agency codes also occur as "r-agency", "d-agency", and "rr-owner" in the records and recorders data sets, and they may be referenced in the remarks of almost every other data set.

If you've seen an agency code (maybe rr-owner = SEB) in another entry and want to learn which agency the code refers to, type

```
find agency = SEB; **
```

The following data elements may occur in an agencies entry:

element name	data type	description
agency (keyed)	character	Agency code.
r	character	Remarks about the agency, its full name, address, and names of people or sub-organizations who can provide information relating to the strong-motion network.

f.3 Station Arrays

Certain groups of stations have been identified as arrays; the members of each array having some common aspect of interest. Any one station may be a member of any number of arrays.

Each member of the arrays data set identifies one array and all of the member stations within it. The following data elements may occur in an array entry:

element name	data type	description
array (keyed)	character	Name of the array.
a-stn (keyed)	integer	A list of the station numbers in the array.
a-sub-stn	character	Substation identification. This will occur only if part of the station, but not all of it, belongs to the array. Each "a-sub-stn" occurrence is subordinate to an "a-stn" in the entry.
r	character	Remarks about the array that indicate what the number stations have in common.
c	character	Comments.

f.4 Groups of Nearby Stations

element name	data type	description
nearby (keyed)	integer	A list of stations that are near one another.
r	character	Remarks.
c	character	Comments.

Appendix A

TYMNET Telephone Numbers and Log-on Procedures.

If Menlo Park is a toll call for you, you will probably be able to dial a number in the TYMNET telecommunications network that is closer to you. Although TYMNET supports a variety of terminal types, only 300 baud lines (30 characters per second) are presently available on the USGS computer for access through the TYMNET dialup network.

A list of all the TYMNET phone numbers is given below.

Take the following steps to connect your terminal to the USGS computer at Menlo Park via the TYMNET:

1- Set any switches, keys, or buttons that allow a choice of operating modes:

transmission speed = 30 cps
on-line
lower case ASCII characters
full duplex (Notice that TYMNET uses full duplex signals, but MULTICS, when dialed direct, uses half duplex)

2- Plug in and turn on the terminal. Turn on the acoustic coupler too, if it's a separate device. Look for a label or diagram that will show you in which direction the telephone cord should go.

3- Dial the TYMNET access number nearest you and wait for the high-pitched tone. If the tone sounds weak or raspy, hang up and redial to obtain a better line.

4- Place the telephone handset in the cradle on the acoustic coupler. Watch for the "carrier detect" light to turn on, indicating that the terminal is properly receiving the signal.

5- TYMNET prompts (shown underlined here) and your response should proceed as follows:

please type your terminal identifier E <cr>
(<cr> is the carriage-return key.)
please log in: <cr>
user name: GS51407<cr>
password: <cr>

6- TYMNET will now make the connection to the computer in Menlo Park. If it is operating, the message "USGS is online" will be printed on your terminal.

Now type: "enter <your_name> SMIRS <cr> <line_feed>" and from here on the dialog will be the same as if you had dialed direct to Menlo Park. However, the computer response may not seem as smooth as when you dial direct.

The following list of TYMNET phone numbers is sorted by State or Foreign Country.

CITY	STATE/COUNTRY	DENSITY	PHONE NO.
BIRMINGHAM	ALABAMA	LO	205/942-4141
PHOENIX	ARIZONA	LO	602/249-9261
LITTLE ROCK	ARKANSAS		501/372-5780 (FEX)
ALHAMBRA	CALIFORNIA		213/572-0999 (FEX)
EL SEGUNDO	CALIFORNIA	HI	213/640-1570
LOS ANGELES	CALIFORNIA	HI	213/626-0365 (1200-212)
LOS ANGELES	CALIFORNIA	HI	213/629-1561
LOS ANGELES	CALIFORNIA	HI	213/629-3001 (1200 202S)
LOS ANGELES	CALIFORNIA	HI	213/683-0451
LOS ANGELES	CALIFORNIA	HI	213/687-8083 (1200 VADIC)
MOUNTAIN VIEW	CALIFORNIA	HI	415/941-8450
MOUNTAIN VIEW	CALIFORNIA	HI	415/961-7970
NEWPORT BEACH	CALIFORNIA	HI	714/540-9560
OAKLAND	CALIFORNIA	HI	415/465-7000
PALO ALTO	CALIFORNIA	HI	415/326-7015
RIVERSIDE/COLTON	CALIFORNIA	HI	714/825-9372
SACRAMENTO	CALIFORNIA	LO	916/441-6550
SAN CLEMENTE	CALIFORNIA		714/498-3130 (FEX)
SAN DIEGO	CALIFORNIA	LO	714/291-8700
SAN DIEGO	CALIFORNIA	LO	714/299-9260 (1200-212)
SAN FRANCISCO	CALIFORNIA	HI	415/391-9325
SAN FRANCISCO	CALIFORNIA	HI	415/397-8461 (1200 202S)
SAN FRANCISCO	CALIFORNIA	HI	415/421-7121 (1200 VADIC)
SAN FRANCISCO	CALIFORNIA	HI	415/982-3770 (1200-212)
SAN JOSE/CUPERTINO	CALIFORNIA	HI	408/257-0593 (CCITT)
SAN JOSE/CUPERTINO	CALIFORNIA	HI	408/446-1470
SAN JOSE/CUPERTINO	CALIFORNIA	HI	408/446-6932 (1200 202S)
SAN JOSE/CUPERTINO	CALIFORNIA	HI	408/446-7001 (1200 VADIC)
SAN JOSE/CUPERTINO	CALIFORNIA	HI	408/446-7309 (1200 212)
SAN JOSE/CUPERTINO	CALIFORNIA	HI	408/984-5500
SANTA BARBARA	CALIFORNIA		805/966-3184 (FEX)
SANTA ROSA	CALIFORNIA	LO	707/526-4260
VAN NUYS	CALIFORNIA		213/986-9503 (FEX)
VENTURA/OXNARD	CALIFORNIA	HI	805/487-0482
COLORADO SPRINGS	COLORADO		303/471-9815 (FEX)
DENVER	COLORADO	HI	303/572-1107 (1200 VADIC)
DENVER	COLORADO	HI	303/573-9981
BRIDGEPORT	CONNECTICUT		203/579-7820 (FEX)
DANBURY	CONNECTICUT		203/792-3060 (FEX)
DARIEN	CONNECTICUT	LO	203/655-8931
HARTFORD	CONNECTICUT	LO	203/568-2610
NEW HAVEN	CONNECTICUT		203/787-5974 (FEX)
WATERBURY	CONNECTICUT		203/757-2537 (FEX)
WASHINGTON	DC	HI	703/525-6290 (212 1200)
WASHINGTON	DC	HI	703/527-7106 (1200 202S)
WASHINGTON	DC	HI	703/841-0200
WASHINGTON	DC	HI	703/841-9330 (1200 VADIC)
WASHINGTON	DC	HI	703/841-9560
WILMINGTON	DELAWARE		302/658-5261 (FEX)
FT LAUDERDALE	FLORIDA		305/467-7550 (FEX)
JACKSONVILLE	FLORIDA	LO	904/721-8100
MIAMI	FLORIDA		305/358-7271 (1200-212)
MIAMI	FLORIDA	LO	305/374-7120
ORLANDO	FLORIDA	LO	305/841-6850
PENSACOLA	FLORIDA		904/434-0134 (FEX)
ST. PETERSBURG	FLORIDA	LO	813/536-7823
TAMPA	FLORIDA		813/229-0981 (FEX)
W.PALM BEACH	FLORIDA		305/622-2871 (FEX)
ATLANTA	GEORGIA	LO	404/581-0619 (1200 212)
ATLANTA	GEORGIA	LO	404/659-6670
SAVANNAH	GEORGIA	LO	912/352-7259 (FEX)
BOISE	IDAHO	LO	208/343-4851
CHICAGO	ILLINOIS	HI	312/346-0201 (1200 212)
CHICAGO	ILLINOIS	HI	312/346-4961
CHICAGO	ILLINOIS	HI	312/368-0022 (1200 202S)
CHICAGO	ILLINOIS	HI	312/368-4607
CHICAGO	ILLINOIS	HI	312/372-0391 (1200 VADIC)
FREEPORT	ILLINOIS	LO	815/232-2181 (30 CPS)
FREEPORT	ILLINOIS	LO	815/232-2186 (10 CPS)
ROCKFORD	ILLINOIS	LO	815/398-6090
FT WAYNE	INDIANA		219/424-5162 (FEX)
INDIANAPOLIS	INDIANA	LO	317/257-3461
INDIANAPOLIS	INDIANA	LO	317/926-1296 (1200-212)
MARION	INDIANA		317/662-0091 (FEX)
SOUTH BEND	INDIANA		219/259-9941 (FEX)
CEDAR RAPIDS	IOWA		319/364-3371 (FEX)
DES MOINES	IOWA	LO	515/280-9600
IOWA CITY	IOWA		319/351-4046 (FEX)
TOPEKA	KANSAS		913/233-1612 (FEX)
WICHITA	KANSAS	LO	316/265-1241
LOUISVILLE	KENTUCKY	LO	502/361-3881
BATON ROUGE	LOUISIANA	LO	504/927-6400
LAFAYETTE	LOUISIANA		318/235-5202 (FEX)
NEW ORLEANS	LOUISIANA	LO	504/586-1071
BALTIMORE	MARYLAND	HI	301/547-8100
BOSTON	MASSACHUSETTS	HI	617/482-1854 (1200 VADIC)
BOSTON	MASSACHUSETTS	HI	617/482-2170 (1200 202S)

CITY	STATE/COUNTRY	DENSITY	PHONE NO.	
BOSTON	MASSACHUSETTS	HI	617/482-4677	
BOSTON	MASSACHUSETTS	HI	617/482-5622	
ANN ARBOR	MICHIGAN	HI	313/995-6250	
DETROIT	MICHIGAN	HI	313/963-2353	(1200 VADIC)
DETROIT	MICHIGAN	HI	313/963-3388	
DETROIT	MICHIGAN	HI	313/963-4676	(1200 BELL)
GRAND RAPIDS	MICHIGAN		616/459-8429	(FEX)
JACKSON	MICHIGAN	LO	517/784-8522	
KALAMAZOO	MICHIGAN	LO	616/385-3150	
SOUTHFIELD	MICHIGAN	HI	313/355-2950	
ST JOSEPH	MICHIGAN		616/429-2568	(FEX)
MINNEAPOLIS	MINNESOTA	LO	612/854-2910	(1200 212)
MINNEAPOLIS	MINNESOTA	LO	612/854-6659	
KANSAS CITY	MISSOURI	LO	816/753-8900	
ST LOUIS	MISSOURI	LO	314/421-5110	
ST LOUIS	MISSOURI	LO	314/621-4660	(1200-212)
OMAHA	NEBRASKA	LO	402/392-2970	
LAS VEGAS	NEVADA		702/386-1899	(FEX)
RENO/CARSON CITY	NEVADA	LO	702/882-7810	
NASHUA	NEW HAMPSHIRE		603/889-8618	(FEX)
ENGLEWOOD CLIFFS	NEW JERSEY	HI	201/894-8250	
LYNDHURST	NEW JERSEY	HI	201/460-0100	
LYNDHURST	NEW JERSEY	HI	201/460-0180	(1200 212)
MOORESTOWN	NEW JERSEY		609/235-3761	(FEX)
PISCATAWAY	NEW JERSEY	HI	201/981-0370	
PRINCETON	NEW JERSEY		609/921-0650	(FEX)
WAYNE	NEW JERSEY	HI	201/785-4480	
ALBANY	NEW YORK		518/463-3111	(FEX)
BUFFALO	NEW YORK	LO	716/856-1400	
CORNING	NEW YORK	LO	607/962-5071	
HUNTINGTON L.I.	NEW YORK		516/673-5780	(FEX)
NEW YORK	NEW YORK	HI	212/344-7445	
NEW YORK	NEW YORK	HI	212/350-9100	
NEW YORK	NEW YORK	HI	212/551-9322	
NEW YORK	NEW YORK	HI	212/689-8850	(1200 BELL)
NEW YORK	NEW YORK	HI	212/689-8910	(1200 VADIC)
NIAGARA FALLS	NEW YORK		716/285-9354	(FEX)
ROCHESTER	NEW YORK	LO	716/546-1410	
SYRACUSE	NEW YORK	LO	315/437-7111	
WHITE PLAINS	NEW YORK	LO	914/694-9361	
CHARLOTTE	NORTH CAROLINA		704/376-0320	(FEX)
DURHAM	NORTH CAROLINA	LO	919/549-0441	
AKRON	OHIO	LO	216/535-1861	
CINCINNATI	OHIO	LO	513/242-7040	
CLEVELAND	OHIO	LO	216/781-7050	
COLUMBUS	OHIO	LO	614/421-7270	
DAYTON	OHIO	LO	513/223-3847	
TOLEDO	OHIO	HI	419/243-3144	(FEX)
OKLAHOMA CITY	OKLAHOMA	LO	405/947-0561	
TULSA	OKLAHOMA	LO	918/663-2220	
PORTLAND	OREGON	LO	503/231-4050	
PORTLAND	OREGON	LO	503/231-4077	(212'S-1200)
ALLENTOWN	PENNSYLVANIA		215/4336131	(FEX)
ERIE	PENNSYLVANIA	LO	814/459-1600	
HARRISBURGH	PENNSYLVANIA		717/236-1190	(FEX)
PHILADELPHIA	PENNSYLVANIA	HI	215/561-6120	
PHILADELPHIA	PENNSYLVANIA	HI	215/567-1381	(1200 212)
PITTSBURGH	PENNSYLVANIA	LO	412/261-4151	(1200-212)
PITTSBURGH	PENNSYLVANIA	LO	412/765-1320	
VALLEY FORGE	PENNSYLVANIA	HI	RESTRICTED	
VALLEYFORGE	PENNSYLVANIA	LO	215/666-9190	
YORK	PENNSYLVANIA		717/846-4802	(FEX)
PROVIDENCE	RHODE ISLAND		401/274-5783	(FEX)
GREENVILLE	SOUTH CAROLINA		803/271-2418	(FEX)
MEMPHIS	TENNESSEE	LO	901/345-1111	
AUSTIN	TEXAS	LO	512/444-3280	
BAYTOWN	TEXAS		713/427-1123	(FEX)
BEAUMONT	TEXAS		713/832-2589	(FEX)
DALLAS	TEXAS	LO	214/638-5800	
DALLAS	TEXAS	LO	214/688-1117	(1200-212)
EL PASO	TEXAS	LO	915/544-9590	
FT WORTH	TEXAS		214/263-2341	(FEX)
HOUSTON	TEXAS		713/977-7671	(212'S-1200)
HOUSTON	TEXAS	HI	713/780-7390	
HOUSTON	TEXAS	HI	713/780-7496	(1200 VADIC)
HOUSTON	TEXAS	HI	713/780-7593	(1200 BELL)
HOUSTON	TEXAS	HI	713/785-4411	
HOUSTON	TEXAS	HI	713/785-4420	
LONGVIEW	TEXAS		214/758-0801	(FEX)
LUBBOCK	TEXAS		806/762-2402	(FEX)
MIDLAND	TEXAS	LO	915/683-5645	
ODESSA	TEXAS		915/563-0273	(FEX)
SAN ANTONIO	TEXAS	LO	512/734-7381	
SALT LAKE CITY	UTAH	LO	801/582-8972	
NORFOLK	VIRGINIA		804/622-0435	(FEX)
RICHMOND	VIRGINIA		804/649-3050	(FEX)
SEATTLE	WASHINGTON	LO	206/622-7930	
MADISON	WISCONSIN	LO	608/221-4211	
MILWAUKEE	WISCONSIN	LO	414/257-3482	
OSHKOSH	WISCONSIN		414/235-4594	(FEX)
CALGARY	CANADA		403/263-2006	(14.8 CPS)
CALGARY	CANADA		403/263-2072	(10 CPS)
CALGARY	CANADA		403/263-7301	(30 CPS)
EDMONTON	CANADA		403/423-4888	
MONTREAL	CANADA		514/878-0584	(30 CPS)
MONTREAL	CANADA		514/878-0588	(10 CPS)
MONTREAL	CANADA		514/878-0589	(14.8 CPS)
OTTAWA	CANADA		613/563-9841	(30 CPS)
TORONTO	CANADA		416/863-6202	
VANCOUVER	CANADA		604/688-4338	(10 CPS)
VANCOUVER	CANADA		604/688-4838	(14.8 CPS)
VANCOUVER	CANADA		604/688-9811	(30 CPS)